

May 12, 1964

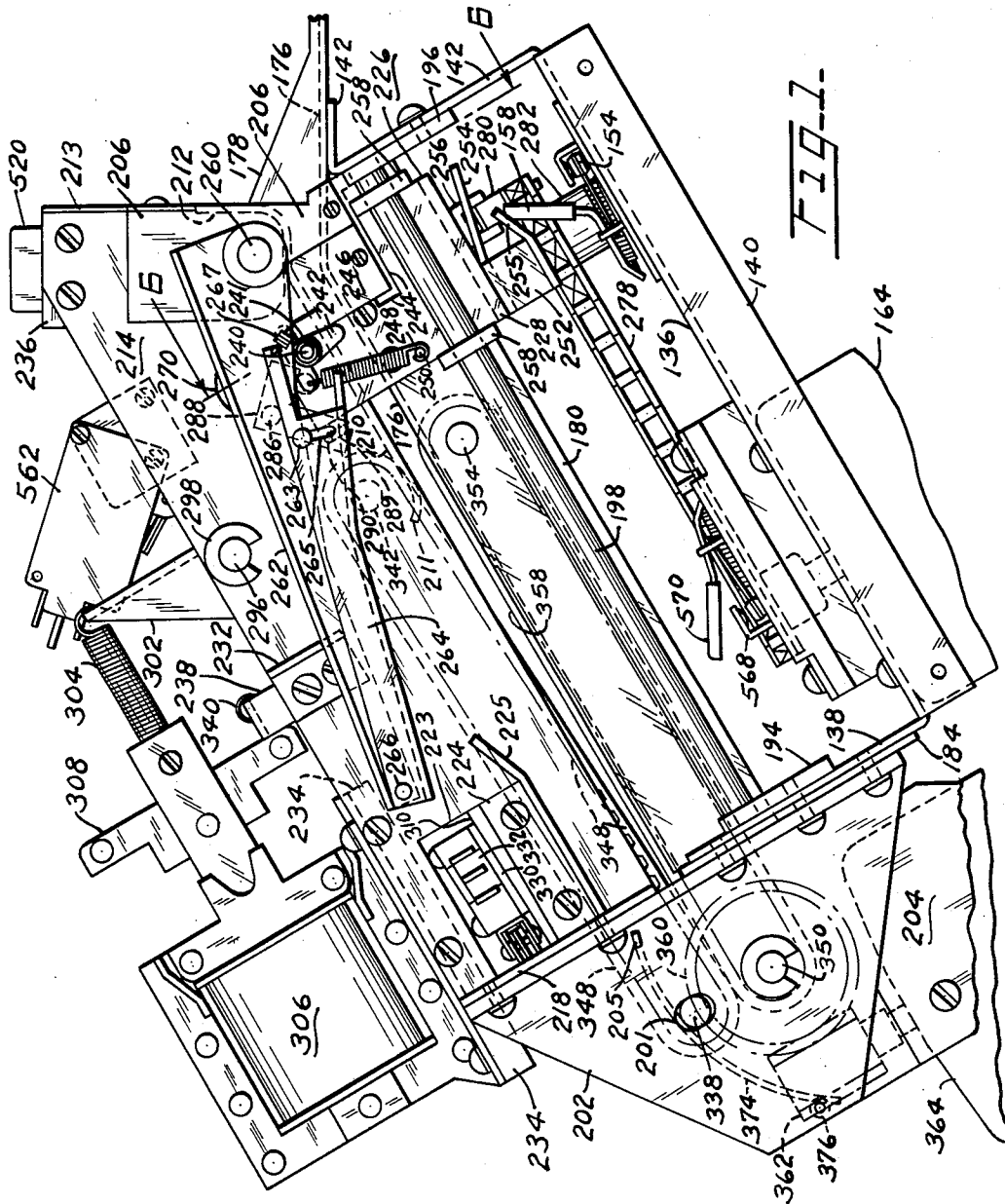
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3,132,737

