

Dec. 2, 1969

F. E. TOWNSEND

3,481,464

BILL VALIDATING APPARATUS

Filed Aug. 3, 1967

4 Sheets-Sheet 1

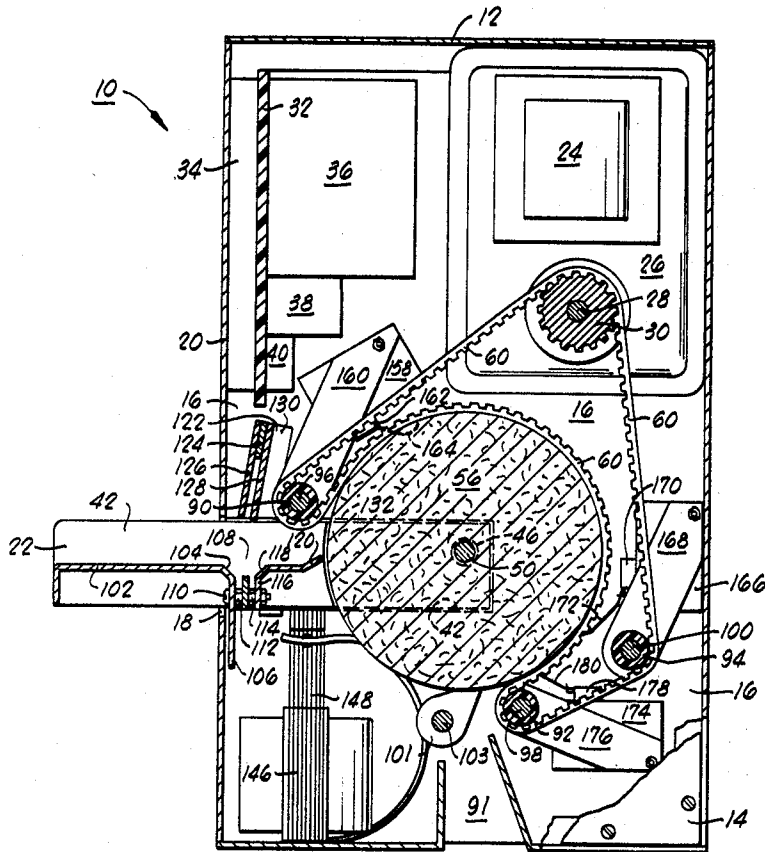


FIG. 2

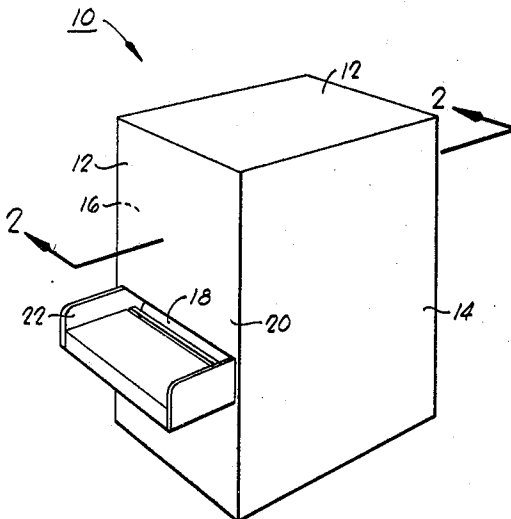


FIG. 1

INVENTOR.
FRANCIS E. TOWNSEND

BY

Dunlap and Loney
ATTORNEYS

Dec. 2, 1969

F. E. TOWNSEND

3,481,464

BILL VALIDATING APPARATUS

Filed Aug. 3, 1967

4 Sheets-Sheet 2

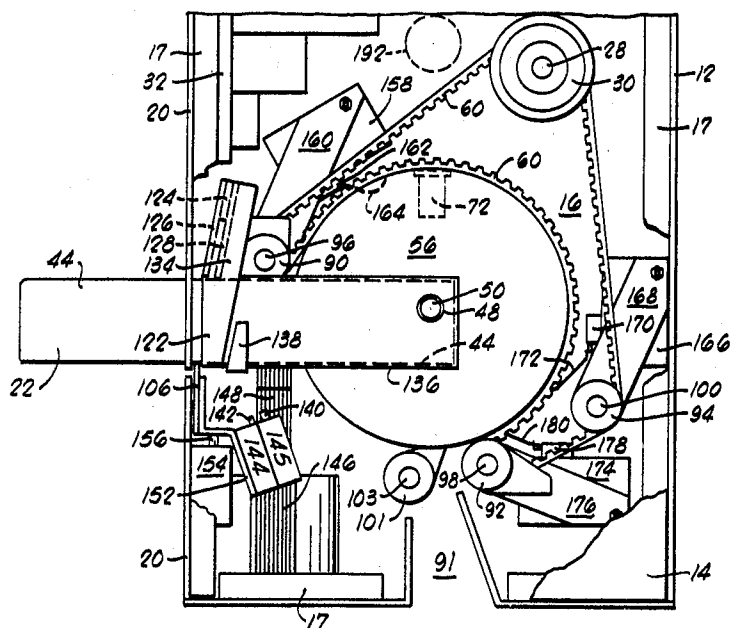


FIG. 3

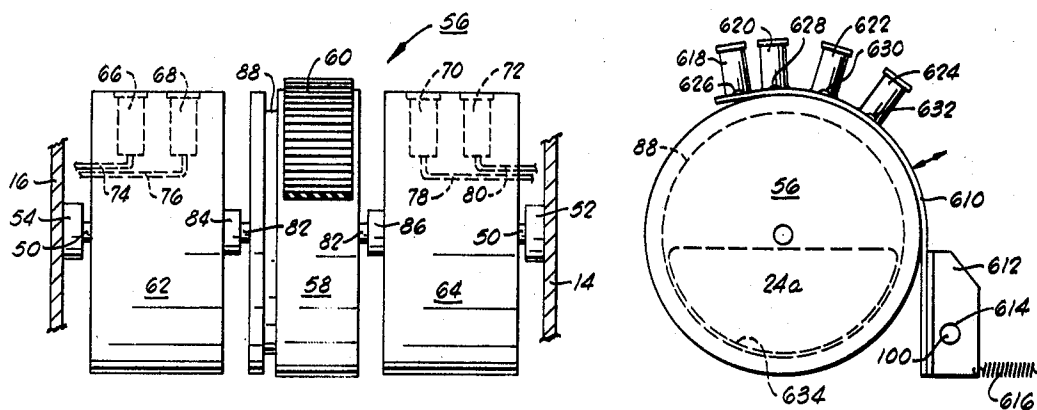
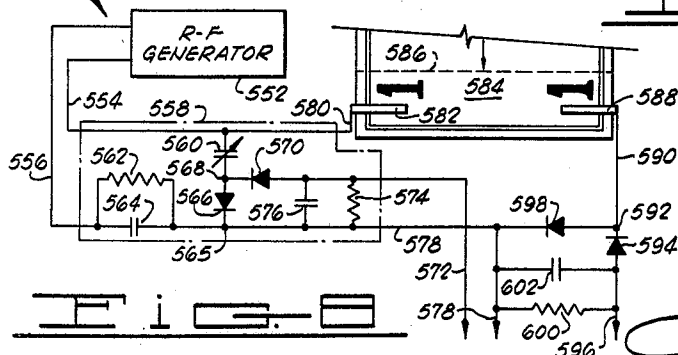


