

June 28, 1966

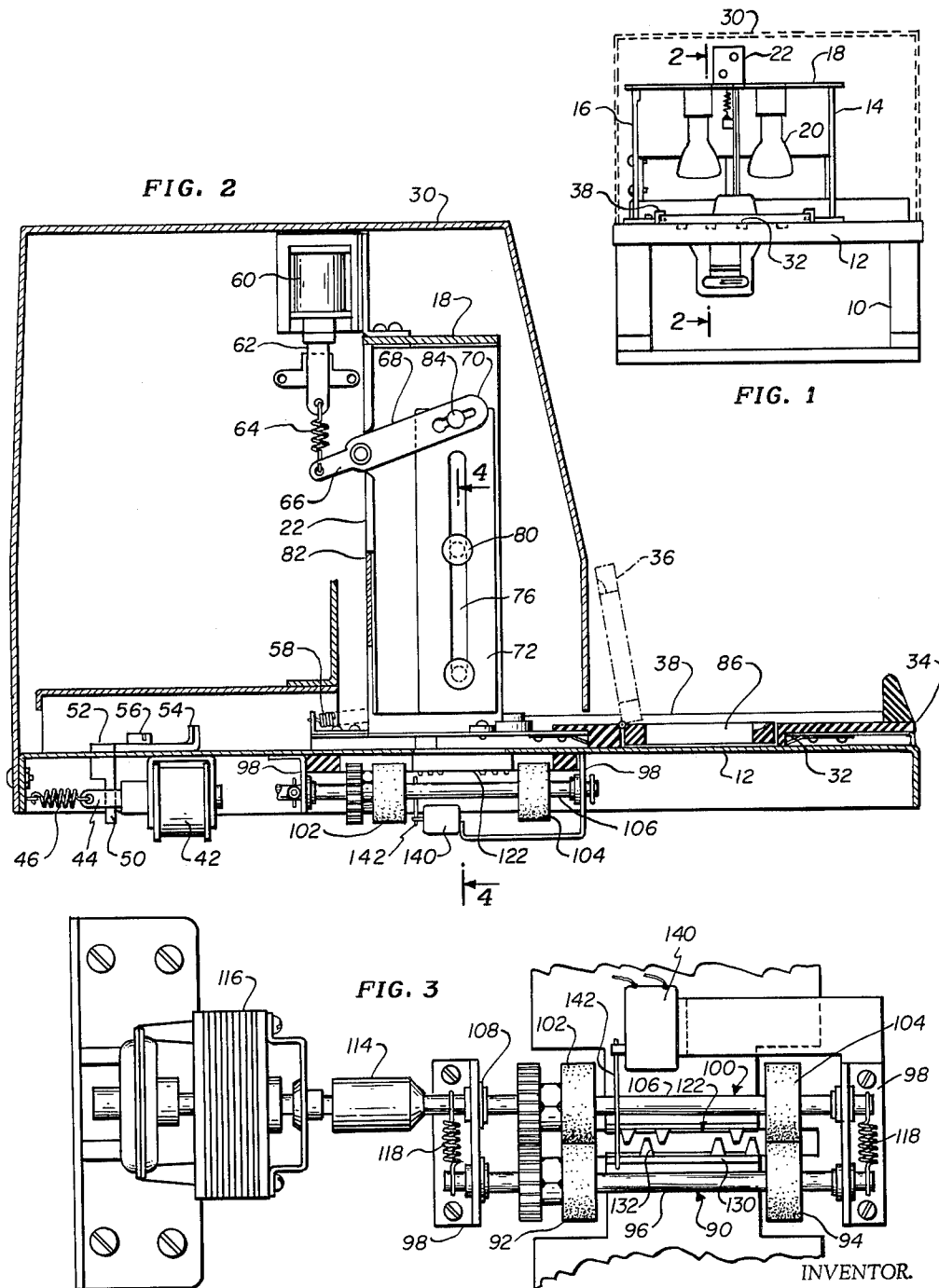
D. E. HOOKER

3,258,098

CURRENCY CHANGER APPARATUS

Filed June 9, 1964

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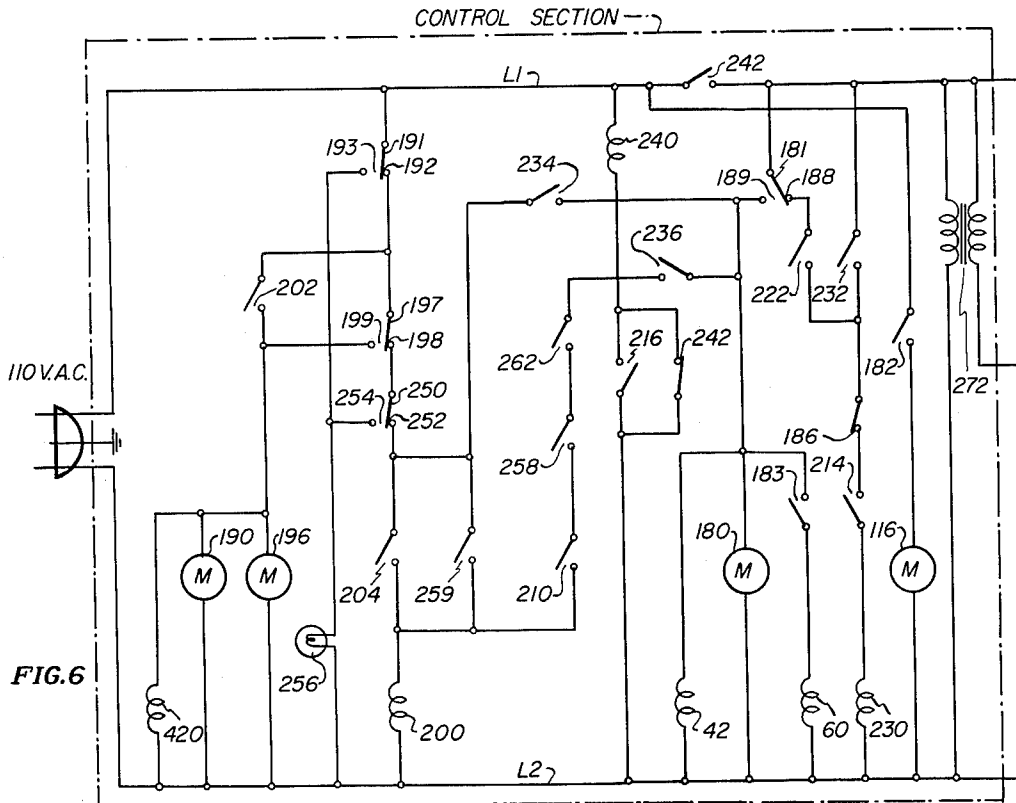