COATING BELT-TYPE CONVEYOR

Filed Oct. 19, 1960

5 Sheets-Sheet 1



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COACTING BELT-TYPE CONVEYOR

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5 Sheets-Sheet 2

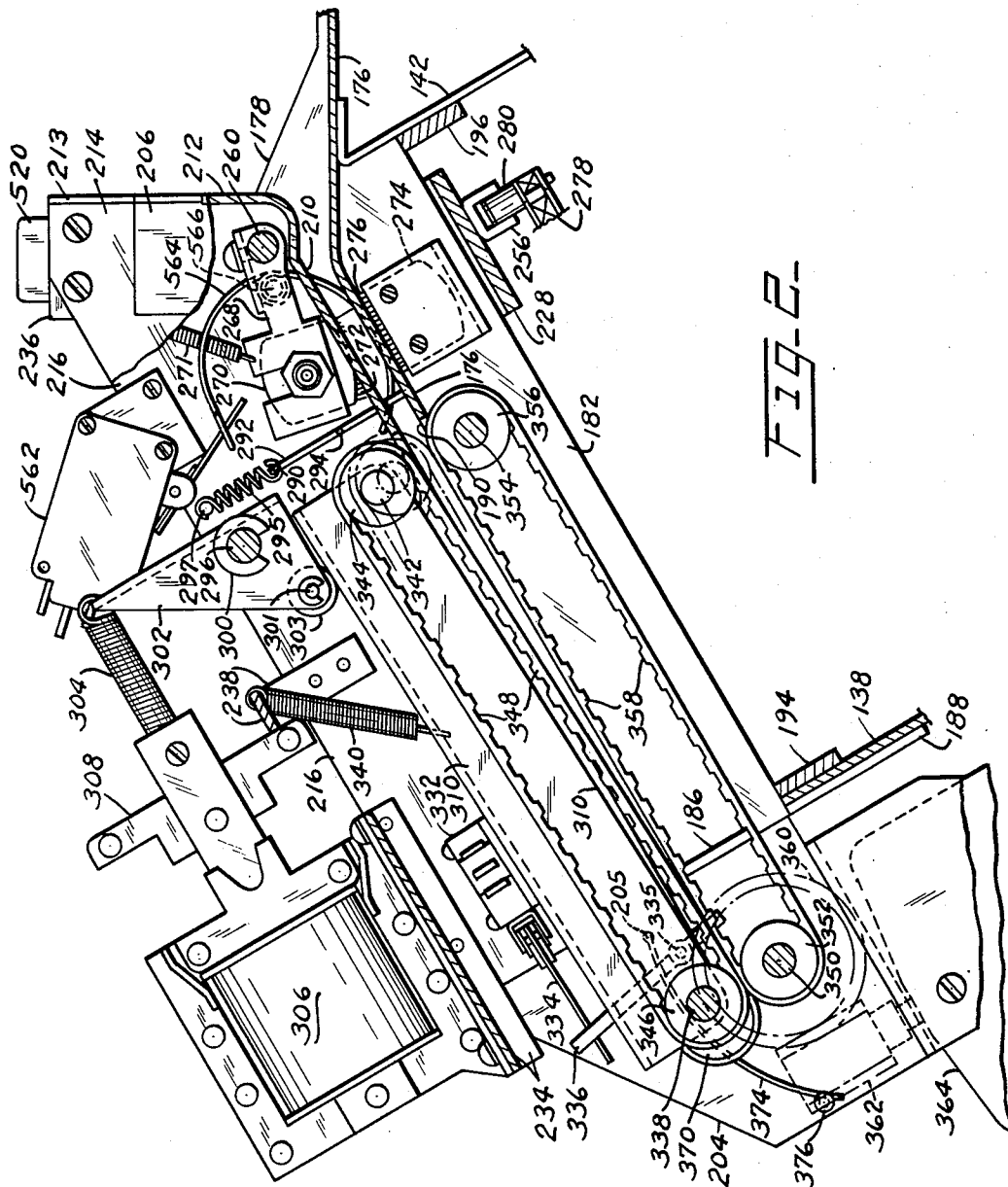


FIG. 2-

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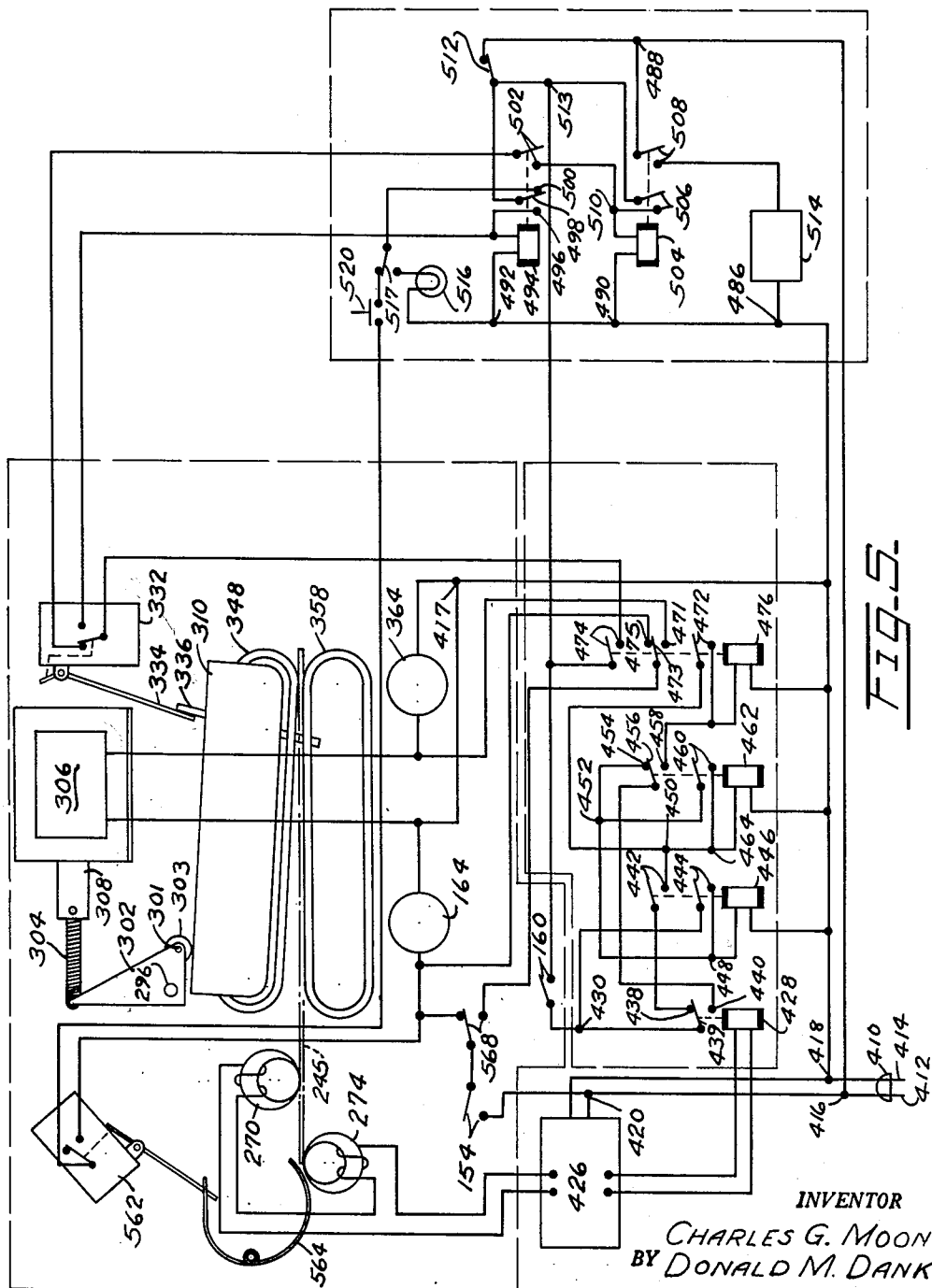
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5 Sheets-Sheet 4



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5 Sheets-Sheet 5

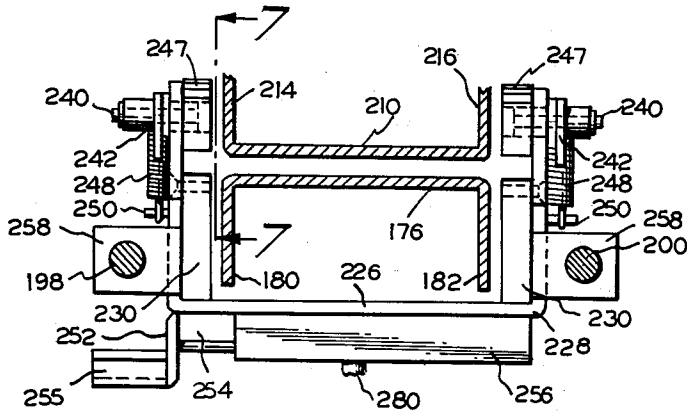


Fig. 6.

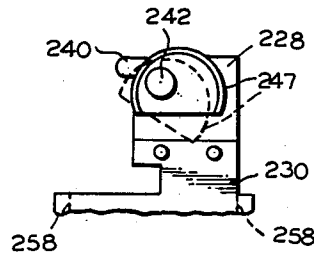


Fig. 7.

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3,132,737

COACTING BELT-TYPE CONVEYOR

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Filed Oct. 19, 1960, Ser. No. 63,602

1 Claim. (Cl. 198—165)

This invention relates to improvements in currency detectors. More particularly, this invention relates to improvements in methods and apparatus for identifying authentic paper currency.

It is therefore an object of the present invention to provide an improved method and apparatus for identifying authentic paper currency.

In the identification of authentic paper currency, it has heretofore been proposed to use a bill-transporting device which has belts that can grip the sides of an inserted bill and that can move that bill; and such a device is workable. Those belts have the leading edges thereof moving in such directions that those belts tend to draw the leading edge of an inserted bill into position between them; and, as a result, the leading edges of most inserted bills will readily move into position between those belts. However, the leading edges of some bills are unusually limp or are unusually crumpled; and such bills may not readily move into position between the belts. It would be desirable to have belts that could readily draw the leading edges of unusually limp and unusually crumpled bills into position between them. The present invention provides such belts by mounting the leading edges of the belts so they are normally spaced apart and are then moved together after the leading edge of the inserted bill has been moved into position between the belts. Those leading edges then remain immediately adjacent each other until the bill has been moved beyond the trailing edges of those belts; and then, finally, the leading edges of those belts are moved back to their initially spaced-apart positions. As a result, the bill-transporting device provided by the present invention can readily accommodate unusually limp and unusually crumpled bills. It is therefore an object of the present invention to provide belts that initially have their leading edges spaced apart, that move those leading edges together after the leading edge of a bill has passed between those leading edges, and that hold those leading edges together until after the bill has moved beyond the trailing edges of those belts.

The belts of the bill-transporting device provided by the present invention are grouped in pairs, and one of the switches of that bill-transporting device has its actuator disposed between those pairs of belts. Further, that actuator is immediately adjacent one of those pairs of belts. That actuator will receive and be moved by the leading edge of the inserted bill; and that actuator will not crumple or roll up the leading edge of that bill because that leading edge will be supported at points disposed on opposite sides of that actuator. Further, that actuator will not crumple or roll up the leading edge of that bill because that leading edge will be given full and immediate support by the adjacent pair of belts. In this way, the present invention makes it possible for the inserted bill to actuate the switch without permitting the leading edge of that bill to crumple or roll up. It is therefore an object of the present invention to provide a bill-transporting device wherein the actuator of a switch is disposed intermediate two pairs of belts and is immediately adjacent one of those pairs of belts.