FIG. 4

FIG. 5



INVENTOR.
FRANCIS E. TOWNSEND

BY

Dunlap and Sany
ATTORNEYS

Dec. 2, 1969

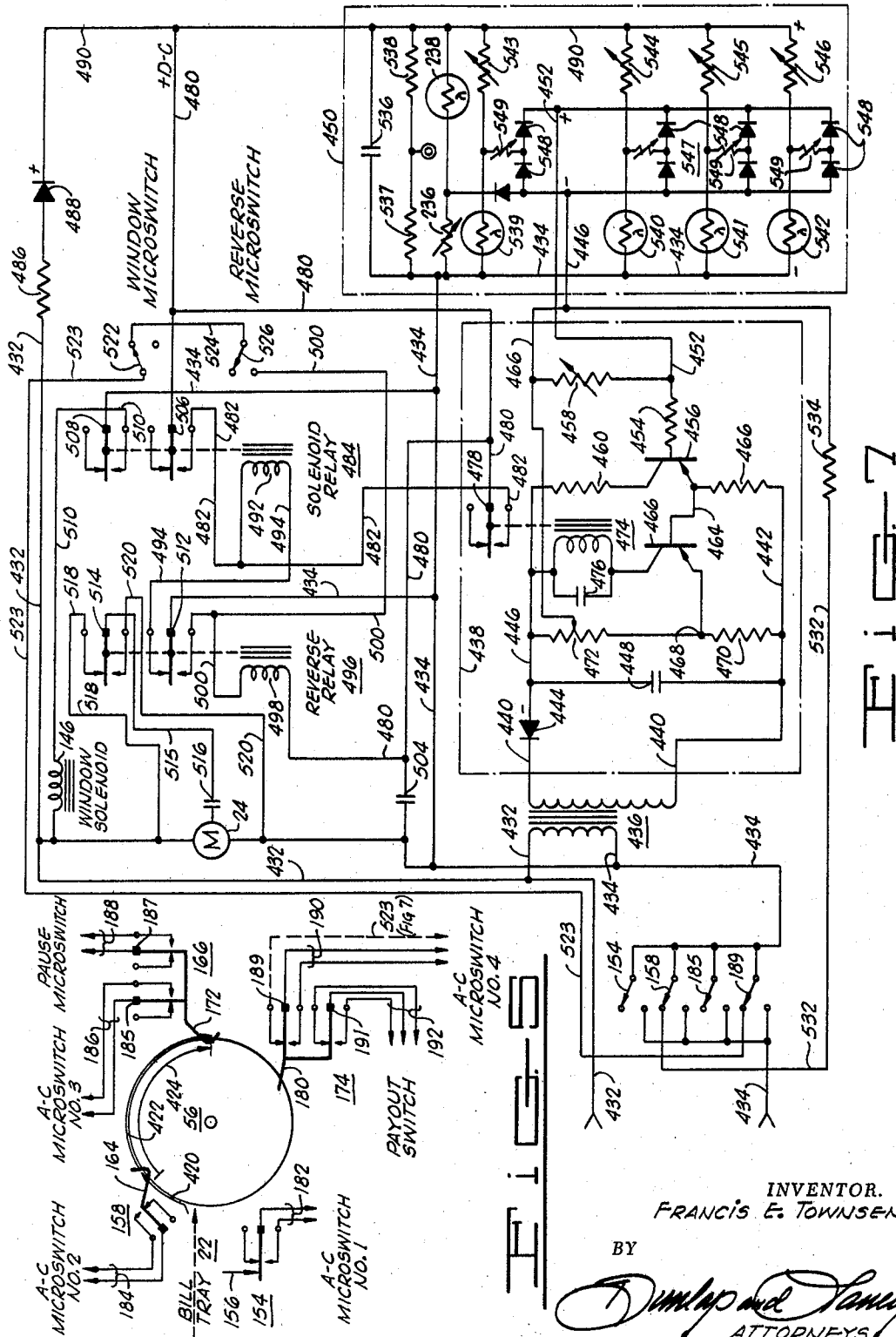
F. E. TOWNSEND

3,481,464

BILL VALIDATING APPARATUS

Filed Aug. 3, 1967

4 Sheets-Sheet 3



Dec. 2, 1969

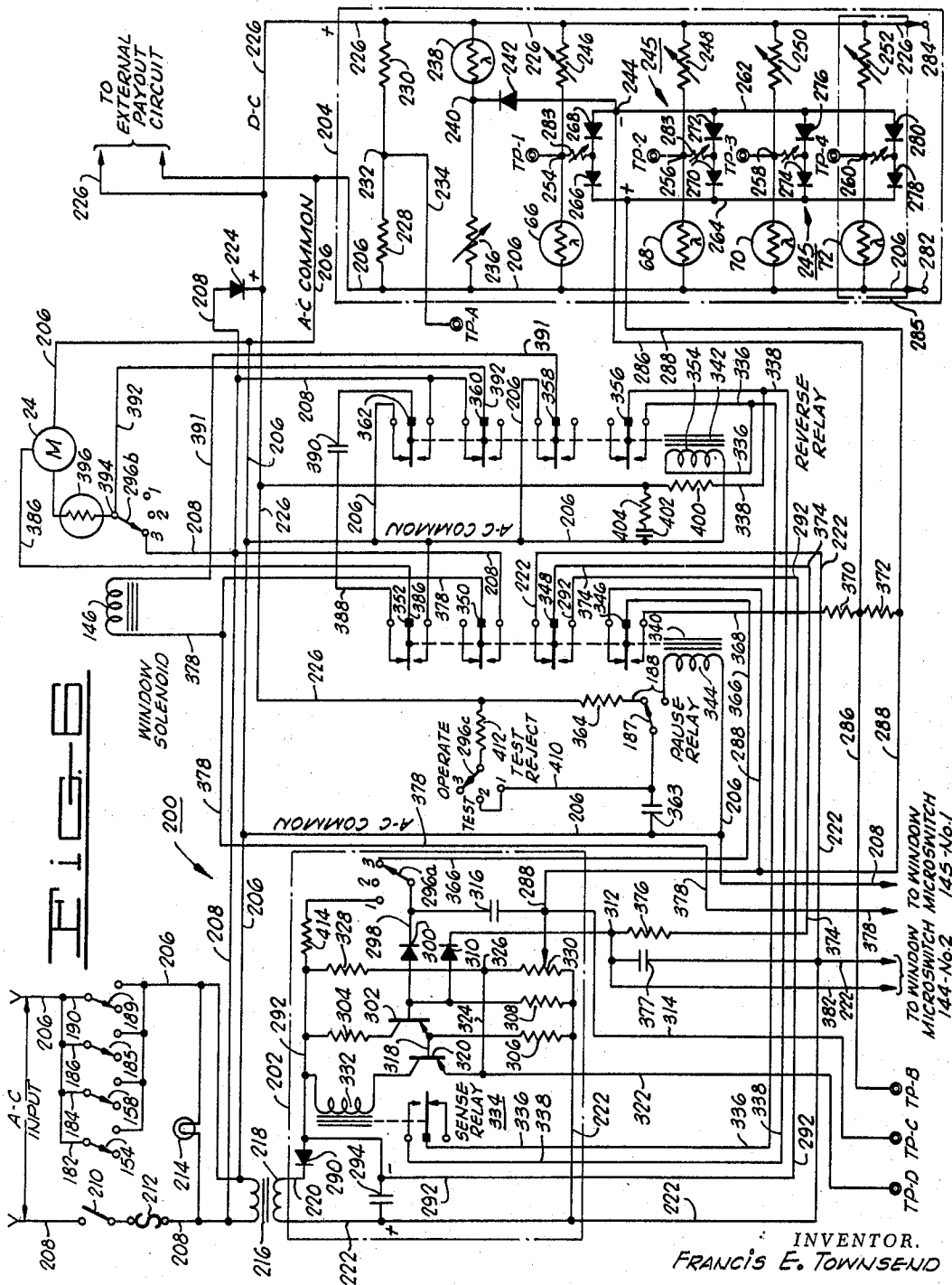
F. E. TOWNSEND

3,481,464

BILL VALIDATING APPARATUS

Filed Aug. 3, 1967

4 Sheets-Sheet 4



INVENTOR.
Francis E. Townsend

BY

Dunlop and Loney
ATTORNEYS

1

3,481,464

BILL VALIDATING APPARATUS

Francis E. Townsend, 1305 N. Hudson,
Oklahoma City, Okla. 73103

Filed Aug. 3, 1967, Ser. No. 658,079

Int. Cl. B07c 3/04, 3/14, 5/34

U.S. Cl. 209-73

23 Claims

ABSTRACT OF THE DISCLOSURE

An apparatus for bill validation wherein an input tray delivers a bill to a drum for transport therearound under the contact of a moving belt. A sensor means is disposed adjacent the drum to check the bill for known physical characteristics and the sensing means provides an electrical output in response to either a positive or negative sense output to deliver valid bills to a desired position while delivering invalid bills back out to the input tray.

BACKGROUND OF THE INVENTION

Field of the invention

The invention relates generally to document validation devices and, more particularly, but not by way of limitation, it relates to improved validation apparatus for use in validity checking paper currency to selectively enable payout and coin-change apparatus.

Description of the prior art

The prior art includes various types of bill validating apparatus which employ several kinds of sensing such as photoelectric, magnetic, thickness-testing, conductivity, etc. Of these prior types, those systems employing photoelectric testing or a combination of photoelectric and magnetic testing have proven to be the most reliable; however, these forms of equipment still suffer from a high failure rate as brought about either by equipment malfunctions or the devious modes of user piracy. Such equipment shortcomings become prohibitive when it is attempted to utilize the devices in connection with large denomination paper currency changing machines and/or machine distribution of relatively high-priced items.

SUMMARY OF THE INVENTION

The present invention contemplates means for energizing an apparatus upon receipt of a bill or such to thereafter move the bill along a transport route which is shaped to occupy a minimal space, sensing the bill at a predetermined transport position for detection of known physical characteristics to generate a validity signal upon detection and an invalidity signal upon nondetection; thereafter, the invalidity signal may be employed to reverse the transport direction and return the bill back out to the insert position, and a validity detection signal may be utilized to initiate payout mechanism and to energize the transport to move the bill to a secure receptacle or collection means.