FIG. 6

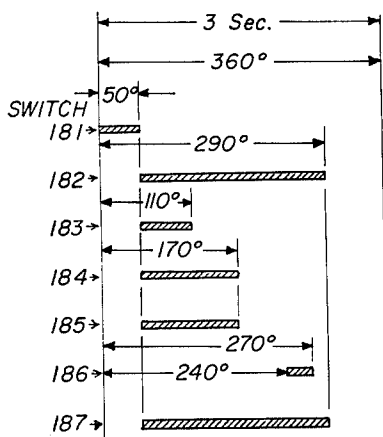


FIG. 8

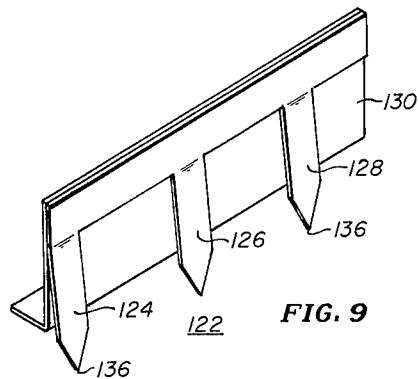


FIG. 9

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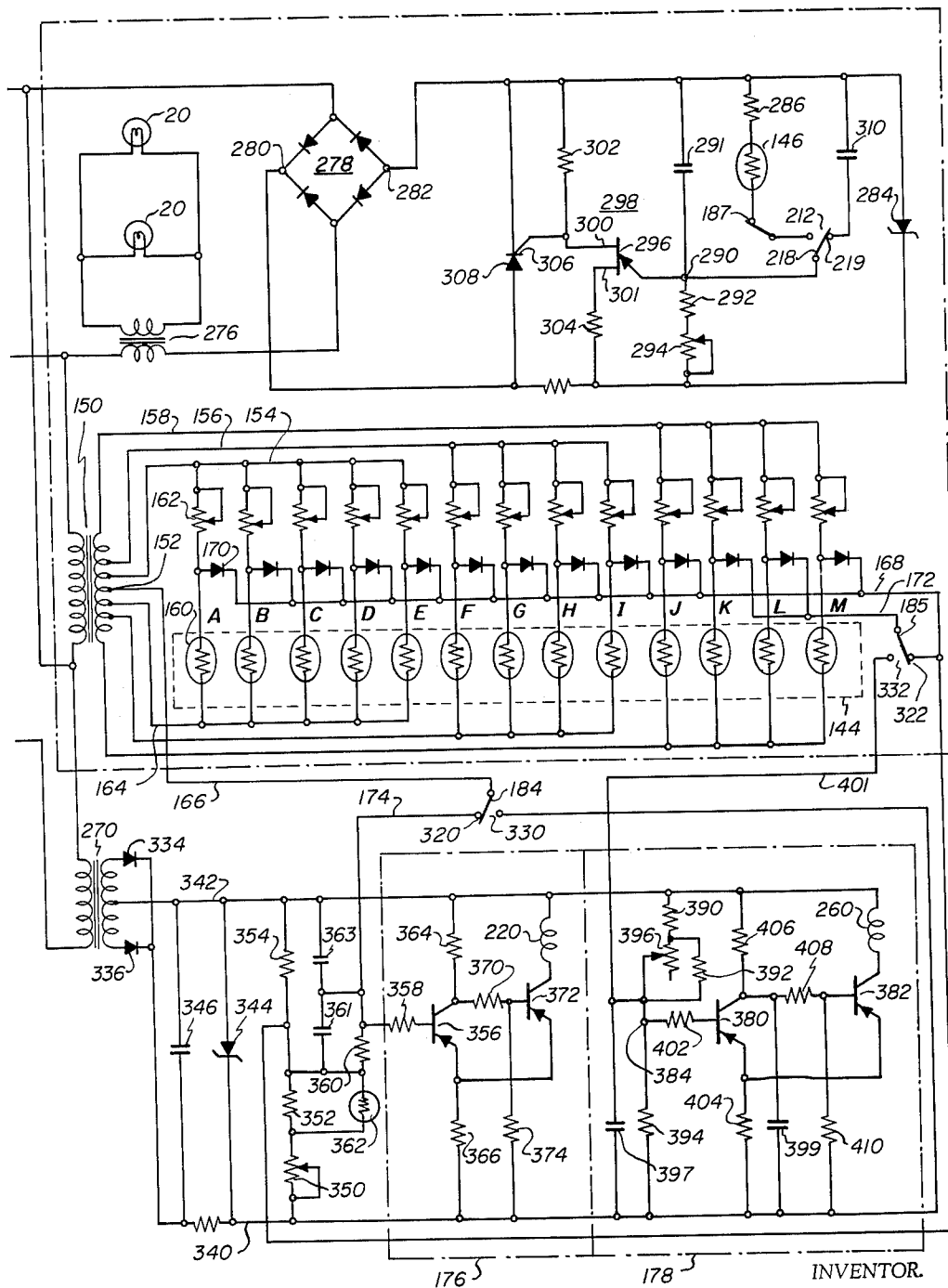
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3,258,098

CURRENCY CHANGER APPARATUS

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4 Claims. (Cl. 194—4)

The present invention relates to machines for testing and evaluating currency, and for returning change therefor, and more particularly to improved testing apparatus for defeating attempts to defraud such machines.

In recent years, there have been a number of commercial attempts to make satisfactory currency changers, and there have issued many patents covering various facets of the devices involved. Very few of the attempts have been successful due to the stringency of the tests to which a currency note must be subjected, but mostly the general lack of success has resulted from the great number of safeguards which must be used to frustrate the many, repeated attempts to defraud these machines. In fact for these reasons, at the time of this invention, very few manufacturers of currency changing machines have been able to produce machines which are commercially successful.

Many devices have been successfully able to differentiate valid from spurious currency notes, even following the great amount of discoloration, staining, and marking of currency resulting from normal use. One major problem which has arisen is that of insuring that a currency note passing the tests and initiating payout is not surreptitiously removed by the user following its validation. One such test is shown in U.S. Patent No. 3,131,798, issued May 5, 1964 to Norbert A. Gecewicz, for Method and Apparatus for Currency Testing. The cited patent and the present invention contemplate the use of a basic structure and general testing arrangement similar to that shown in U.S. Patents No. 3,108,692, and No. 3,108,693, issued on October 29, 1963 to W. A. Patzer, for Currency Testing Arrangements. It should be noted that these three patents are the product of the leading and possibly the only commercially successful manufacturer of currency changers, at the present time.