In the magnetic sensing of paper currency, it is essential to establish and maintain a high signal-to-noise ratio. Because the magnetic properties of the ink in bills are beyond the control of a manufacturer of currency detectors, and because those magnetic properties are very

2

limited, the most practical way to increase the overall signal-to-noise ratio is to reduce the spurious signals to which the magnetic head is sensitive, such as the stray magnetic field of a motor or solenoid energized from the A.C. power line. The present invention reduces the noise level by breaking magnetic paths in the frame of the currency detector. As a result, the flow of magneto-electric currents in that frame which could lead to stray coupling to the magnetic head will be minimized. It is therefore an object of the present invention to break magnetic paths in the frame of a currency detector.

In the manufacture of currency detectors, it is important to provide safeguards against the theft of inserted bills. For example, it is important to keep a patron from withdrawing an inserted bill, as by attaching a thread, tape or other member to the bill and then pulling on that thread, tape or other member after the desired product has been vended or the desired change has been dispensed. The present invention prevents the withdrawal of a bill, by a pull on a thread, tape or other member, by providing a bill-delivering mechanism which is very powerful, which applies extremely heavy forces to the bill, and which rapidly moves the bill to the cash box. The rapid movement of the bill plus the heavy forces which are applied to that bill will keep a patron from withdrawing that bill by the use of a thread, tape or other member.

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, a preferred embodiment of the present invention is 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 claim.

In the drawing FIG. 1 is a partially-broken, side elevational view of one embodiment of bill-transporting device that is made in accordance with the principles and teachings of the present invention.

FIG. 2 is a partially-broken, vertical section through the embodiment of bill-transporting device shown in FIG. 1.

FIG. 3 is a partially-broken, plan view of the rear portion of the embodiment of bill-transporting device shown in FIG. 1.

FIG. 4 is a partially-broken, rear view of the bill-transporting device shown in FIG. 1.

FIG. 5 is a schematic diagram of the bill-transporting device of FIG. 1 and of the electrical circuits used with that bill-transporting device, and

FIG. 6 is a sectional view through the bill-transporting device shown in FIG. 1, and it is taken along the broken plane indicated by the broken line 6—6 in FIG. 1, and

FIG. 7 is a sectional view through the bill-transporting device shown in FIG. 1, and it is taken along the plane indicated by the line 7—7 in FIG. 6.

Referring to the drawing in detail, the numeral 136 denotes the bottom plate of an embodiment of bill-transporting device that is made in accordance with the principles and teachings of the present invention. That bottom plate has an upwardly extending rear flange 138, an upwardly extending front flange 142, and downwardly extending flanges 140 at each of the sides thereof. That bottom plate and the four flanges thereof are made thick enough to be sturdy and stiff. That bottom plate is set at an angle to the horizontal; and that bottom plate will be suitably held in that position.

A switch 154 is mounted on that bottom plate adjacent the front end of that plate, as shown particularly by FIG. 1. That switch has an actuator 158 that inclines upwardly and to the right from the plane of the bottom plate

3

136. A second switch 160 is mounted immediately adjacent the switch 154, but that second switch is overlain and obscured by the switch 154 in FIG. 1. An electric motor 164 is secured to the bottom plate 136, and that motor depends downwardly from that plate. That motor is disposed adjacent the rear of the bottom plate 136, as shown particularly by FIG. 1.

The front flange 142 of the bottom plate 136 has the upper edge thereof bent forwardly and downwardly to lie in a horizontal plane. That upper edge underlies the horizontal front portion of a platform 176 which has downwardly and rearwardly inclining central and rear portions. The downwardly and rearwardly inclined central and rear portions of the platform 176 are parallel to the plane of the base plate 136. The horizontal front portion of the platform 176 has shallow flanges 178 extending upwardly from the sides thereof, and the rear portions of those flanges incline upwardly, as shown by FIGS. 1 and 2. The central and rear portions of the platform 176 have flanges 180 and 182 extending downwardly from the sides thereof, and the lower edges of those flanges are parallel to the plane of the bottom plate 136. The flanges 180 and 182 stiffen the platform 176 and give the central and rear portions of that platform an inverted U-shaped configuration in cross section. A flange 184 extends to the right from the rear edge of the flange 180, and a flange 186 extends to the left from the rear edge of the flange 182, all as shown by FIG. 4. A narrow and elongated flange 188 extends downwardly from the rear edge of the downwardly inclined rear portion of the platform 176; and that flange is intermediate the flanges 184 and 186. The lower portions of the flanges 184, 186 and 188 abut and are suitably secured to the flange 138 on the bottom plate 136.

The central and rear portions of the platform 176 have a pair of elongated slots 190 therein, and those slots are disposed adjacent the opposite edges of those portions of that platform. The central portion of the platform 176 also has a large opening, not shown, which accommodates a magnetic head 274 and a pressure member 276 near that magnetic head; and that opening is disposed immediately rearwardly of the bend between that central portion and the horizontal front portion of that platform.

The numeral 194 denotes a flat plate which is generally U-shaped in front elevation, and that plate is secured to the right-hand face of the flange 138 on the bottom plate 136. The central portion of the plate 194 spans the gap between the downwardly-depending flanges 180 and 182 on the rear portion of the platform 176, and the opposite ends of that plate extend upwardly from the bottom edges of those flanges. That plate helps stiffen and reinforce the flange 138 at the rear of the bottom plate 136. A similar reinforcing plate 196 is disposed at the left-hand face of the front flange 142 on the bottom plate 136. The central portion of the plate 196 spans the gap between the downwardly-depending flanges 180 and 182 on the central portion of the platform 176, and the opposite ends of that plate extend upwardly from the bottom edges of those flanges. A rod 198 of circular cross section extends between and is secured to the reinforcing plates 194 and 196; and a similar rod 200 also extends between and is secured to the plates 194 and 196. The rod 198 is disposed outwardly of the downwardly depending flange 180 on the central and rear portions of the platform 176; and the rod 200 is disposed outwardly of the downwardly depending flange 182 on those portions of that platform.

The numeral 202 denotes a generally triangular plate which has a flange at the wide end thereof. That flange on that plate is secured to the flanges 138 and 184 and also to the reinforcing plate 194; and the upper ends of that plate and flange project upwardly beyond the top of the rear portion of the platform 176. A plate 204 has an upper portion which is generally similar to the plate 202, but the plate 204 has an offset in the lower portion there-

4

of, as shown particularly by FIG. 4. The flange at the wide end of the plate 204 is secured to the flange 186, the flange 138 and the reinforcing plate 194; and the upper ends of the plate 204 and its flange project upwardly beyond the upper face of the platform 176. Slots 201 are formed in the plates 202 and 204, and those slots are elongated in a generally vertical direction. The slots 201 in the plates 202 and 204 are in horizontal registry with each other. Also, the plates 202 and 204 have openings 205 therein adjacent the flanges on those plates; and those openings are in horizontal registry with each other. The flange on the plate 202 extends to the right from that plate, and the flange on the plate 204 extends to the left from that plate, all as shown by FIG. 4.

The numeral 206 denotes a prismatic block that has its inner side fixedly secured to the downwardly depending flange 180 of the central portion of the platform 176. That block projects upwardly beyond the uppermost part of the platform 176 and also projects upwardly beyond the uppermost parts of the flanges 178 on the front portion of that platform. A similar block, not shown, has its inner side secured to the downwardly-depending flange 182 of the central portion of the platform 176. That second block projects upwardly beyond the uppermost part of the platform 176 and also projects upwardly beyond the uppermost parts of the flanges 178 on the front portion of that platform. A plate 210, which has a bend corresponding to the bend in the platform 176, has the front portion thereof disposed in between the block 206 and its counterpart. The plate 210 is disposed above the platform 176; and the bends in platform 176 and in plate 210 are in vertical alignment, as shown particularly by FIG. 2. The plate 210 has an upstanding front portion 212, as shown particularly by FIG. 2; and that front portion is connected to the short horizontal front portion of that plate by a rounded portion.