The present invention also sets forth improvements in sensing circuitry whereby a plurality of photoelectric sensing means are employed to sense a bill or document for predetermined physical characteristics, and the photoelectric means are connected in a novel parallel circuit with each photoelectric sensor having a respective auto-adjusting balancing network to maintain a uniform output voltage characteristic. In addition, the invention contemplates radio frequency sensing apparatus for performing non-destructive testing of certain documents having conductive material integrally contained therein.

Therefore, it is an object of the present invention to

2

provide a bill validating device which is extremely compact and small in size while yielding a much increased reliability of document detection.

It is also an object of the present invention to provide validation apparatus wherein a drum and belt are utilized to form a bill traverse path of minimal length having increased accessibility for document sensing purposes.

It is another object of the invention to provide photoelectric sensing means having improved stability and, therefore, the ability to yield much improved document sensing reliability.

It is yet another object of the present invention to provide two different electrical control circuits which will enable either "pause" or "no pause" operation of the validating apparatus.

Finally, it is an object of this invention to provide a bill validating apparatus of reduced size and weight which provides a higher degree of reliability both as to piracy through counterfeiting as well as through the use of physical objects such as threads, prys, etc.

Other objects and advantages of the invention will be evident from the following detailed description when read in conjunction with the accompanying drawings which illustrate the invention.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective view of a validating apparatus constructed in accordance with the present invention;

FIG. 2 is a vertical section taken as indicated by lines 2-2 of FIG. 1;

FIG. 3 is a partial side elevation of the validating apparatus of FIG. 1 with the side panel shown cutaway;

FIG. 4 is a front view of one form of drum which is employed in the present invention;

FIG. 5 is a plane view of the drum and microswitch arrangement of the invention;

FIG. 6 is a schematic diagram of the electrical circuitry (pause operation) of the bill validating apparatus;

FIG. 7 is a schematic diagram of electrical circuitry (no pause operation) which forms an alternative embodiment of the invention;

FIG. 8 is a schematic diagram of R-F detection circuitry which may be employed in the present invention; and

FIG. 9 is an alternative form of drum and sensing apparatus which can be employed in the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A bill validating apparatus 10 as shown in FIG. 1 consists of a frame member 12 which may be a rectangularly bent metal frame and opposite side panels 14 and 16 (not shown) which are suitably secured thereon. An opening 18 is provided through the front panel 20 of frame 12 and a bill receiving tray 22 extends therethrough in movable relationship as will be further described.