The cited Patzer patents show a currency testing machine, in which a currency note is placed in a drawer or trough, and a perforate cover is closed over the note. The drawer is then advanced slideably into the machine to an advanced or test position. A light source is then activated and photo-electric cells sense the amount of light transmitted through selected spots on the note in test. The response of these cells to the selected spots or areas has been calibrated, the calibration having been based on normal currency. A spurious note is rejected and returned to the user summarily.

On the completion of a successful test denoting a valid currency note, the note and note-bearing drawer are locked in place, so that the note may be collected, and thereafter the proper change may be paid out. It is at the note removal stage that the apparatus shown by the cited Gecewicz patent comes into play. That apparatus is actuated after the collection of the currency note, and conducts a further light test on the note-bearing drawer. This test must show that the currency note has, in fact, been collected before a payout signal is initiated. Instituting such a test has proved quite important in greatly lessening the chances of fraudulent removal of a successfully tested note following the termination of the test, and in greatly lessening the success of attempts to defraud the machine.

The present invention adds to the apparatus previously described: first, a series of one-way blocking members interposed in the passage of a note to the collection area; and second, a note acceptance switch actuated by the note

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as it is being collected, and only by the note after the note has passed through the one-way members. Once the note has passed the one-way members, it cannot be retrieved by expedients, such as strings tied to it, without severely damaging the note. Only after the note has cleared the members, is the acceptance switch actuated in the output circuit to initiate change payout.

In addition, the "clear tray" or note removal test of the note testing area is effected by only a small number of the photo cells used for the acceptance testing, one or more of these cells checking each half of the note area; thereby insuring that both halves of the note are collected.

With this combination of added tests, the possibility of a machine utilizing the safeguards of the present invention being defrauded is measurably lessened. As a result, the use of the added tests greatly improves the reliability of currency changers and should lead to greater usage and public acceptance of currency changers.

The invention both as to its mode of operation together with further objects, features, and advantages thereof, will best be understood by reference to the following description read in conjunction with the accompanying drawings in which:

FIGURE 1 is an elevational view of an apparatus embodying the present invention;

FIGURE 2 is a sectional view taken along the line 2—2 of FIGURE 1;

FIGURE 3 is a partial plan view taken from the bottom side of FIGURE 1;

FIGURE 4 is a sectional view taken along the line 4—4 of FIGURE 2;

FIGURE 5 is a sectional view as FIGURE 4 showing the stripper member in its lowered position;

FIGURES 6 and 7, when fitted together, with FIGURE 7 to the right of FIGURE 6, comprise a schematic diagram for the apparatus;

FIGURE 8 is a switch or cam operating chart for use with the circuit diagram of FIGURES 6 and 7; and

FIGURE 9 is a perspective view of one set of note anti-theft members or one-way member, as used herein.

General construction

In FIGURES 1—5, there is shown generally the operative structure of a currency testing apparatus. The structure includes a main structural frame 10, on which is mounted the stationary, horizontal base platform 12. This platform is substantially rectangular in configuration and has secured approximately midway along its lateral edges two spaced uprights 14 and 16. A lintel 18 parallel to the platform spans the uprights and serves as a mount for lamps 20, which extend downwardly toward the platform 12. The lintel 18 further serves as the mounting for a note stripping mechanism 22 whose function will be described in detail in this description.

The platform 12 extends in a forward direction (right as viewed in FIGURE 2) past the front of upper housing 30. Housing 30 surrounds and encloses the operative structure above the platform and covers also approximately the rear two-thirds of the platform 12. A cabinet (not shown) covers the operative structure below housing 30 and includes conventional change-making apparatus and a cash box or collection box (not shown).

Toward the front of the platform outwardly of the housing 30, there is provided a slideable drawer member 32, resting on the platform and suitably biased to a normal position fully extended to the exposed or front end 34 of platform 12. This drawer includes a pivotal cover 36, which may be rotated through an arc from a closed position in which it forms a planar surface with the drawer top, to an open position (shown in broken lines in FIGURE 2) allowing access to the platform. This cover is slightly greater in surface area than the

flat area of a note, such as a dollar bill note. Thus, when the cover 36 is in the open position, a note, such as a dollar bill, may be laid flatwise on the platform in the opening exposed by the cover, and the cover may be closed over the note. The cover is perforated at regular intervals to allow light to penetrate through the cover and note, as will be described later.

The drawer is slidable rearwardly within platform side guides 38 from its exposed or forwardmost position, as shown in FIGURE 2, to a test position in which the cover 36 is within the housing 30 and is positioned directly below the stripper mechanism 22 and the lamps 20. The drawer lower surface has fingers or keys (shown only in broken lines), fitting into suitable slotted keyways (shown only in broken lines), extending longitudinally in the platform. The combination of the keys riding in the keyways and the drawer sidewalls riding in the slide guides acts to constrain the drawer 32 to front-to-rear slide motion along the upper surface of platform 12. As the drawer is being pushed toward the test position within housing 30, the keys push a note in the drawer to the test position.

At the rear of the platform there is mounted a solenoid 42 having an operating plunger 44, which is impelled forwardly against the bias of spring 46 on energization of the solenoid. The plunger carries with it the depending leg 50 of a pivot bar 52. The pivot bar has an upstanding finger 54 which is rotated on the energization of the solenoid to engage the rear edge of the drawer, when the drawer has been moved to its rearmost position. This engagement holds the drawer in the rearmost test position as long as the solenoid remains energized. Release of the solenoid allows spring 46 to compress drawing plunger 44 rearwardly and pivoting pivot bar 52 about its pintle 56 to release the engagement with drawer 32. Drawer 32 will then be restored to its normal position forward of the housing 30 by the action of tension spring 58.

To collect a note, which has been tested and validated, there is provided the stripper mechanism 22. This mechanism, as mentioned previously, is mounted on lintel 18 above the platform 12. The stripper mechanism is solenoid-actuated, there being an actuating solenoid 60 drawing its upwardly acting plunger 62 against the bias of tension spring 64. Spring 64 is connected at its upper end to the bottom end of plunger 62 and at its lower end to one end 66 of lever arm 68. The other end 70 of lever arm 66 is coupled to the upper end of stripper plate 72. This stripper plate is constrained to vertical motion by the engagement of its vertically elongated slot 76 with pins 80 which protrude horizontally from stationary vertical support bracket 82. Vertical support bracket 82 is secured in a permanent manner below lintel 18 and further supports the structure of solenoid 60.