The plate 210 has an upturned side wall 214 which is disposed in the plane defined by the downwardly-depending flange 180 on the central and rear portions of the platform 176. The plate 210 also has an upturned side wall 216 which is disposed in the plane defined by the downwardly-depending flange 182 on those portions of the platform 176. Those upturned side walls are fixedly secured to, and rigidly held by, the inner sides of the block 206 and its counterpart. A flange 218 is provided at the rear edge of the upturned side wall 214 on the plate 210, and that flange is in the plane defined by the flange 184 at the rear edge of the downwardly depending flange 180 on the rear portion of the platform 176. A flange 220 is provided at the rear edge of the upstanding wall 216 on the plate 210, and that flange lies in the plane defined by the flange 186 at the rear edge of the downwardly-depending flange 182 on the rear portion of the platform 176. The flanges 218 and 220 are secured to the flanges on the plates 202 and 204. As indicated by FIG. 4, the plates 202 and 204 are thick; and those plates will coact with the bottom plate 136, the platform 176, the plate 210, the block 206 and its counterpart to constitute a sturdy and rugged frame for the bill-transporting device shown in FIG. 1.

A number of the parts of the frame for the bill-transporting device can be made of magnetic material such as carbon steel. However, some parts of that frame must be made of non-magnetic material to provide breaks in the magnetic paths in that frame. Absent such breaks, magneto-electric currents in that frame could produce sufficient stray coupling to the magnetic heads 270 and 274 to adversely affect the signal-to-noise ratio.

Large parts of the central and rear portions of the plate 210 are cut away; and the parts which are cut away in the central portion are cut away in such a manner as to form an opening, not shown, for the magnetic head 270 and a pressure member 272 and also to form a rearwardly-extending tongue 211. That tongue is disposed rearwardly of the opening for the magnetic head and for the pres-

5

sure member, and that tongue curves upwardly, as shown particularly by FIG. 1. The open areas which are at the sides of, and which are disposed rearwardly of, the tongue 211, are denoted by the numeral 222.

The numeral 224 denotes an L-shaped bracket which has the vertical arm thereof secured to the upturned side wall 214 of the plate 210; and that bracket is located adjacent the rear of that wall. That bracket is disposed immediately adjacent the bottom edge of an opening 223 in that side wall. The bracket 224 is suitably secured to the side wall 214 by fasteners, shown as machine screws; and that bracket has an inclined leading edge 225. The numeral 227 denotes a similar bracket, and that bracket is secured to the upstanding wall 216 of the plate 210. As shown particularly by FIG. 3, that bracket is secured to the wall 216 adjacent the rear of that wall; and that bracket has an inclined leading edge 229.

The numeral 226 generally denotes a bill carrier which is similar to the identically-numbered bill carrier in co-pending Smith et al. application Ser. No. 849,066 for Currency Detectors which was filed on October 27, 1959. The bill carrier 226 includes a rigid U-shaped frame 228 which spans the gap between the downwardly-depending flanges 180 and 182 on the central and rear portions of the platform 176; and the arms of that frame project upwardly into registry with the lower portions of the upturned side walls 214 and 216 of the plate 210. That bill carrier has bearing plates 230 which have the tops thereof aligned with the upper surfaces of the downwardly and rearwardly inclined central and rear portions of the platform 176. Those bearing plates can accommodate the side edges of a bill 245 which is inserted between the upper surface of the platform 176 and the lower surface of the plate 210. An L-shaped bracket 252 is secured to and depends downwardly from the bill carrier 226; and that bracket has an upwardly inclined camming surface 255. That bracket also has a downwardly inclined camming surface 254.

The numeral 232 denotes an L-shaped bracket that is secured to, and that projects horizontally outwardly from, the upturned side wall 214 of the plate 210. That bracket is secured adjacent the upper edge of the wall 214, and that bracket overlies the rod 198.

The numeral 234 denotes a plate which has down-turned edges; and that plate is disposed adjacent the rear of the bill-transporting device of FIG. 1. That plate is dimensioned so the down-turned edges thereof fit between, and abut, the upturned side walls 214 and 216 of the plate 210. As a result fasteners, shown in the form of machine screws, can extend through openings in the upturned side walls 214 and 216 and seat in threaded openings in the down-turned edges of the plate 234. The numeral 236 denotes an inverted U-shaped bracket which is secured to the front ends of the upturned side walls 214 and 216 of the plate 210. That bracket is secured to those walls by fasteners, shown in the form of machine screws which extend through openings in the upstanding walls 214 and 216 and seat in threaded openings in the bracket 236. That bracket constitutes a support for a push button 520. A front plate 213 overlies and conceals that push button and extends down to abut the top of the front end 212 of the plate 210.

The numeral 238 denotes a U-shaped bracket which is secured to the upturned side walls 214 and 216 of the plate 210 adjacent the centers of those side walls. The closed end of that bracket extends upwardly a short distance beyond the upper edges of those side walls. As indicated particularly by FIG. 1, the inverted U-shaped bracket 238 is generally in register with the L-shaped bracket 232 that is secured to the upturned side wall 214.

The U-shaped frame 228 of the bill carrier 226 has short shafts 240 rotatably mounted in the upper portions of the arms thereof. Generally T-shaped levers 242 are fixedly secured to the outer ends of those shafts; and bill-gripping discs 247 are secured to the inner ends of those

6

shafts. Those bill-gripping discs are identical with the corresponding bill-gripping discs shown in the said Smith et al. application. Slots 244 are formed in the arms of the U-shaped frame 228 of the bill carrier 226, and those slots accommodate horizontally-directed portions of the block 206 and its counterpart which underlie the sides of the leading edge of the bill 245 as that bill is introduced into the bill-transporting device.

Vertical plates 246 are secured to the outer faces of the block 206 and its counterpart; and those plates lie in the paths of the vertical parts of the levers 242 which are carried by and which rotate with the shafts 240. Helical extension springs 248 have the upper ends thereof hooked through the left-hand arms of the T-shaped levers 242, and those springs have the lower ends thereof hooked around pins 250 which are carried by the arms of the U-shaped frame 228. A roller 241 is mounted on one of the pivots 240, and that roller is in register with the horizontally-directed portion of an elongated member 264. A slotted block 256 is secured to, and depends downwardly from, the closed end of the U-shaped frame 228 of the bill carrier 226, as shown particularly by FIG. 2. Ears 258 are provided on the arms of the U-shaped frame of the bill carrier 226; and those ears have openings which accommodate the rods 198 and 200. The ears 258 coast with the rods 198 and 200 to support the bill carrier 226 relative to the platform 176 while permitting guided reciprocal movement of that bill carrier relative to that platform.

The numeral 260 denotes a shaft which is rotatably supported by the block 206 and its counterpart; and that shaft extends through the upturned side walls 214 and 216 of the plate 210. An elongated arm 262 is fixedly secured to that shaft, and that arm has a narrow lip at the upper edge thereof which extends outwardly and away from the upturned side wall 214 on plate 210. That lip stiffens and reinforces the arm 262. The arm 262 extends to the left from the shaft 260, as indicated particularly by FIG. 1; and that arm carries a pivot 266 at the left-hand end thereof. That pivot rotatably supports the elongated member 264 of L-shaped cross section, as indicated particularly by FIG. 1. The vertically-directed portion of the elongated member 264 abuts the outer face of the arm 262, and the horizontally-directed portion of that elongated member underlies the bottom edge of that arm and extends toward the upturned side wall 214 of the plate 210. A pin 263 is secured to the arm 262 adjacent the lower edge of that arm, and that pin extends through a slot 265 in the right-hand end of the elongated member 264. That pin and slot permit limited vertical movement of the right-hand end of the elongated member 264 relative to the arm 262. As indicated particularly by FIG. 1, the horizontally-directed portion of the elongated member 264 has a bend therein. Also, as indicated by FIG. 1, the horizontally-directed portion of the elongated member 264 terminates a short distance to the left of the shafts 240 carried by the arms of the U-shaped frame 228 of the bill carrier 226.