Referring now to FIG. 2, the bill validating apparatus 10 has a drive motor 24 mounted within a gear box 26 which provides rotational output on a shaft 28 having a toothed pulley 30 affixed thereon. Various forms of electric motor may be employed for motor 24 but one form which has been employed to good advantage is a two-pole, four coil, reversible A-C motor of the permanent capacitor type. The gear box 26 is so designed that the rotational output at toothed pulley 30 is approximately sixty revolutions per minute although this is not a particularly limiting factor.

An insulative platform or circuit board 32 is suspended along the inside of front face 20 of frame 12 by means of suitable braces 34. The circuit board 32 may contain the various elements of the electrical circuitry thereon.

The proper placement of the components is a further aid in the compactness of the design; that is, taller components can be affixed to circuit board 32 in the area 36, smaller components in the area 38 and, finally, the relatively shallow space 40 may be utilized if needed. Such placement and design arrangements fall within the normal skills of the art and constitute no part of the present invention.

The insert tray 22 is a generally bifurcated member having opposite side panels 42 and 44 (see also FIG. 3) which extend through front opening 18 into apparatus 10 for pivotal engagement therein. Thus, the side plates 42 and 44 are formed with respective holes 46 and 48 which are pivotally secured by insertion of a drum shaft 50 there-through. Drum shaft 50 extends transversely across the validation apparatus 10 and may be secured between opposite side panels 14 and 16 as by suitable journal affixures 52 and 54 as shown in FIG. 4.

FIG. 4 shown one form of drum 56 which may be employed in the present invention. Drum 56 includes a central portion 58 which is rotatable with an endless belt 60 which is driven in contact therewith as will be described. Drum 56 is also comprised of outer, concentric drum components 62 and 64 which contain photosensors 66, 68, 70 and 72 situated therein in recessed positioning. The number and array pattern of photosensors 66-72 may be varied in accordance with design requirements for detection of predetermined physical characteristics which will appear on the document to be examined. Respective lead wires 74, 76, 78 and 80 are provided from each of photosensors 66-72 to their respective connections (not shown) at the electronic circuit board 32.

The outer drum portions 62 and 64 of drum 56 must remain stationary; hence, the respective drum shaft extensions 50 may be formed in a particular keyed shape to mate with journal members 52 and 54 which form similarly keyed bushing members such that drum portions 62 and 64 remain stationary and continually maintain photosensors 66-72 in predetermined positions. The inner drum portion 58 is not necessarily required to rotate as it would be sufficient if it were simply a smooth, low friction surface which the endless belt 60 could slide around; however, it is deemed preferable to design the drum 56 so that the inner portion 58 does revolve. Thus, for example, in inner drum portion 58 may be fitted with an inner drum shaft 82 affixed therethrough and this in turn is rotatably inserted within such as the bushing members 84 and 86 which may be secured along the central axis of respective outer drum portions 62 and 64. The inner drum portion 58 is also formed to have a shallow groove 88 formed therearound in close proximity to the raceway of belt 60 for the purpose of receiving microswitch actuating extenders when in their normal positions, as will be further described.

Referring again to FIGS. 2 and 3, the endless belt 60 is a toothed, flexible belt which is driven from the toothed drive pulley 30 providing the rotational output from motor 24 and gear box 26, previously described. The endless belt 60 is guided over a first idler 90 and then around a major portion of drum 56, e.g., about two-thirds of the cylindrical surface to an exit slot 91 where it is taken off around another idler pulley 92. The belt 60 is then passed around a tension pulley 94 for return to the toothed drive pulley 30. The respective pulleys 90, 92 and 94 are each rotatable as retained on traverse shafts 96, 98 and 100 which are suitably journaled between opposite side panels 14 and 16 of frame 12. A stripper 101 secured to a transverse shaft 103 provides a mechanism whereby the bill can be removed from drum 56 and directed through exit slot 91. An alternative structure which permits even greater miniaturization contemplates the placement of the drive motor 24 within a volume of the drum 56 (as will be described) and, in this event, the belt 60 is moved only by its contact with drum 56.

The bill tray 22 is formed by a flanged plate member

102 which is affixed as by welding, brazing or such between the opposite side plates 42 and 44. Plate member 102 is formed with about a thirty degree taper or edge 104 which is extended vertically downward as a support plate 106. A knife-edge 108 having its top edge disposed slightly lower than the top of said plate member 102 is then secured to the support plate 106 by means of a suitable fastener or bolt 110 and spacer 112. An additional spacer 114 is then employed to further separate a plate extension 116. Plate extension 116 is formed to extend on inward of said opening 18 of frame 12 with a similar thirty degree taper portion 118 and an upturned end portion 120 which serves to guide an input document along the proper entry path.

The parallel spacing provided by plate vertical support 106—knife edge plate 108—plate extension 116 constitutes part of a safe-guarding device which prevents the insertion of threads or prys into the machine along with a bill to be examined. Thus, a vertically movable window gate member 122 is provided to effect such a test. Window gate member 122 carries a horizontally secured spacer bar 124 having similarly sized front and rear knife plates 126 and 128 secured thereto. The knife plates 126 and 128 are formed to have a width which will fit down within the side plates 42 and 44 of bill tray 22. Thus, upon actuation (as will be described) window member 122 is moved downward and the respective knife plates 126 and 128 pass downward on each side of the knife edge 108.

The window member 122 is formed to have a left pivotal side plate 130 affixed to a pivot arm 132 (FIG. 2) which extends into frame 12 for pivotal engagement about drum shaft 50. Also, a right pivotal side plate 134 and right pivot arm 136 (FIG. 3) extend inward in similar, parallel relationship for rotatable affixture about drum shaft 50. An actuating plate 138 is secured across the underside of pivot arms 132 and 136 in a position to contact actuators 140 and 142 of a pair of microswitches 144 and 145.

A solenoid 146 is securely mounted to the bottom of frame 12 to extend an armature 148 upward into contact with the window gate member 122. Thus, armature 148 may be spring-biased upward by a suitable spring such as spring 150 such that it can be drawn downward upon energization of solenoid 146 to allow window gate member 122 to fall downward into contact with switch actuators 140 and 142. The microswitches 144 and 145 are secured to a bracket 152 (FIG. 3) which is secured, as by welding or such, to the plate vertical support 106, bracket 152 being formed in a configuration which places the actuators 140 and 142 in proper position beneath the striking or actuating plate 138 of window gate member 122. Still another microswitch 154, a normally open A-C microswitch No. 1, suitably secured to the frame front panel 20 so that it extends an actuator 156 upward within striking distance of bracket 152 such that switch 154 is closed upon depression of the bill tray 22. The various switch actuating sequences and effects will be further described below.