The stripper plate is forcibly depressed by the solenoid actuation through a longitudinal slot 86 in cover 36. Slot 86 is mated (with the drawer in test position) with a similarly sized slot 88 in platform 12, so that the stripper plate passes through both slots, and when fully depressed extends considerably below the platform, as shown best in FIGURE 5. This depressive motion of the stripper plate will cause the stripper plate to strike the upper surface of a note in the drawer, to fold the note about the stripper plate, and to carry the note below the platform. The folded note will then be removed from the stripper plate for delivery to the collection chamber (not shown).

Beneath the platform 12, and on either side of slot 88, there are positioned two opposed sets of rollers, an idler set 90, and a driven set 100. The idler roller set 90 includes two rollers 92 and 94 spaced apart on a common idler shaft 96, the shaft being secured within suitable, horizontally oversized slots (not shown) in side mounting supports 98. On the other side of slot 88 is the driven roller set 100, comprising rollers 102 and 104

spaced apart on a common shaft 106 mounted in suitable bearings 108 within side mounting supports 98 allowing only rotation of shaft 96. Shaft 106 is connected to a coupling 114, which is directly driven by a unidirectional drive motor 116 suspended from the underside of platform 12. The motor 116 rotates shaft 106 in the clockwise direction (FIGURES 3 and 4). Tension springs 118 join opposed shafts 96 and 106 at their remote ends to bias the opposed rollers into surface contact along their cylindrical surfaces. These springs 118 normally maintain this surface contact in a manner allowing the idler roller set 90 to be forced away from drive roller set 100 on the exertion of pressure between the rollers. The idler roller set is allowed to move the length of its mounting slot (not shown) which may allow movement of from 1/4" to 1/2" laterally of idler roller set 90. This amount of movement allows the stripper plate and folded note carried thereby to pass between the rollers. The motor 116 rotates shaft 106 in the clockwise direction (as viewed in FIGURES 3 and 4), so that rollers 92, 94, 102, and 104 grasp a note on the stripper plate and carry the note downwardly to free the bill of the stripper plate, which may then be retracted upwardly.

Within slot 88 in platform 12 on either side, there are mounted two opposed sets of knives generally designated 122, one set of which is shown in detail in FIGURE 9. Each knife set includes three blades 124, 126, and 128 sharpened to a point at their free ends. The blades are inherently spring-tensioned to extend away from their common mounting plate 130. The blades, when matched with opposed knife set 132 and its blades 134, are interdigitated, so that the blade tips 136 of the first set extend transversely past the blade tips 138 of the opposed set 132. The individual knives are tensioned, so that there is a slight opposing force to downwardly directed movement. The blade tips 136 and 138, however, will exert a considerable gripping and tearing force on objects, such as currency notes which are attempted to be retrieved by an upward pull. The opposed faces of stripper plate 72 are sufficiently smooth and of harder material than the knife blade tips 136 and 138, so that the stripper plate 72 is not gouged by the tips on upward stripper plate movement.

With these knives in place, any attempt to pull a note carried by the stripper upwardly through slots 86 and 88 will be opposed by the tension of the knives. A note pulled in this way will be gripped and held against such movement or torn badly. In this way, persons tying a string to a note and attempting to remove a valid note, once it has been stripped, will merely rip the note beneath the knife tips and the note will be either held by the knives or torn completely.

Further, there is mounted below platform 12, a note strip switch 140. Switch 140 is a miniature snap switch with an actuating spring arm 142. Arm 142 extends upwardly into the space between the roller shafts 96 and 106, and laterally into the space between the rollers on either shaft. The arm 142 is adjacent one pair of contacting rollers and is positioned outwardly of the path of the stripper plate but within the path of traverse of a note as the note is being carried to the collection box (not shown) below the roller sets. This switch arm 142 normally extends obliquely upwardly from the switch 140 to a level above the bottom of the blade tips 136 and 138. Switch 140 cannot be actuated until the note being depressed by the stripper plate is in the grip of the knife sets 122. By providing this feature, the accepted note must be within the grip of the blade tips before the dispensing of change can be initiated by the actuation of switch 140.

Validity testing apparatus

To effect the validity testing and note removal testing, there are provided a plurality of photo-electric cells 144 embedded in the upper surface of platform 12 within the test area. Thirteen cells have been used herein, the cells

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being spaced about the area of a dollar bill, some of the cells under the white, or unprinted areas of the dollar bill, others under the green areas, and still others under the black areas. A light intensity adjusting cell 146 is placed below one of the white areas, as will be explained. All these cells are of the type whose resistance decreases with increases in light intensity received by the cell active surface. Naturally, the cell active surfaces are directed upwardly through openings in the platform toward the underside of a note, such as a dollar bill, resting in drawer member 32 within the test area.

The circuit diagram of FIGURES 6 and 7 may be considered as comprising a number of functional elements: FIGURE 6—the operative control section; the uppermost portion of FIGURE 7—light intensity adjusting section; the central portion of FIGURE 7—the validity or detection test cell section; the lower left portion of FIGURE 7—both the detection trigger section and the note removal test section.

Turning now to the circuit diagram of FIGURES 6 and 7 in greater detail, we will first consider the validity test cell section of FIGURE 7. Within this section are a number of individual circuits, each of which is in itself a self-contained bridge circuit. Common to all the bridge circuits is a transformer 150, the secondary 152 of which is tapped at a number of levels to provide various voltage outputs. The lowest voltage level is fed commonly through conductor 154 to the first five of the photo cell circuits, the cells of which are adjacent the white areas of a dollar bill. The next higher voltage level is fed through conductor 156 to the next successive four photo cell circuits representing green areas, and the remaining four photo cell circuits receive a successively higher voltage from conductor 158 for the rakest areas of a dollar bill. In one exemplary condition, these voltage levels may be five volts, six and one-half volts, and nine volts, respectively.

Considering the photo cell circuit to the first or A cell 160, this circuit may be traced from the centertap of transformer secondary 152, through conductor 154, potentiometer 162, and photo cell 160 for a return through conductor 164 and the secondary 152 of transformer 150 to centertap 166. The previously-mentioned bridge includes four resistance legs which are respectively potentiometer 162, cell 160, and the two equal sections of secondary 152 between the respective conductors 154 and 164, and the centertap conductor 166. Centertap conductor 166 provides one output lead from the bridge circuit. The other output conductor 168 leading from the junction of potentiometer 162 and cell 160 includes a feed back preventing diode 170 isolating each bridge circuit from the remaining bridge circuits. The potentiometer 162 within the first bridge circuit is used to balance the response characteristic of the A cell 160, the response being dependent on the transmission characteristics of the area of a valid note adjacent the particular photo cell. Thus, potentiometer 162 is set for the normal response of cell 160 to the white area of a note to which it is adjacent.