A bracket 268 is disposed between the upturned side walls 214 and 216 of the plate 210; and that bracket is fixedly secured to the rotatable shaft 260. That bracket supports the magnetic head 270 and the pressure member 272; and that bracket holds that pressure member in register with the magnetic head 274 while holding that magnetic head 270 in register with the pressure member 276. The pressure member 276 and the magnetic head 274 are stationary; and the magnetic head 270 and pressure member 272 will be moved toward and away from them as the shaft 260 is rotated. In the particular embodiment shown, the pressure members 272 and 276 are brushes with short, stiff nylon bristles. A short helical extension spring 267 has the upper end thereof hooked through an opening in the right-hand end of the elongated member 264 and has the lower end thereof hooked under the edge of the arm 262. That spring biases the elon-

7

gated member 264 for rotation in the clockwise direction about the pivot 266 at the left-hand end of the arm 262. However, that spring can yield to permit counter clockwise rotation of that elongated member about that pivot. The numeral 271 denotes a helical extension spring that has the lower end thereof hooked through an opening in the bracket 268 and that has the upper end thereof hooked through an opening in the upturned side wall 214 of the plate 210. That spring biases the bracket 268 for rotation to the position shown by FIG. 2 and biases the arm 262 for rotation to the position shown by FIG. 1. However, that spring can yield to permit counter clockwise rotation of that bracket and of that arm.

The numeral 278 denotes a sprocket chain which has a pin 280 projecting upwardly therefrom. That pin is disposed within the U-shaped block 256 which is secured to the closed end of the U-shaped frame 223 of the bill carrier 226, but that can move longwise of that block. The chain 278 is supported by, and extends around, a sprocket wheel that is mounted on a pivot 282 at the front of the bottom plate 136. That chain also is supported by, and extends around, a sprocket wheel which is mounted on and driven by the shaft of the motor 164.

The numeral 286 denotes a pivot which is mounted on the upturned side wall 214 on the plate 210, and that pivot rotatably supports an L-shaped lever 288. A similar pivot and lever, not shown, are mounted on the upturned side wall 216 on the plate 210. The pivot 286 and its counterpart are coaxial. The L-shaped lever 288 and its counterpart have slots 289 therein; and those slots accommodate the opposite ends of a pin 290 which extends through openings, not shown, in the upturned side walls 214 and 216 of the plate 210. The right-hand arms of the L-shaped levers 288 are normally engaged by projections on the upper ends of the arms of the U-shaped frame 223 of the bill carrier 226; and those projections will normally hold those levers in the positions indicated by FIG. 1. At such time, the upper ends of the slots 289 in those levers force the pin 290 downwardly and thereby force a gate 292 downwardly into the space intermediate the lower surface of the plate 210 and the upper surface of the platform 176. In that position, the gate 292 constitutes a stop which will limit the extent to which the bill 245 can be inserted into the bill-transporting device. A pin 294 is carried by the gate 292, adjacent the center of that gate, and that pin is suitably held and guided by slots, not shown, in the upturned side walls 214 and 216 on the plate 210. Those slots coact with the pin 294 to guide the movement of the lower end of the gate 292. Two pins 297 are secured to the confronting faces of the upturned side walls 214 and 216 of the plate 210, and those pins support the upper ends of helical extension springs 295. The lower ends of those springs are hooked around the pin 290; and those springs bias the gate 292 upwardly so the lower end thereof will clear the space between the lower surface of plate 210 and the upper surface of platform 176. However, that spring can yield to permit the L-shaped levers 288 to force that gate down into bill-intercepting position.

The numeral 296 denotes a pivot which is secured to the upturned side walls 214 and 216 of the plate 210 adjacent the upper edges of those walls; and that pivot is disposed to the right of the inverted U-shaped bracket 238. C-washers 298 are seated in grooves adjacent the opposite ends of the pivot 296, and those washers hold that pivot in assembled relation with the upturned side walls 214 and 216 of the plate 210. C-washers 300 are seated in grooves in the pivot 296 at points spaced inwardly of the upturned side walls 214 and 216 on plate 210; and those C-washers 300 are disposed on opposite sides of a generally U-shaped bracket 302. That bracket is triangular in side elevation, as shown by FIG. 2; and a pivot 301 is carried by that bracket adjacent the lower left-hand portion of that bracket. That pivot rotatably

8

supports a roller 303; and the bracket 302 can rotate about the pivot 296 to raise or lower the roller 303.

A tightly-coiled helical spring 304 has the right-hand end thereof hooked through an opening in the upper part of the closed end of the U-shaped bracket 302, and that spring has the left-hand end thereof suitably secured to the plunger 303 of a solenoid 306. That plunger is shown in its extended position in FIGS. 1 and 2; and in that position that plunger abuts the left-hand edge of the closed end of the U-shaped bracket 238 which is secured to the upturned side walls 214 and 216 of the plate 210.

The numeral 310 denotes an inverted channel and that channel is shorter and narrower than the downwardly inclined central and rear portions of the plate 210. That channel is disposed between, and is spaced from, the upturned side walls 214 and 216 of the plate 210. A rectangular opening 311 is provided in the web of the channel 310 adjacent the rear of that channel as shown particularly by FIG. 3. A plate 330 is secured to the web of the channel 310; and that plate is disposed to the right of the opening 311, as that plate and opening are viewed in FIG. 3. That plate extends to the right from the channel 310, as indicated by FIG. 4. An enclosed type switch 332 is secured to the plate 330, and that switch has an elongated arm 334. A lever 336 is pivotally secured to one side of the channel 310 by a pivot 335; and the upper end of that lever extends upwardly through the opening 311 in the web of channel 310 to engage and actuate the switch arm 334. The lower end of that lever extends downwardly below the level of the flanges on the channel 310, as indicated by FIG. 2. In the position shown by FIGS. 2 and 3, the lever 336 permits the switch 332 to have its movable contact in the position shown by FIG. 5; but when that lever is rotated in the clockwise direction in FIG. 2 and in the counter clockwise direction in FIG. 5, the movable contact of that switch will be shifted into engagement with its other fixed contact. As indicated by FIG. 2, the lever 336 is disposed rearwardly of the platform 176 and of the plate 210.

The numeral 338 denotes an elongated pivot that is disposed within the slots 201 in the plates 202 and 204 at the rear of the bill-transporting device; and that pivot extends through openings in the sides of the channel 310. As a result, that pivot 338 permits raising and lowering of the leading edge of the channel 310. A helical extension spring 340 has the lower end thereof hooked through an opening 339 in the web of the channel 310, as indicated by FIG. 3, and that spring has the upper end thereof secured to the U-shaped bracket 238, as indicated by FIGS. 1 and 2. That spring biases the channel 310 for rotation to the upper position shown by FIG. 2; but that spring can yield to permit the channel 310 to be rotated downwardly until the lower edges of the flanges thereof are substantially parallel to the downwardly and rearwardly inclined central and rear portions of plate 210 and platform 176.

The pivot 338 rotatably supports timing belt pulleys 346 and, as indicated by FIG. 4, those timing belt pulleys are disposed outwardly of the flanges of the channel 310. A pivot 342 is carried by the front end of the channel 310, and that pivot rotatably supports timing belt pulleys 344. The timing belt pulleys 344 and 346 coact to support two timing belts 348; and those timing belts are disposed outwardly of the flanges of the channel 310.