Additional microswitches are disposed about the drum 56 for the purpose of controlling the sequence of operations of the bill validating apparatus 10. A microswitch 158 is fastened in conventional manner to a switch support 160 which is secured to the transverse shaft 96 to hold microswitch 158 in a proper position relative to drum 56. Microswitch 158, the A-C microswitch No. 2, is positioned so that an actuator 162 holds an extensor 164 in actuating relationship with drum 56, i.e., extensor 164 extends within the groove 88 (FIG. 4) of drum 56. A microswitch 166 is similarly positioned by means of a switch support plate 168 secured to transverse shaft 100. Microswitch 166 contains two sections, the A-C microswitch No. 3 and the pause switch (to be further described), and these switches are controlled by an actuator 170 and its associated extensor 172 which extends into contacting position with a bill or document.

passing around drum 56. Finally, a microswitch 174, a two-section switch serving as A-C microswitch No. 4 and the payout switch as will be further described, is supported by a switch plate 176 as secured to transverse shaft 98. Microswitch 174 includes an actuator 178 and extensor 190 which are maintained in actuating position adjacent drum 56.

The dashed line outline 192 (FIG. 3) denotes the approximate position wherein the illumination lamp of the photoresponsive detection circuitry may be located. This lamp may be a standard screw or bayonet type of selected wattage rating and a conventional form of socket can be secured to the inside of side panel 14 so that it extends the illumination device or lamp into the general position of area 192. The illumination positioning is not critical since the electronic circuitry (to be described) can be adjusted to operate on whatever the intensity of light. Thus, when using the drum 56 of FIG. 4, the amount of light transmitted through a bill under test to the respective photoresponsive element 66-72 may vary in intensity and angle of incidence but the variations can be compensated for in the electronic circuitry as will be described.

FIG. 5 shows the drum 56 and associated microswitches in schematic form. Microswitch 154 is a single section, two-pole microswitch which is connected normally open. Thus, depression of the bill tray moves actuator 156 to close the microswitch 154 and enable A-C energization through leads 182. Microswitch 158 is also operated normally open so that its actuation provides A-C energization through leads 184. Microswitch 166 is a two-section switch, both sections being operated normally open. Actuation of a section 185 enables A-C energization on leads 186 and actuation of a switch section 187 closes leads 188 to energize the "pause" circuitry as will be described. Finally, a microswitch switch 174 is also a two-section microswitch with a first A-C section 189 operated normally open to conduct A-C energization on leads 190 when closed, and a second section 191 provides switch actuation among three leads 192 for controlling an associated payout mechanism, tally counter or whatever.

FIG. 6 shows a first form of electronic circuitry 200 which may be employed in the bill validating apparatus 10. The circuit 200 consists of an amplifier section 202 and a photosensor section 204 which function together to energize various relay and switching circuitry as will be described. An A-C line voltage input is provided across leads 206 and 208 through various input switching arrangements.

A main power switch 210 turns the equipment on and a suitable fuse 212 provides overload protection. A series of microswitches or switch sections 154, 158, 185 and 189 provide sequential energization in response to the presence of a bill or document under test. An illumination device or lamp 214, generally located in space 192 of FIG. 3, is connected across the A-C input leads 206 and 208 as is an input transformer 216. A secondary 218 of transformer 216 then provides A-C input power on leads 220 and 222 to the amplifier section 202. Parallel branching of the A-C input is provided such that lead 206 supplies the A-C common lead while lead 208 connects the other side of the A-C line throughout the remaining circuitry.

The A-C lead 208 is applied to a rectifier 224 which provides a positive D-C output on lead 226 for application relative to the A-C common lead 206 to energize the photosensor section 204. A pair of resistors 228 and 230 are connected in series between the power supply leads 206 and 226 and a divided voltage taken off at junction 232 via lead 234 provides a voltage check output to test point TP-A. A variable resistor 236 is connected in series, voltage dividing relationship with a photocell 238 across power input leads 206 and 226. The photocell 238, a commercially available type of photoconductor such as a cadmium sulfide photoresistor or such, is placed in

light viewing relationship to the illumination lamp 214 to provide a safety cutoff in response to lamp failure. That is, as the illumination of lamp 214 ceases, the resistance of photoconductor 238 will vary inversely to compensate and provide a proper voltage at the dividing junction 240. The photoconductor 238 performs a valuable safety function in that it disables any detector output and, therefore, any payout when the lamp 214 burns out. Normally then, the voltage at junction 240 exists as a nearly constant value which is applied through a diode 242 as a reference value for connection to a junction 244, the positive side of a diode balancing network 245 as will be further described.

Each of the photoresponsive elements 66, 68, 70 and 72, e.g., conventional cadmium sulfide photoconductive elements, is connected in series with a respective potentiometer 246, 248, 250, and 252, and each of the series configurations is connected between the voltage supply leads 206 and 226. Each series circuit forms a central junction point 254, 256, 258, and 260, respectively, which are connected to external test points TP-1, TP-2, TP-3 and TP-4. The diode balancing network 245 includes a negative output lead 262 which is connected to the negative input junction 244 and a positive lead 264. Then, referring to a first photoresponsive circuit including photoresponsive element 66, a first isolating diode 266 is connected from the positive lead 264 to junction 254 while a second isolating diode 268 is connected from junction 254 in the negative lead 262. Similar connections are made between isolation diode pairs 270, and 272, 274 and 276, and 278 and 280 as connected between each of the respective junctions 256, 258 and 260 and the respective negative and positive leads 262 and 264. Thus, the diode configuration constitutes a balancing network 245 wherein output taken across leads 262 and 264 is applied to the amplifier section 202 which is effectively floating with respect to the A-C common lead 206. The resistance characteristic of the photoresponsive elements 66-72 can then change without affecting the level of input voltage on leads 288 and 366 to amplifier 202.

The particular circuitry of photosensor circuits 204 offers extremely good stability and reliability of operation due to the fact that sensitivity variations of photoconductive cells are compensated. That is, such photoconductive cells as are commonly employed have an inherent characteristic wherein output values for given illumination or energization will tend to change over extended periods of time. This can be particularly disadvantageous in a coin payout machine since a machine which remains energized for a period of six or eight hours may completely lose its ability to discriminate checkpoints on paper currency accurately thereby to enable payout in response to invalid indications.

The present photosensor circuitry 204 is a self-regulating network which is highly stable as the individual photocells may be of similar sensitivity and connected into photosensor circuitry 204 to constitute a leg of a D-C bridge circuit wherein ratio discrimination takes place. A control signal output taken from leads 262 and 264 on output leads 286 and 288 will remain in the same voltage range despite changes in the characteristics of photoresponsive elements 66-72. The output signal across leads 286 and 288 is then applied to amplifier circuitry 202 as will be described. In the event that it is desired to examine additional check points or a greater number of physical characteristics, a requisite number of additional photoresponsive bridge circuits can be connected to power input leads 206 and 226 between the terminals 282 and 284.