As mentioned previously, thirteen photo cells are used herein in the photo cell 144, the cells being individually positioned about the area which would be covered by a valid dollar bill during testing. Each of these photo cells is included within a bridge circuit, two equal resistance legs of which are formed within the secondary 152 of transformer 150, the other legs of which include a validity detecting photo cell and a settable potentiometer. Designating the circuit of the first or A photo cell 160 as bridge circuit A, and successively lettering the remaining photo cells, the remaining circuits will be designated A through M. Each of these lettered circuits also includes a feedback prevention diode 170 in its connection to common output conductor 168, as described for the A circuit. Circuits K and L have as their output conductor, conductor 172 which is transferable between detection trigger network 176 and the note removal trigger network 178.

Similarly, the other common output conductor from

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the bridge circuits, conductor 166, is normally connected to the detection trigger network 176 and is transferable for note removal testing. Detection trigger network 176 is actuated to provide an indication that the note in test by the test cells is valid to initiate the operation of the control circuit of FIGURES 6 and 7.

Control circuit

The validity cell section operates to test the note under the direction of the control circuit of FIGURE 6. The operation of validity test section is initiated by the action of a plurality of feeler switches (shown only diagrammatically) responsive to the movement of the drawer member 32 to the test position. Once a determination of validity has been made (as will be explained), the control circuit is actuated to control the note removal, continued testing, and change payout under the control of a cycle timer motor 180. This timer motor controls a number of cam-actuated contacts 181-187, the operating period (3 seconds approximately) of which is shown by the cam-operating chart of FIGURE 8. Some of these cam-actuated contacts, i.e. 182, 183, 186, and 187 assume either an open or a closed position. Of these contacts, contacts 182 and 183 are normally open and close only during the operative period indicated on the cam chart of FIGURE 8. Contacts 186 and 187 are normally closed and open only during the operative period indicated by the bar of the cam chart of FIGURE 8. The remaining contacts 181, 184, and 185 are of the transfer type, normally closed to one circuit, and on operation, these contacts open the original circuit and close a second circuit. Contact 181 is normally closed to contact 188 and on operation transfers its closure to contact 189 in circuit to timing motor 180.

The control circuit generally has a second timing motor 190, called a dispenser timer motor. This dispenser timer motor has a cam-actuated timing contactor 191, which is normally closed to a first contact 192, and on energization of the motor opens the circuit to contact 192 and closes a second circuit to contact 193. This motor, once operated, continues to time the payout during the normal change dispensing period and thereafter ends its cycle to terminate payout and insure only a single dispense period per machine cycle.

A dispensing motor 196, when energized, controls the dispensing coins from the bill changer. This motor may act to emit four quarters simultaneously from four quarter payout tubes in a conventional manner. On operation, this motor closes a cam-actuated contactor 197 from a normally closed contact 198, to a second contact 199, thereby to lock the dispenser motor 196 operated for the duration of its operative cycle. To actuate the dispenser motor 196, there is provided a dispenser relay 200 which includes two normally open contact sets 202 and 204; these contact sets are closed on actuation of the dispenser relay to operate various circuits, as will be explained in greater detail.

The control circuit section has a plurality of switch-actuated contacts 210, 212, 214, and 216, which are operated by the previously-mentioned feeler switches from their normal position on the movement of the drawer member 32 into the test position. Contacts 210 and 214 are normally open and close to their stationary contacts on operation. Contacts 216 are normally closed and open on operation, and contacts 212 transfer from their normal closure to stationary contacts 218 to closure to stationary contacts 219.

Within the detection trigger network, an indicating relay 220 controls a plurality of contacts for acceptance or rejection of the dollar bill in test in a manner which will be explained more fully in detail. Operation of accept relay 220, indicating acceptance of the note in test, causes closure of its contacts 222. The last-mentioned contacts are in a circuit to a trigger slave relay 230, which, on operation, closes its contacts 232, 234, and 236.

The elements of the control section further include a line relay 240 which protects against misoperations caused by withdrawing the line leads L1 and L2 from the A.C. source during test. This relay actuates normally open contacts 242 in its own operating path, and normally open contacts 244 in line conductor L1. These contacts must be closed to complete dispensing, but cannot close if relay 240 is deenergized during a dispensing cycle.

Also shown in the control section is a conventional magazine empty switch contact 250, which is normally closed to its stationary contacts 252. When the quarter payout tubes or magazines become empty, the switch closes contact 250 to stationary contact 254 to complete a circuit to empty light 256; the empty light carrying a suitable legend which indicates to the user that there is no change in the machine. The control section has further a normally open set of contacts 258 which is closed by the actuation of arm 142 of the bill strip switch 140. Also shown within the control unit is a normally open set of contacts 262 controlled by the note removal relay 260. Relay 260 is located in the note removal network of the circuit and provides an indication on its operation that the valid note has in fact been removed from the drawer. Contacts 259 are test contacts closed manually by a service man to test the dispense relay 200. Contacts 259 are maintained open at all other times.

Lamp intensity control

Line leads L1 and L2 provide 110 volt A.C. power to the control section directly, to the test cell section through transformer 150, to the detection circuit, and note removal sections through transformer 270, and for the lamp intensity section through voltage stabilizing transformer 272. The primary of transformers 270 and 272 are connected in parallel directly across leads L1 and L2. The secondary of transformer 272 and the primary of transformer 150 in parallel are connected to one end of the primary winding of lamp transformer 276. The other end of the primary winding of lamp transformer 276 is connected to a full wave rectifier bridge 278. Lamps 20 are connected across the secondary of transformer 276.

The lamp intensity control, or light adjusting network, as it may otherwise be called, acts to modulate the power received by the lamps 20 by phase shifting the load in the output of transformer 276. The actual adjusting network is connected across opposed output terminals 280 and 282 or bridge 278 to receive a pulsating direct current input therefrom. Connected across the output terminals 280 and 282 is a Zener diode 284 of the type whose reverse breakdown voltage is 20 volts. This diode is polled in opposition to the input from terminals 280 and 282 to effect the conventional voltage stabilization of the network. A series combination including a light sensing photo cell 146 and resistor 286 provides the sensing function on which the adjustment depends, as will be explained. The circuit to this combination is normally in a standby condition, open between the movable contact 212 and stationary contact 219. When contact 212 is closed to contact 219 by the movement of the drawer member 32 into the test position, a circuit is closed from the photo cell series combination to junction 290 of a capacitor 291, a resistive network including a fixed resistor 292 and a potentiometer 294, and the emitter 296 of a unijunction transistor 298. Potentiometer 294 is normally settable for the nominal brightness of a typical unmarked (or white) area of a dollar bill to set the network response level.