The numeral 350 denotes a shaft which is supported by openings in the plates 202 and 204; and that shaft projects outwardly to the left beyond the plate 204, as that plate is viewed in FIG. 4. A worm wheel 360 is fixedly secured to the left-hand end of that shaft, and that worm wheel meshes with and is driven by a worm gear 362. That worm gear is mounted on the output shaft of a motor 364; and, as a result, energization of the motor 364 will cause rotation of the shaft 350. A pair of timing belt pulleys 352 are fixedly secured to the shaft 350,

and those pulleys are in register with the pulleys 346 which are rotatably mounted on the pivot 338. A pivot 354 is supported by the downwardly-depending flanges 180 and 182 on the central portion of the platform 176; and timing belt pulleys 356 are rotatably supported by that pivot. The timing belt pulleys 352 and 356 support two timing belts 358; and those timing belts are below, but in register with, the timing belts 348.

The numeral 366 denotes a wide-faced roller that is fixedly secured to and rotates with the shaft 350; and that roller is disposed between the timing belt pulleys 352. The numeral 368 denotes a pair of narrow-faced rollers which are fixedly secured to and rotate with the shaft 350; and those rollers are disposed outwardly of the timing belt pulleys 352. The numeral 370 denotes four eccentrically-mounted discs which are rotatable relative to the pivot 338. As indicated particularly by FIG. 2, the rear portions of those discs are caused to extend rearwardly beyond the rear faces of the timing belts 348; and this is done so those discs can be rotated in the counter clockwise direction into tight engagement with the rollers 366 and 368. Helical extension springs 372 are secured to projections on those discs and extend upwardly to suitable supports. In the case of the springs 372 which are connected to the centrally-located discs 370, that suitable support is the extreme rear portion of the channel 310. As a result of the bias applied by the springs 372, the discs 370 tend to bear tightly against the rollers 366 and 368; but those discs can respond to counter clockwise rotation of the rollers 366 and 368 and of shaft 350, as that shaft is viewed in FIG. 2, to raise upwardly. Any such raising movement will permit a bill 245 to pass between those rollers and those eccentrically-mounted discs. Any effort to retract an inserted bill, after any part of that bill became interposed between those rollers and those discs, would jam those discs solidly against that bill and thus jam that bill solidly against the rollers 366 and 368. The faces of the discs 370 and the faces of the rollers 366 and 368 will be covered with rubber, cork or some other material having a desirably high coefficient of friction; and hence those discs and those rollers will effectively prevent retraction of an inserted bill.

The numeral 376 denotes pins that are secured to the inner faces of the plates 202 and 204. Elongated wire-like springs 374 have their forward ends extending into and held by the openings 205 in the plates 202 and 204, have their central portions extending over the pivot 338, and have their rear ends extending under and held by the pins 376. Those springs must be bent to place the rear ends thereof below the pins 376, and hence those springs will apply a downward force to the pivot 338 and thereby urge the belts 348 downwardly into engagement with the belts 358.

The numeral 562 denotes a switch that is secured to the upturned side wall 216 of the plate 210 adjacent the front of that wall. The arm of that switch extends into a loop at the upper end of a large, circular, actuator 564. That actuator is rotatably mounted on a pivot 566, on the wall 216, and the lower part of that actuator extends downwardly through a slot, not shown, in the central portion of the platform 176. In the position shown by FIGS. 2 and 5, the actuator 564 permits the contacts of the switch 562 to be open. However, when a bill engages that actuator and rotates it in the clockwise direction, that actuator will close the contacts of the switch 562. The actuator 564 has a large radius of curvature; and a chord of that actuator is generally parallel to the downwardly inclined central and rear portions of the platform 176.

The shaft 260 and the shaft 350 will be suitably mounted in bearings or bushings to minimize friction and wear. However, to keep the drawing simple, those bushings or bearings have not been shown.

The numeral 568 denotes a switch that is mounted on the bottom plate 136 adjacent the rear of that plate.

That switch has an actuator 570; and that actuator extends up into the path of the inclined camming surface 254 on the bracket 252 which is secured to the U-shaped frame 228 of the bill carrier 226. The inclined camming surface 255 on that U-shaped frame is in the path of the actuators of switches 154 and 160.

Referring to FIG. 5, the numeral 426 denotes a unit which contains a tuned amplifier and a control element of the type disclosed in the said Smith et al. application. The windings of the magnetic heads 270 and 274 are connected in series and are then connected to the input of that unit. The output of that unit is connected to the coil 428 of a relay; and that relay has fixed contacts 438 and 440 and a movable contact 439. A second relay has a coil 446 and has two pairs 442 and 444 of normally open contacts. A third relay has a coil 462, has a pair of normally open contacts 460, and has fixed contacts 454 and 458 and a movable contact 456. A fourth relay has a coil 476, has normally open contacts 472 and 474, and has fixed contacts 471 and 475 and a movable contact 473.

FIG. 5 also discloses, in schematic form, components that might be expected to be found in a vending machine that was actuated by the currency identification device of the present invention. Those components are enclosed within a dotted enclosure; and the push button 520 also is enclosed within that enclosure. The numeral 514 denotes the motor or other source of motive power for the vending machine, the numeral 504 denotes the coil of a relay which has normally open contacts 506 and 508, and the numeral 494 denotes the coil of a relay which has normally open contacts 502 and fixed contacts 496 and 500 and a movable contact 498. The numeral 512 denotes the delivery switch of the vending machine, the numeral 516 denotes the empty lamp, and the numeral 517 denotes the empty switch of that vending machine.

Whenever the bill-transporting device provided by the present invention is at rest, the electrical and mechanical components of that bill-transporting device and the electrical components of the circuits associated with that device will be in the positions shown by FIGS. 1-5. When a bill 245 is laid on the horizontal front portion of the platform 176 and is then forced under the actuator 564 of the switch 562, that bill will raise that actuator and close the contacts of the switch 562. Thereupon, the push button 520 can be pressed to complete a circuit via prong 412 of the plug 410, junction 416, junction 488 in the vending machine, delivery switch 512, contacts 498 and 500, the movable and upper fixed contacts of the empty switch 517, push button 520, switch 562, motor 164, junction 417, junction 418 and prong 414 of the plug 410. The resulting energization of the motor 164 will rotate the sprocket wheel attached to the shaft of that motor, and will act through the sprocket chain 278 and the pin 280 which is disposed within the U-shaped block 256 to start moving the bill carrier 226 toward the rear of the bill-transporting device.

As the patron inserted the leading edge of the bill 245, that insertion was limited by the lower edge of the gate 292. However, that insertion was not hindered by the bill-clamping discs mounted on the shafts 240, because those discs were held up out of engagement with the bearing plates on the bill carrier 226. As that bill carrier starts moving toward the rear of the bill-transporting device, the right-hand arms of the T-shaped levers 242 will move out of engagement with the plates 246; and thereupon the helical extension springs 248 will rotate those levers in the counter clockwise direction. As those levers so rotate they will act through the shafts 240 to cause the bill-clamping discs to engage the bill 245 and force that bill down into clamping engagement with the bearing plates on the bill carrier 226.

Also, as the bill carrier 226 starts to move toward the rear of the bill-transporting device, the L-shaped levers 288 will be freed; and those levers will respond to the

11

springs 295 to rotate in the clockwise direction and permit the gate 292 to be moved upwardly until its lower edge is above the lower surface of the plate 210. At such time, that gate 292 will not be able to interfere with the movement of the bill rearwardly between the upper surface of the platform 176 and the lower surface of the plate 210.

As the bill carrier 226 moves toward the rear of the bill-transporting device, the inclined camming surface 255 on the bracket 252 will move out of engagement with the actuators of the switches 154 and 160; and thereupon those switches will close. The closing of the switch 154 will complete a running circuit for the motor 164 via prong 412, junction 416, junction 420, switch 154, the movable and upper fixed contacts of the switch 568, motor 164, junction 417, junction 418 and prong 414. The closing of the switch 160 will not complete a circuit at this time but will merely pre-set certain circuits. The closing of the switch 154 thus establishes a running circuit for the motor 164 which will assure movement of the bill carrier 226 to the rear of the bill-transporting device.