A plurality of potentiometers 283, one per photocell channel, are connected between respective junctions 254, 256, 258 and 260 and their associated diode junctions, i.e., the junction of diodes 266 and 268, etc. These potentiometers 283 provide an individual sensitivity control for each photocell channel such that channels can be leveled

so that they are equally effective in the total discrimination. This enables the output from each photocell 66, 68, 70 and 72 to be of larger amplitude for a given density variation, e.g., white to black as viewed by the individual photoresponsive units.

In some cases it may be desirable to render photosensor circuits 204 amplitude sensitive in addition to the normal ratio sensitivity. This would enable an ability to discriminate as to background densities or the basic light transmission differences between new paper and old paper. This can be done by placing one photocell channel such as shown by dashline 285 in stationary or continual viewing relationship to illumination transmitting (or reflecting as the case may be) paper of selected or standard density such that a fixed null point is established relative to remaining photocell channels (photocells 66, 68, etc.). A change in photocell resistivity characteristic or in illumination level will also be accounted for and maintained within proper ratio discrimination limits.

The amplifier circuitry 202 is energized by D-C circuitry which is derived from the secondary 218 of the input transformer 216. The A-C output on lead 220 is applied through a rectifier 290 to provide a negative D-C potential on lead 292 while the remaining A-C lead 222 from secondary 218 acts as a reference or common lead. A suitable capacitor 294 is connected between D-C lead 292 and common lead 222 to provide filtering of the D-C voltage.

Amplifier input is provided through a switch section A of switch 296. Switch 296 is a three-position switch wherein position No. 1 is "test reject" position, No. 2 is the "test" position and position No. 3 is the "operate" setting. Thus, switch section 296a delivers an input signal on lead 298 for input through a diode 300 to the base of a PNP-type transistor 302. Transistor 302 has its collector connected through a limit resistor 304 to the negative D-C potential 292 and its emitter is connected through a load resistor 306 to the reference lead 222. The base of transistor 302 is biased by connection through a resistor 308 to the reference lead 222 with a parallel connection through diode 310 to a junction 312 which receives additional inputs as will be further described. The amplifier input can be checked between the low side test point TP-C, which connects lead 288 from photoresponsive circuits 204, and high side test-point TP-B connected to lead 286.

An output from transistor 302 is taken from its emitter via input lead 318 which is connected to the base of another PNP-type transistor 320. Transistor 320 has its emitter connected via lead 322 to the test point TP-D as well as through a parallel jumper 324 to a junction 326. Junction 326 constitutes a voltage dividing point between a resistor 328 and potentiometer 330 which are connected in series between negative D-C supply lead 292 and the reference voltage lead 222. A wiper connection of potentiometer 330 is joined to the control output lead 288 from the photosensor circuitry 204. The collector of transistor 320 is connected through an energizing coil 332 of a sense output relay 334 to the D-C supply lead 292. Thus, transistor 320 can be rendered conductive in response to a predetermined input signal such that current flow through energizing coil 332 activates sense relay 334 to make the connection between wiper lead 336 and normally open lead 338 of sense relay 334. The energization of leads 336 and 338 contributes to the reversing function of the validation apparatus 10 as will be further described below.

In addition to and working in conjunction with the photosensor circuitry 204 and the amplifier circuitry 202, the various functions of the validation apparatus 10 are controlled by a "pause" relay 340 and a "reverse" relay 342 in accordance with the validation conditions of the particular test. Pause relay 340 consists of an energizing coil 344 which operates to control a plurality of contact sections 346, 348, 350 and 352. Similarly, the "reverse"

relay 342 is comprised of an energizing coil 354 which functions to control the actuation of a plurality of contact sections 356, 358, 360 and 362.

The "pause" relay coil 344 is connected at one side to the A-C common lead 206 and the other side is connected to the normally open contact of the microswitch section 187 of the microswitch 166 (see FIG. 5). Thus, when the pause microswitch 187 is actuated, the relay coil 344 is connected to a fully charged capacitor 363 to energize the relay 340. Capacitor 363 is selected to be of a size which will allow the relay 340 to remain energized for a brief period during which bill sensing is carried out. When relay 340 falls out of conduction, and after microswitch 187 has been allowed to revert to its normal position (as shown in FIG. 6), the relay firing capacitor 363 will be recharged by D-C potential on lead 226 through capacitor 364.

The wiper of switch section 346 is connected via a lead 366 to supply input signal to switch position 3, the "operate" position, of switch section 296a in the amplifier circuitry 202. The normally open switch contact of section 346 is connected through a lead 368 and relatively high resistance 370 to the more negative balance voltage output on lead 286 from the isolation output circuit of photosensor circuitry 204. A load resistor 372 is connected between the more negative output lead 286 and the more positive D-C output lead 288, and lead 286 is extended over to the test point TP-B for pre-adjustment purposes. The normally closed contact of relay section 346 is connected to a parallel branch of balance voltage output lead 288 which is connected to the wiper of a voltage divider potentiometer 330. Thus, the potential on lead 288 can be varied to set the turn-on or energizing bias on the base of transistor 302 to thereby set the discrimination level of amplifier section 202.

The wiper contact of relay section 348, carrying negative potential from lead 292, is connected by a lead 374 through a resistance 376 to the junction 312 which provides an input bias level variation through diode 310 to the base of transistor 302. The resistor 376 and a capacitor 377 form an R-C combination which unblocks the amplifier circuits 202 after a present delay time unless the window microswitch No. 2 (leads 222 and 282) is closed to bypass the capacitor 377. The normally opened contact of contact section 348 is connected to the negative D-C supply lead 292 while the normally closed contact is connected to the common or reference lead 222. A relay section 350 has its wiper connected by lead 378 to window microswitch No. 1, actuator 140 of microswitch 144 in FIG. 3. Lead 378 is also connected through window solenoid 146 (FIG. 3) which is also controlled in response to the actuator of the "reverse" relay 342, to be further described.

Contact section 352 of "pause" relay 340 has the wiper contact connected by a lead 386 to one input of the motor 24. The normally opened relay contact of contact section 352 is connected to the A-C common lead 206 and the normally closed contact is connected via a lead 388 through a motor capacitor 390 to the wiper element of contact section 362 in the "reverse" relay 342. Capacitor 390 is a motor capacitor which is here arranged for reversible connection to motor 24 as will be described.