As mentioned, junction 290 is connected to the unijunction transistor emitter 296 and the voltage level at this junction as determined by the voltage divider comprising cell 146, resistors 286, 292, and 294, provides the conduction timing of the transistor 298. The bases 300 and 301 of transistor 298 are each connected to separate resistors 302 and 304, the remote ends of these resistors

302 and 304 being connected respectively to the conductors to terminals 282 and 280 at bridge 274, forming a voltage divider across the rectifier terminals 280 and 282. The junction between base 300 of transistor 298 and resistor 302 is connected to the control element or gate 306 of a control rectifier 308, the anode and cathode of which are connected to the bridge output terminals 280 and 282. The adjusting network further includes a capacitor 310 which is connected to bridge junction 282 and stationary contact 218. Contact 218 is normally closed through movable switch contact 212 to junction 290 to bias transistor 298 in its normal condition.

Triggering circuits

The detection trigger network 176 and the note removal network 178 both include separate trigger circuits which are individually, regeneratively bistable and whose operation is dependent on the amplitude of the voltage received from the detecting cell section.

The input leads to these trigger circuits are transferable by the movement of cam-actuated contacts 184 and 185 from a normal position providing the input to the detection trigger 176 to an operated position providing the input to the note removal trigger 178. With these contacts in their unoperated position, closed to stationary contacts 320 and 322 respectively, the common output conductors 166 and 168 from the bridge circuits A-M are connected by the input conductors to the detection trigger circuit 176. When these contacts 184 and 185 are in their operated condition during the period indicated by the cam operation chart of FIGURE 8, contacts 184 and 185 are closed to respective stationary contacts 330 and 332 to connect the bridge output conductors 166 and 172 to the input of the note removal test trigger network 178.

Both trigger networks receive filtered, full-wave, pulsating direct current in multiple from the secondary of transformer 270, rectifiers 334 and 336 and conductor 340, and from the center tap of transformer 270 through conductor 342; conductors 340 and 342 being the line conductors to the trigger circuits. The direct current output across conductors 340 and 342 is regulated or clipped at 20 volts by Zener diode 344 connected across the line conductors 340 and 342 and the D.C. output is filtered by the use of filter capacitor 346. A voltage divider network including a settable variable resistor 350 and two fixed resistors 352 and 354 is also connected across these line conductors with the base of transistor 356 connected through bias resistors 358 and 360 to the junction of the two fixed resistors 352 and 354 in the voltage divider network. Two suitable capacitors 361 and 363 are connected in the circuit for bias and filtering purposes. A thermistor 362 is connected across fixed resistor 352 in this transistor bias circuit to provide temperature compensation for the transistors. Transistor 356 is normally maintained in the conductive state to complete an emitter-collector circuit through resistors 364 and 366. The collector of transistor 356 is connected through resistor 370 to the base of output transistor 372. The base of this transistor is connected into the voltage divider formed by resistors 364, 370, and 374. The emitter of output transistor 372 is connected in multiple with the emitter of input transistor 356, so that transistor 372 is normally maintained in a non-conductive state by the conduction of transistor 356. The collector circuit of this latter transistor includes the output relay 220 which may be a reed relay or the like.

The note removal network 178 is also bistable and includes two regeneratively coupled transistors 380 and 382. The base of the normally conductive transistor 380 is normally biased from the intermediate junction 384 of a voltage divider including fixed resistors 390, 392, and 394, and a settable potentiometer 396 connected in parallel with resistor 392. Biasing capacitors 397 and 399 are respectively connected to the base circuits of transistors

380 and 382. Conductor 401 from contact 332 connects the triggering input from test cells L and M to the base of transistor 380 through junction 384 and bias resistor 402. The emitter-collector circuit of transistor 380 comprises a voltage divider of resistors 404 and 406. The emitters of both transistors are connected in multiple to resistor 404. The collector resistor 406 forms a voltage divider with resistors 408 and 410, the junction between the last-mentioned resistors feeding the base of transistor 382. The collector circuit of normally non-conductive transistor 382 contains an output relay actuated only when transistor 382 conducts.

Lamp intensity adjustment circuit operation

Once the unit is plugged in and line relay 240 is energized closing its contacts 244, transformers 272 and 276 are energized lighting lamps 20. The drawer switches are unoperated, retaining contact 212 closed to stationary contact 218. This contact position places the photo cell 146 in the active circuit and unijunction transistor is maintained non-conductive by the bias imposed on its emitter. The circuit is now in its standby condition.

Contact 212 is transferred to stationary contact 219 on movement of the drawer member 32 to the test position. Cell 146 is thereby positioned below a white area on the bill within the tray. Assuming no bill is present in the drawer, then the brightness of light received by cell 146 is a maximum amount and the resistance of cell 146 decreases to a minimum. Thus, the emitter voltage of unijunction transistor 298 is increased to its maximum value. As mentioned previously, the voltage received from rectifier bridge 278 is pulsating direct current. In each half cycle, the voltage transmitted to the lamp adjusting circuit rises from 0 volts to a clipped maximum of 20 volts. Thus, as the input voltage from terminals 280 and 282 increases from zero, the input voltage builds slowly to a voltage greater than the voltage at the emitter to cause transistor 298 to conduct late in the half cycle. This conduction emits a pulse to the gate 306 of controlled rectifier 308 late in the half cycle. The rectifier conducts, shorting across the load and increasing the current to transformer 276 late in the half cycle. This increased current is transmitted to the lamps late in the half cycle, thereby maintaining a low lamp intensity. At the conclusion of the half cycle, the controlled rectifier 308 is shut off and the continuing cycles maintain the lamps at a low intensity.

If the opposite condition were to occur, i.e., the user placing a black piece of paper over cell 146, the resistance of this cell will increase greatly, thereby greatly decreasing the emitter voltage to a minimum. The conduction of unijunction transistor 298 would occur early in the half-cycle. The controlled rectifier 308 also would be triggered very early in the half-cycle, supplying maximum power to the lamps 20, depending on the setting of potentiometer 294.

Between these terminal conditions, the lamp intensity is adjusted according to the phase angle of the controlled rectifier firing. When the firing occurs early in the half-cycle, indicating high light reception by cell 146, the lamp intensity is decreased considerably. Conversely, when the firing of rectifier 308 occurs later in the cycle indicating a darkened object between the lamps and cell 146, the intensity of the lamps is maintained at a high level.