As the bill carrier 226 continues to move toward the rear of the bill-transporting device, the roller 241 carried by one of the pivots 240 will engage the right-hand end of the horizontally-directed portion of the elongated member 264 and will start moving that end downwardly. Such movement will act through the slot 265 and the pin 263 to rotate the arm 262 from the raised position in FIG. 1 to a lowered position. That rotation will act through the shaft 260 to rotate the bracket 268, and thus force the magnetic head 270 down against the bill 245 to force that bill down against the pressure member 276. Also, that rotation of the arm 262 will act through the shaft 260 and the bracket 268 to force the pressure member 272 down into engagement with the bill 245 to force that bill down into engagement with the magnetic head 274. The overall result is that the magnetic face of the inserted bill 245 will be forced into intimate engagement with either the air gap of the magnetic head 270 or the air gap of the magnetic head 274.

Prior to the time the roller 241 effects full counter clockwise rotation of the arm 262, the motor 164 will have raised the bill carrier 226 to its predetermined synchronous speed; and that motor will be powerful enough to keep that bill carrier moving at that synchronous speed despite the increased frictional resistance applied to the bill 245 by the magnetic heads 270 and 274 and by the pressure members 272 and 276. The roller 241 will continue to hold the elongated member 264 and thus the arm 262 in lowered position until the roller 241 passes beyond the left-hand end of the elongated member 264. Thereafter, the spring 271 will be free to raise the arm 262 upwardly.

If the bill 245 is an authentic bill, the magnetic face thereof will coact with either the magnetic head 270 or the magnetic head 274 to provide voltage variations; all as disclosed in the said Smith et al. application. Those voltage variations will be suitably amplified by a tuned amplifier in the unit 426 and will cause the control element in that unit to produce two validating signals, all as disclosed in the said Smith et al. application.

The first of those validating signals will energize the relay coil 428 and thereby move the movable contact 439 down into engagement with the fixed contact 440. Such movement establishes a circuit via prong 412, junction 416, junction 488, delivery switch 512, junction 513, switch 160, junction 430, contacts 439 and 440, contacts 456 and 454, junction 452, junction 448, relay coil 446, and junction 418 to the prong 414 of plug 410. Thereupon, the relay contacts 442 and 444 will close; and the contacts 444 will establish a holding circuit for the relay coil 446.

As that first validating signal passes, the relay coil 428 will become de-energized and the movable contact 439 will move back up into engagement with the fixed con-

12

tact 438; and that engagement will complete a circuit via prong 412, junction 416, junction 488, switch 512, junction 513, switch 160, junction 430, contacts 439 and 438, the now-closed contacts 442, junction 450, junction 464, relay coil 462, and junction 418 to prong 414. The resulting energization of coil 462 will close contacts 460 to establish a holding circuit for that coil; and it will also cause the contact 456 to move down into engagement with the fixed contact 458. Such movement will break the connection between the contact 456 and the relay coil 446; but the breaking of that connection cannot de-energize that relay coil because of the holding circuit established by the now-closed contacts 444.

The second validating signal will re-energize the relay coil 428; and the resulting downward movement of the contact 439 will complete a circuit via prong 412, junction 416, junction 488, switch 512, junction 513, switch 160, junction 430, contacts 439 and 440, contacts 456 and 458, relay coil 476, and junction 418 to the prong 414. Relay contacts 472 and 474 will then close, and the contacts 472 will complete a holding circuit for the coil 476. The movable contact 473 will move down into engagement with the fixed contact 471; but that movement will not cause any immediate change in the position of any of the electrical components of FIG. 5, because the movable contact of the switch 568 is still in its upper position. The closing of the contacts 474 also does not cause any immediate change in the position of any of the electrical components of FIG. 5 because the movable contact of switch 332 is still in its left-hand position and the relay contacts 502 are still open. The passing of the second validating signal will again de-energize the relay coil 428 and thus disconnect the movable contact 439 from the relay coil 476, but that coil will be kept energized by the holding circuit established by the contacts 472.

The motor 164 will continue to act through the sprocket chain 278 to move the bill carrier 226 toward the rear of the bill-transporting device until the inclined camming surface 254 on the bracket 252 engages the actuator 570 of the switch 568. Thereupon, the movable contact of that switch will move down into engagement with the lower fixed contact of that switch, thereby completing a circuit via prong 412, junction 416, junction 420, switch 154, the movable and lower fixed contacts of switch 568, contacts 473 and 471, motor 364, and junctions 417 and 418 to the prong 414. Simultaneously, a second circuit will be completed via prong 412, junction 416, junction 420, switch 154, the movable and lower fixed contacts of switch 568, contacts 473 and 471, solenoid 306, and junctions 417 and 418 to the prong 414. Those circuits will energize the motor 364 and the solenoid 306; and that motor will start rotating the shaft 350 in the counter clockwise direction in FIG. 1. Such rotation will start the confronting faces of the timing belts 348 and 358 moving rearwardly of the bill-transporting device. The energization of the solenoid 306 will cause the plunger 303 to pull the spring 304 to the left in FIG. 1 and to the right in FIG. 5, and will thereby cause the U-shaped bracket 302 to rotate and cause the roller 303 to force the leading end of the channel 310 to move downwardly. The resulting movement of the leading end of that channel will force the leading edges of the timing belts 348 down toward the leading edges of the timing belts 358, and thus into engagement with the bill 245 which has already been interposed between the leading edges of those belts. The solenoid 306 is a powerful solenoid, and the motor 364 and the gears 362 and 360 are powerful and rotate the shaft 350 quite rapidly. As a result, the inserted bill 245 will experience a rapid and strongly motivated movement toward the rear end of the bill-transporting device; and the leading edge of that bill will be quickly moved into position between the rollers 366 and 368 and the eccentrically-mounted discs 370. Such rapid and strongly motivated

movement will keep the patron from holding onto the trailing edge of the inserted bill; which trailing edge will, at that moment, still be projecting outwardly beyond the upturned front end 212 of the plate 210. Further, that movement of that bill will be so rapid and so strongly motivated that a patron will be virtually unable to halt such movement by use of a thread, tape or other member attached to that bill. The overall result is that the inserted bill 245 will be promptly moved to the cash box.

The right-hand arms of the T-shaped levers 242 engage the inclined edges 225 and 229, respectively, on the brackets 224 and 227 a fraction of a second after the inclined camming surface 254 on the bracket 252 causes the actuator 570 to shift the movable contact of the switch 568. As those arms of those levers engage those leading edges, they will rotate the short shafts 240 and raise the bill-gripping discs up out of engagement with the bill. As a result, the bill 245 will be freed by those discs almost immediately after the belts 348 and 358 have been forced into gripping engagement with that bill.

The rollers 366 and 368 will apply discharging forces to the bill 245, and will thereby help direct that bill to the cash box; and hence those rollers serve as bill-discharging rollers. It will be noted that those rollers are adjacent the trailing edges of the timing belts 348 and 358 and, further, that those timing belts hold onto the bill 245 until the rollers 366 and 368 have engaged and are applying discharging forces to that bill.

As the switch 568 had its movable contact moved down into engagement with its lower fixed contact, the running circuit to the motor 164 was opened and that motor came to rest. However, the bill 245 will continue to move toward the cash box under the action of the belts 348 and 358 which are driven by the motor 364. As the leading edge of the bill 245 is moved rearwardly by the belts 348, that leading edge will engage and move the actuator 336 for the switch 332. That leading edge of that bill will be supported, by the pairs of belts 348 and 358, on opposite sides of the point where that leading edge engaged the actuator 336. Furthermore, the portion of the leading edge of the inserted bill 245 which engages the actuator 336 will be immediately adjacent one of those pairs of belts. As a result, that portion of the leading edge of the bill 245 which engages the actuator 336 will receive full and immediate support from the belts 348 and 358 and will be kept from crumpling or rolling up.