Referring now to "reverse" relay 342 contact section 356 has its wiper connected to the sense output lead 338 from sense relay 334, and the normally open contact connected to sense output lead 336 and no connection is made to the normally closed position of contact section 356. Relay section 358 has the wiper connected via lead 391 to one side of the window solenoid 146 (FIG. 3) while the normally closed connection is to the A-C common lead 206. Relay section 360 connects from the wiper through a lead 392 to the switch wiper terminal 394 of selector switch 296b. The wiper terminal 394 is then connected through a thermal overload device 396 to the motor 24 and, also, when switch section 296b is in its "operate"

or No. 3 position, the circuit is connected to the A-C lead 208. The thermal overload 396 is an additional safety precaution which prohibits energization of motor 24 upon detection of excessive heat. The normally closed contact of relay section 360 is then connected to the A-C lead 208. As previously stated, the relay contact section 362 has its wiper connected to the starting capacitor 390 to provide alternate or opposite energization as between the normally opened contact which is connected to the A-C lead 208 and the normally closed contact which is connected to the A-C common lead 206.

A parallel segment of sense relay output lead 338 is also connected through a resistor 400 to the positive D-C supply lead 226. A capacitor 402 and resistor 404 are connected in series between the A-C common lead 206 and the D-C supply lead 226 to provide smoothing and transient suppression. The selector switch 296 provides different modes of operation to enable certain specific test procedures. Thus, with the switch in "operate" or position No. 3, input signal is applied from lead 366 through switch section 396a (position No. 3) to control the conduction of transistors 302 and 320; the section 296b is set to provide energization of motor 24 in the operate position; and, finally, section 296c allows no bypass of the pause microswitch section 187. The section 2 or "test" switch position disables amplifier circuitry 202 with no input through switch section 296a; and motor 24 is similarly disabled by removal of capacitor 390; and switch section 296c conducts a signal on lead 410 with pause microswitch 187 actuated such that pause relay 340 is energized for test purposes. On switch position No. 3, the "test reject" position, similar test is enabled for the pause relay 340 through switch section 296c; but, in addition, a negative D-C potential from supply lead 292 through a resistor 414 is supplied through switch section 296a to control the amplifier circuitry 202. Thus, a high negative potential applied on input lead 298 through diode 300 will cause conduction of transistor 320 through relay coil 332 thereby to activate sense relay 334 to initiate the invalidation or rejection function, the reverse relay activation and so forth as will be further described.

OPERATION

The bill validating apparatus 10 may be preset to identify any type of document in accordance with a selection of predetermined physical characteristics. Thus, as particularly employed in paper currency validation, the photocells 66-72 (FIG. 4) may be set in any selected pattern to receive light response from a particular area of the bill. The array of photocells 66-72 can be adjusted to examine any denomination of bill on either side in accordance with known characteristics; however, it has been well established that certain identifying features which appear on various paper bills does provide optimum identification response. It should be understood that the term "bill" as used herein may include currency, negotiable instruments, coupons, tokens and similar documents of value even though the following operation is described with particular reference to paper currency bills.

The operator first places a bill to be validated on the bill tray 22 such that the identifiable side is properly oriented. Depression of the bill tray 22 then actuates microswitch 154, microswitch No. 1, which applies A-C input to the electrical circuitry as shown in FIG. 6. The motor 24 is directly connected across the A-C input leads 206 and 208 and it drives belt 60 around the drum 56. The bill is then maintained on bill tray 22 and urged inwardly until it is caught between drum 56 and belt 60. The bill tray 22 should be depressed until the bill is about halfway in, or until the bill front edge has raised the extensor 164 to actuate microswitch 158 (A-C microswitch No. 2) to maintain A-C input energization to the system. It is also contemplated to include a well-known type of time delay switch (not shown) which may be

actuated by microswitch 154 to hold the motor 24 energized for a short period during which bill entry is effected.

Once microswitch 158 has been energized, the bill is carried around the periphery of drum 56 beneath the flexible, endless belt 60 toward a more inward or inaccessible position whereat bill sensing and related functions take place. Reference to FIG. 5 shows the bill traverse path in relation to the microswitch positions about the drum 56. For example, at the point of insertion, the front edge of a paper currency bill would traverse along the arrow 420 by manual insertion and actuation of A-C microswitch No. 1 by depression of bill tray 22. Once the front edge of the bill has lifted the extensor 164 and actuated A-C microswitch No. 2 the bill can be released to traverse on around the path of arrow 422. When the pause microswitch 187 is actuated by contact of the front edge of the bill with extensor 172 the bill will be completely held about a portion of the periphery of drum 56, for example, a portion as denoted by the arrow 424. Thus, the spacing of extensors 164 and 172 are preferably slightly less than the length of that particular type of bill being examined.

When the front edge of the bill lifts the extensor 172 each of the A-C microswitch No. 3 (185) and the pause microswitch 187 are actuated closed such that the pause relay 340 is energized to stop the motor 24 and to enable photoelectric sensing of the bill. Referring more specifically to FIG. 6, actuation of the pause microswitch 187 energizes pause relay 340 and a first contact section 346 is connected to apply the photosensor output on lead 286 through a time delay consisting of resistor 370 and capacitor 316 to the input of the amplifier circuitry 202. Pause relay section 348 removes the amplifier common 222 while applying a negative potential input to the base of transistor 302. This negative potential is applied via lead 374 through a time delay consisting of resistor 376 and capacitor 377. The pause relay section 350 connects lead 378 to the A-C lead 208 such that window solenoid 146 is energized. Referring to FIG. 3, this causes pull-down of armature 148 to allow window gate 122 to fall downward thereby to test for threads or such which may be present in an attempt to retract the bill after validation actuation. The pause relay section 352 serves to stop the motor 24 by removing the starting capacitor 390 from the circuit and connecting the capacitor input lead 386 to the A-C common lead 206.

If the window gate 122 was able to close down over knife edge 108 (FIGS. 2 and 3) indicating no threads or such, the actuating plate 138 would depress actuators 140 and 142 of the microswitches 144 and 145, i.e., the window microswitches No. 1 and No. 2. These microswitches are normally opened and closure of microswitch No. 1 shorts the A-C lead 208 to the window solenoid lead 378 to act as a holding circuit, maintaining the window gate 122 closed downward even after release of pause relay 340. The window microswitch No. 2 closes to short amplifier common lead 222 to a lead 382 and junction 312 such that R-C capacitor 377 is bypassed and the common potential is present at junction 312 in the input circuit to the first transistor 302 of amplifying circuitry 202. This tends to remove any negative voltage which could build up through the R-C combination, resistor 376 and capacitor 377, and to prevent the transistors 302 and 318 from conducting to energize the sense relay 334 and initiate a rejection sequence of functions, to be further described. Thus, in the case where a thread were present to block the downward travel of window gate 122 such that window microswitch 144 could not be closed, the negative potential on lead 374 from pause relay section 348 would cause conduction of the amplifying circuitry 202.