Detection trigger circuit operation

For detecting whether a dollar bill is valid, the timer-actuated contacts are maintained in their normal position with contact 184 closed to contact 320 and contact 185 closed to contact 322. With no dollar bill in test or with an invalid bill in the drawer during a test, the cells A-M detect this condition and one or more of the cell bridge circuits will be out of balance due to the increase or decrease of the photo cell resistance. This unbalance condition is applied across resistor 360 and results in trans-

sistor 356 remaining conductive and maintaining transistor 372 non-conductive. This stable condition is the normal one for this circuit. In any event, the detection of an unbalance condition retains reed relay 220 inoperative and the drawer lock and payout cycles cannot occur.

When a condition of balance is achieved in all of the cells A-M, the voltage applied to the base of transistor 356 decreases below a given value and transistor 356 becomes non-conductive. Transistor 372 is rendered conductive thereby and completes a circuit through reed relay 220. Energization of this relay energizes its slave relay 230 over contacts 222. This condition indicates that a bill has satisfied all cells in test, a condition which can only occur on a valid dollar bill, or other currency note for which the cells have been set, having been detected in the test drawer. On occurrence of the operation of relays 220 and 230, the cycle may continue toward dispensing of correct change.

Note removal test circuit operation

To effect this test, contacts 184 and 185 are transferred to a closure to contacts 330 and 332, respectively. Cells K and L, each below a different transverse half of the note in test, are now connected through conductor 401 to junction 384 at the base of transistor 380. The centertap of secondary 152 of transformer 150 again provides two legs of the bridge circuits through the L and M cells, and is now connected to lead 340. The transferred condition of contacts 184 and 185 occurs only when a valid note has been detected in the validity test and the cycle has progressed past the period when the note should have been stripped from the drawer.

Thus, the indication which is necessary to signal the proper functioning of the cycle is that of unbalance in both bridge circuits K and L, indicating the absence of the bill from the test position. Again, the first transistor in the system is normally conducting and must be extinguished to emit the output signal by actuating the output relay, in this case relay 260.

If the note has properly been removed, cells K and L will receive an excess amount of light. These cells will decrease their resistance and the resulting unbalance in the bridges will be applied across resistor 394 to insure that transistor 380 will become nonconductive on the unbalance condition. Transistor 382 will thereby be rendered conductive energizing reed relay 260. Energization of relay 260 closes its contacts 262 in the series circuit to the dispensing control.

On occurrence of a balance condition of one or both cells K and L, the amount of voltage applied to the base of transistor 380 is not sufficient to shut this transistor off, relay 260 cannot be energized, the series circuit to the dispense system cannot be completed, and no change payout can occur.

Operation

The operation of the apparatus is as follows generally:

The person desiring change, called the user, opens the drawer cover 36 and places a dollar bill face-up, flat in the drawer opening. The cover 36 is then closed and the bill is resting on platform 12. The drawer is then pushed forwardly into housing 30 and toward the test position. As the drawer member 32 with the bill to be tested approaches the test position, drawer feeler switches (not shown) operate contacts 210, 212, 214, and 216 to their test position.

The drawer is held momentarily in test position manually as the detection takes place. First, the lamp adjustment section is activated by the operative transfer of contacts 212 to adjust the intensity of lamps 20 according to the newness of the bill in test. Then, the test cells A-M test the bill for validity. If the bill in test is found invalid, at least one bridge circuit of the A-M sets will be out of balance, and relay 220 cannot operate. The drawer lock solenoid 42 cannot operate, and the drawer will restore under the influence of springs 58. The control sec-

tion cannot be actuated, and the bill is summarily rejected.

If the bill in test is tested and found valid, relay 220 operates, and closes its contacts 222 to actuate its slave relay 230 through a path from lead L2 and relay 230, through contacts 214, 186, 222, and contacts 188-191 to lead L1. Relay 230 operates actuating its contacts 232, 234, and 236. At contacts 232, relay 230 locks itself operated over a circuit through closed contacts 214, 186, and its own contacts 232. A path is closed to tray lock solenoid 42 from lead L2 through contacts 234, 252-250, 198-197, and 192-191 to lead L1. The tray solenoid is operated to pivot finger 54 into engagement with drawer 32 to lock the drawer member 32 in the test position within housing 30, debarring access to the drawer and the bill held therein.

Concurrently, timer motor 180 is energized over the previously described path through contacts 234 and begins its operative cycle as shown in FIGURE 8. Contact 181 transfers to a closure to stationary contact 189 to lock the motor 180 operated during the first 50° of revolution of the timer motor. After 50° of rotation, contact 181 transfers back to its original closure to contact 188; contacts 182 and 183 close; contacts 187 open, and contacts 184 and 185 transfer to their bill removal test position closed to respective stationary contacts 330 and 332.

Contacts 182 close to complete an obvious circuit to stripper motor 116. Motor 116 is energized and rotates the roller shaft 106. Contacts 183 energize the stripper solenoid 60 over a path from lead L2, through solenoid 60, contacts 183, 234-252, 198-197, and 192-191 to lead L1. Contacts 187 open the circuit to the light intensity test cell 146 to allow the lamps to reach maximum intensity for note removal testing.

The stripper solenoid depresses stripper plate 72 to the position shown in FIGURE 5 carrying with it the note which had been tested and found valid for acceptance. The note having been successfully removed from the drawer, the note removal test operates the note removal relay 260. Relay 260 is energized to close its contacts 262. Concurrently with the success of this test activity, switch 140 is operated by the edge of the note depressing its actuate arm 142. Arm 142 closes contacts 258. Thus, only when the following conditions are maintained: (1) the drawer remains held in the test position, as indicated by continued closure of contacts 210; (2) switch 140 is operated by the actual passage of a note being collected, as indicated by the closure of contacts 258; (3) the note having been successfully removed from the drawer to operate relay 260, as indicated by the closed contacts 262; (4) the retention of the trigger slave relay 230 operated by a successful validity test, as indicated by closed contacts 234; and (5) non-operation of the dispensing motors 190 and 196, as indicated by the closed path through contacts 191-192 and 197-198—only then can the circuit be completed to dispense relay 200. Any one of these contacts remaining open will maintain dispense relay 200 unoperated and no change payout can occur. In the event of an incomplete circuit to dispense relay 200, the timing motor 180 will continue its cycle and restore the apparatus to normal with no change payout having occurred.

On the successful collection of a valid note, relay 200 operates closing its contacts 202 and 204. Contacts 202 energize the dispense timer motor 190 and the dispense motor 196 as well as a dispense counter 420. The actual dispensing of change begins at this time provided all the previously-described safeguards have functioned successfully.