The actuator 336 will respond to the leading edge of the bill 245 to shift the movable contact of the switch 332 into engagement with the right-hand fixed contact of that switch; and thereupon a circuit will be completed via prong 412, junction 416, junction 488, switch 512, junction 513, now-closed contacts 474, the movable and right-hand fixed contacts of switch 332, relay coil 494, and junctions 492, 486 and 418 to the prong 414. The resulting energization of the relay coil 494 will shift the movable contact 498 into engagement with the fixed contact 496 and thereby provide a holding circuit for that relay coil via prong 412, junctions 416 and 488, switch 512, contacts 498 and 496, relay coil 494 and junctions 492, 490, 486 and 418 to the prong 414. The closing of the relay contacts 502 does not cause an immediate change in the position of any of the other electrical components of FIG. 5 because the movable contact of switch 332 is out of engagement with the left-hand fixed contact of that switch.

As the inserted bill 245 continues to move toward the cash box, under the action of the belts 348 and 358, the trailing edge of that bill will move out of engagement with the actuator 336 and permit the movable contact of the switch 332 to return to the position shown by FIG. 5. Thereupon, a circuit will be established via prong 412, junctions 416 and 488, switch 512, junction 513, contacts 474, the movable and left-hand fixed con-

tacts of the switch 332, the now-closed relay contacts 502, junction 510, relay coil 504, and junctions 490, 486 and 418 to the prong 414. The resulting energization of the relay coil 504 closes the relay contacts 506 and 508. The closing of the contacts 506 establishes a holding circuit for that relay coil, and the closing of the contacts 508 energizes the motor 514 of the vending machine. That motor will cause the vending machine to dispense the desired product and, if that vending machine is equipped with a change maker, to dispense the required amounts of change. As the product is dispensed, the switch 512 will be opened; and thereupon the holding circuits for the relay coils 494 and 504 will be opened. At such time the components of the vending machine will return to the positions shown by FIG. 5.

The opening of the switch 512 also breaks the holding circuits to the relay coils 446, 462 and 476; and thereupon each of those coils will become de-energized. As a result, all of the contacts of the relay coils 446, 462 and 476 will return to the positions shown by FIG. 5. The return of the movable contact 473 to its normal upper position will break the circuits to the motor 364 and to the solenoid 306 and thereby de-energize that motor and that solenoid. That motor will come to rest, and that solenoid will permit the spring 340 to raise the leading end of the channel 310 and thus raise the leading edges of the belts 348. The movement of that movable contact up into engagement with the fixed contact 475 will complete a circuit via prong 412, junctions 416 and 420, switch 154, switch 568, contacts 473 and 475, motor 164, and junctions 417 and 418 to the prong 414. The resulting re-energization of the motor 164 will act through the sprocket chain 278 to cause the pin 280 to move transversely through the U-shaped block 256, secured to the U-shaped frame 228 of the bill carrier 226, and thereby cause that bill carrier to start moving toward the front of the bill-transporting device. As that bill carrier so moves, the inclined camming surface 254 on the bracket 252 will move out of engagement with the actuator 570 of the switch 568; and thereupon the movable contact of that switch will move out of engagement with the lower fixed contact and will move up into engagement with the upper fixed contact of that switch. Such movement will break the circuit for the motor 164 through the contacts 473 and 475 of the relay but will establish a circuit for that motor via prong 412, junctions 416 and 420, switch 154, the movable and upper fixed contacts of the switch 568, motor 164, and junctions 417 and 418 to the prong 414. This circuit will keep the motor 164 energized until the inclined camming surface 255 on the bracket 252, secured to the U-shaped frame 228 of the bill carrier 226, engages the actuators of the switches 154 and 160 and thereby opens those switches. At such time the bill carrier 226 will be adjacent the front of the bill-transporting device and the various electrical components will be in the positions shown by FIG. 5. Also, the mechanical components of the bill-transporting device will be in the positions shown by FIGS. 1-4.

In the foregoing description of the operation of the currency detector of the present invention, it was assumed that the inserted bill 245 was an authentic bill; but if that bill had been a spurious bill, that currency detector would not have accepted that bill. Specifically, if that bill had been a spurious bill, the relay coil 428 would not have received two validating signals; and hence the relay coil 476 would not have been energized. This means that the motor 364 and the solenoid 306 would not have been energized. As the bill carrier 226 would reach the rear of the bill-transporting device, the engagement of the inclined camming surface 254 on bracket 252 with the actuator 570 of the switch 568 would cause the movable contact of that switch to move out of engagement with the upper fixed contact of that switch and to move into engagement with the lower fixed contact

of that switch. Such movement will break the circuit for the motor 164 but will immediately complete another circuit for that motor via prong 412, junctions 416 and 420, switch 154, the movable and lower fixed contacts of switch 568, still-closed relay contacts 473 and 475, motor 164, and junctions 417 and 418 to the prong 414. This second circuit will keep the motor 164 energized until the pin 280 passes around the sprocket wheel on the shaft of motor 164 and starts the carrier 226 moving toward the front of the bill-transporting device. As that carrier so moves, the inclined camming surface 254 on the bracket 252 will move out of engagement with the actuator 570 of switch 568 and the movable contact of that switch will return to its upper position and restore the original circuit for the motor 164. That original circuit will be broken, and the motor 164 will come to rest, when the inclined camming surface 255 on the bracket 252 forces the switches 154 and 160 to reopen. The patron would thus have his bill returned to him, but he would not receive the desired product or any change, because the relay coil 476 would not have been energized and because the actuator 336 for the switch 332 would not have been moved.

If a passerby presses the push button 520 without inserting a bill, the motor 164 will not be energized. This is due to the fact that the switches 520 and 562 are connected in series with the motor-starting circuit. As a result, passersby can not subject the motor to useless cycling.

The bends in the platform 176 and in the plate 210 are desirable because they force the inserted bill 243 to bend as its leading edge approaches the actuator 564 of the switch 562. That bending of that bill will tend to stiffen the leading edge of that bill and thus resist crumpling of that leading edge. The bends in the platform 176 and in the plate 210 also make it difficult for persons to insert tools or knives into the bill-transporting device.

Whereas the drawing and accompanying description have shown and described a preferred embodiment 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 we claim is:

In a bill-transporting device, a bill carrier that is normally in a bill-receiving position but that can be moved to a bill-transferring position and then back to said bill-receiving position, said bill carrier having bill gripping members, a motor that can move said bill carrier to said bill-transferring position and then back to said bill-receiving

ing position, a plurality of endless belts that have forward ends disposed forwardly of said bill-transferring position and that have rearward ends disposed rearwardly of said bill-transferring position and adjacent a bill-discharging area, pulleys that hold said belts in register with each other, a second motor that drives said belts, the pulleys adjacent the forward ends of said belts normally being spaced apart and the pulleys adjacent the rearward ends of said belts being adjacent each other to enable said belts to normally define a converging space to receive the leading edge of a bill introduced by said bill carrier, one of said pulleys adjacent said forward ends of said belts being movable towards the other pulley to cause said forward ends of said belts to co-actively engage and convey the introduced bill inserted into said space, a member for moving said movable pulley, said member being electromagnetic and having a movable portion that moves when said member is energized, a yielding connection between said movable portion of said member and said movable pulley, said yielding connection initially responding to movement of said movable portion of said member to cause movement of said movable pulley and thereafter permitting movement of said movable portion of said member to its fully seated position after said forward ends of said belts have been moved into engagement with the introduced bill, and a circuit-closing means for said member that actuates said member to cause said movement of said movable pulley, said circuit-closing means being actuatable only after the leading edge of the introduced bill is inserted between the forward ends of said belts, said belts responding to said second motor and to said member to convey the introduced bill toward said bill-discharging area, said second motor driving said belts faster than the first said motor moves said bill carrier, whereby said belts will expel the bill from the gripper members after that bill has been moved to said bill-transferring position and has been engaged by said belts.

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