At about this time, the timer motor 180 will have completed 110° of its cycle at which time contacts 183 open to de-energize the stripper solenoid which then restores. The timing cycle continues. Shortly thereafter, the dispense motor switch transfers contact 197 to contact 199,

paralleling contacts 202 to retain motors 190 and 196 energized.

When 170° of timer motor rotation is reached, contacts 184 and 185 transfer to their normal condition de-energizing detector reed relay 220 and note removal relay 260. This transfer restores cells K and L to their detecting or validity testing condition.

Next, when 240° of rotation of motor 180 is reached, contacts 186 open to restore relay 230. At 270°, these contacts close the lock path to relay 230 which is now open at contacts 232. Relay 200 is de-energized by the restoration relay 230 and opens contacts 202. Dispense motors 190 and 196 remain energized over the alternate path, previously described. Opening of contacts 234 and 236 of relay 230 opens the circuits to solenoid 42 and timer motor 180. Motor 180 continues its cycle. The drawer restores.

At 290° of rotation, contacts 187 reclose to prepare the operative circuit to intensity test cell 146, and contacts 182 open to de-energize stripper motor 116. At 360° of revolution, contacts 181 restore. The drawer switches open, the dispense motor circuits open, and the circuit restores.

At this time, the note will have been tested and found to be valid, the note will have successfully been collected, the proper change will have been paid out, and the circuit will have restored to its standby condition awaiting further notes for testing.

While there has been described what is at present thought to be a preferred embodiment of the invention, it will be understood that modifications may be made therein, and it is intended to cover in the appended claims all such modifications which fall within the true spirit and scope of the invention.

What is claimed is:

1. In a currency test device of the type having a fixed receiving position co-planarly spaced from the receiving position:

- (1) means for moving the currency from the receiving position to the test position to conduct a validity test thereon,
- (2) means for testing the currency for validity at said test position,
- (3) means responsive to a successful test of validity of the currency,
 - (a) for latching the currency in the test position,
 - (b) for initiating removal of the valid currency from the test position, and
 - (c) for actuating a successful detection signal device,
- (4) a currency ejector responsive to said removal initiation for effecting removal of the currency, said ejector shiftable in a plane perpendicular to the plane of the currency in test position and substantially intermediate the ends thereof to effect said removal,
- (5) means for actuating the ejector for movement in travel path from a normal to a currency collection position whereby the ejector engages the currency intermediate its ends to fold the currency for displacement with the ejector toward said currency collection position, and
- (6) a plurality of blade members interposed in said travel path and deflectable by said ejector on movement of said ejector toward said currency collection position to allow passage of said ejector and currency borne thereon toward said collection position and debarring return movement of said currency on return of said ejector toward its normal position,
- (7) a switch member positioned to be actuated by the fold of the currency only after the fold of the currency has passed the blade members, and
- (8) means responsive to a series of signals including actuation of said successful detection device, latching

of the currency in test position and actuation of said switch member.

2. In a bill test device having a bill receiving position and a test position spaced from the receiving position:

- (1) a tray for carrying a single bill in a flat condition from said receiving to said test position,
- (2) light sensing means positioned to test the bill for validity at said test position,
- (3) first means responsive to the validity of the bill in test for locking said tray in the test position,
- (4) switch means actuated responsive to the validity of the bill in test for signalling the validity of the bill in test,
- (5) further means actuated on the validity of the test bill for effecting removal of the bill, comprising an ejector reciprocable in a plane perpendicular to the plane of the flat bill in test position and substantially intermediate the ends thereof, and means for driving the ejector to fold the bill for displacement with the ejector toward the bill collected position,
- (6) a plurality of individually resilient, interdigitated blades interposed in said ejector path, biased to be deflected by said ejector on movement of said ejector and bill toward said bill collection position and biased to debar return movement of said bill while allowing return movement of said ejector, and
- (7) switch means actuated by the fold of the bill only after having passed through said blades for signalling collection of said bill.

3. A bill testing and change payout device of the type having a fixed test position, comprising:

- (1) means for testing said bill for validity,
- (2) means responsive to the determination of the validity of the bill for producing a valid bill signal,
- (3) means responsive to a determination of validity of the bill for effecting removal of the bill, comprising a flat plate ejector shiftable in a plane perpendicular to the plane of the bill in the test position,
- (4) means for actuating the ejector plate for movement in a travel path from a normal position to a bill collected position whereby the ejector engages the bill intermediate its ends to fold the bill for displacement with the ejector to said bill collected position,
- (5) a plurality of resilient blade members interposed in said travel path, said blade members biased into an interdigitated relationship blocking said travel path, said blade members individually deflectable outwardly by the ejector plate on displacement of a bill toward collection to permit movement of said ejector and bill toward said collection position and debarring return movement of said bill while allowing return movement of said ejector.
- (6) a switch member positioned externally of said ejector plate to be actuated by the fold of a bill having passed through said blade members for signalling collection of said bill, and
- (7) means operable to initiate a transfer for said bill only on the concurrence of:
 - (a) valid bill signal, and
 - (b) actuation of said switch member.

4. A currency detecting and collecting device, including:

- (1) means for testing currency for validity while said currency is held flat at a test position,
- (2) a valid currency indicator responsive to a determination of validity by said test for initiating the removal of the validated currency from said test position,
- (3) currency removal means including a plate reciprocable normal to the test position intermediate the ends of currency at said test position, said plate being narrower than the currency,
- (4) means responsive to said initiation for actuating said currency removal means to move said plate in a removal direction whereby said currency folds about said plate for movement therewith through a removal path toward a collection bin,
- (5) means for inspecting said test position for the completion of removal of said validated currency,
- (6) an output member,
- (7) means responsive to the successful inspection of said test position for actuating the output member,
- (8) a plurality of resilient blocking blades positioned in said removal path to be deflected individually by the plate on movement of the plate through said removal path whereupon currency folded about said plate passes between said blades, said blades mounted to resiliently restore individually to a position blocking possible return movement of said currency on movement of said plate in a restoring direction,
- (9) said resilient blocking blades each having a pointed tip for engaging and gripping currency attempted to be moved in the restoring direction,
- (10) switch means, an actuating arm on said switch means positioned to actuate said switch means only when currency in said removal path has passed between said blade tips, and
- (11) means responsive only to the concurrence of
 - (a) a determination of validity by said valid currency indicator,
 - (b) the actuation of said output member, and
 - (c) the actuation of said switch means, for actuating an output condition.

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