Assuming then that no thread detection was made, the pause relay 340 will hold the motor 24 de-energized for a period determined by delay capacitor 363 while the

drum 56 and, therefore, the bill to be examined are held in a stationary position in predetermined relationship to the photo optics of the system. Thus, it is next to determine whether or not the photosensor circuitry 204 derives a correct response from examination of the bill. Each of the photoconductive cells 66-77 is pre-adjusted to a certain output level by manipulation of the respective series connected potentiometers 346-252. Outputs in the form of voltage variations at respective junctions 254-260 are combined in the balance diode circuit to provide a predetermined output between balance output leads 264 and 262 and respective output leads 268 and 288. Thus, a voltage variation on leads 286 and 288 is developed across a resistor 372 and an input control signal is applied through the timing resistor 370 and pause relay section 346 to switch 296a, diode 300 and the base of transistor 302.

A more negative input control signal will bring about conduction of transistor 302 to place a more negative base potential on lead 318 of transistor 320 to cause increased conduction such that coil 332 of sense relay 334 is actuated. Actuation of sense relay 334 then completes a circuit between leads 336 and 338 to cause current flow through coil 354 to energize the "reverse" relay 342. Reverse relay contacts 356 provide holding contacts for closing leads 336 and 338 after sense relay 334 has been deactivated due to reduced condition of transistor 320. Reverse relay contacts 358 remove the A-C common connection on lead 206 to lead 391 which releases the energization of the window solenoid 146 to permit reversed traverse of the bill. Also, "reverse" relay contact 360 breaks the A-C lead 208 connection via lead 392 to the thermal overload element 396, this circuit only being of use during test periods, i.e. when switch 296 is on positions No. 1 and 2. Finally, reverse relay contacts 362 remove starting capacitor 390 from connection with A-C common lead 206 and place it in connection with the A-C lead 208 such that A-C connections to motor 24 remain the same with the exception of the starting capacitor 390 and the motor 24 is energized in its reverse direction. This then causes drum 60 and drum 56 to run in the reverse direction and to move the bill back out onto the bill tray 22 whereupon the leading edge of the bill passes the A-C microswitch No. 2 allowing it to open to remove A-C input to the unit while holding the bill lightly tabbed in the entrance window and resting on bill tray 22.

In the event that a valid photosensing test is made, a voltage output between leads 286 and 288 from photosensor circuitry 204 will be less than a predetermined voltage value. Little or no output between leads 286 and 288 is insufficient to cause condition of transistor 302 and, therefore, transistor 318 such that sense relay 334 will not be energized. Thus, a bill acceptance is registered and various acceptance functions may follow thereafter. At the end of the pause period, after the R-C time circuit (capacitor 363 and relay coil 344) allows release of pause relay 340, the pause relay contact section 352 again energizes motor 24 to drive belt 60 and drum 56 such that the bill under examination is moved for deposit through the bill exit slot 91 into a suitable bill receptacle.

ALTERNATIVE EMBODIMENT

An alternative embodiment of the bill validating apparatus 10 can be constructed utilizing the mechanical equipment and switch assemblies of the preceding embodiment but employing a different electronic circuit which provides bill sensing and validation without a pause requirement. FIG. 7 illustrates a schematic diagram of an electronic circuit 430 which provides "no pause" operation. Circuit 430 is energized by A-C input between leads 432 and 434 which energize an input transformer 436 to the amplifier circuitry 438. The A-C input is enabled in the same manner as for the previous FIG. 6 embodiment, i.e., the A-C lead 434 is selectively closed by bill actuation of microswitch sections 154, 158, 185 and 189, the A-C microswitches Nos. 1-4.

Amplifier 438 is similar to the pre-amplifier 202 of the FIG. 6 embodiment. Thus, A-C is taken from the secondary of transformer 436 on leads 440 and 442 and lead 440 is connected to a rectifier 444 which serves as a negative voltage power supply. A negative D-C potential exists between leads 446 and the A-C common lead 442 and a suitable filter capacitor 448 is connected thereacross.

A negative input lead 445 provides input to the amplifier circuitry 438. A more positive reference input lead 452 from photosensor circuit 450 is also connected as an input lead to amplifier circuitry 438. Thus, lead 452 is connected through a resistor 454 to the base of a PNP-type transistor 456 and a potentiometer 458 is connected between the reference input leads 446 and 452 for the purpose of adjusting the voltage input. The collector of transistor 456 is connected through a load resistance 460 to the negative voltage lead 446 and the emitter of transistor 456 is connected through a resistor 462 to the A-C common lead 442, an emitter output being applied on lead 464 to the base of a transistor 466.

The emitter of transistor 466 is connected to a junction 468 which is a voltage dividing point between series resistor 470 and potentiometer 462 connected between negative potential lead 446 and the A-C common potential 442. The collector of transistor 466 is connected to conduct through a sense output relay 474 to the negative potential lead 446 and a transient suppressing condenser 476 is connected in parallel with the sense output relay 474. Thus, conduction of transistor 466 energizes the sense output relay 474 such that it normally opened contacts 478 will provide D-C conduction through leads 480 and 482 to energize a solenoid relay 484 as will be further described below.

The A-C input leads 432 and 434 are extended in parallel such that the motor 24 may be connected thereacross. The high side of the A-C input lead 432 is connected through a voltage dropping resistor 486 to the negative side of a rectifier 488 to produce a positive D-C potential on lead 490. Thus, the positive D-C lead 480 from sense relay contact 478 is connected to the positive supply lead 490.

The solenoid relay 484 is controlled by a coil 492 which is connected between lead 482 and lead 494. A "reverse" relay 496 is controlled by a coil 498 which is connected between a lead 500 and the D-C potential lead 480. A capacitor 504 is connected between the A-C common lead 434 and the D-C potential lead 480 to provide a filtering function. A first solenoid relay contact section 506 provides conduction between the sense output lead 482 and the D-C potential 480 when solenoid relay 484 is energized. Also upon energization of solenoid relay 484, a second relay contact section 508 provides continuity from the A-C common lead 434 through a lead 510 to energize the window solenoid 146 with return to the A-C lead 432.

Upon energizing the reverse relay 496, a first relay section 512 breaks continuity between A-C common lead 434 and an energizing lead 494 to the solenoid relay 484 while establishing a connection between the A-C common lead 434 and a lead 500 which is connected through the reverse relay coil 498 to D-C lead 480. Thus, solenoid relay 484 would be released simultaneously with the energization of reverse relay 496. Also, when reverse relay 496 is energized its second contact section 514 controls the reversal of motor 24. That is, the starting capacitor 516 is removed from continuity with lead 518 to the high A-C lead 432 and it is placed in conduction with the lead 520 which is connected to the common side of the A-C line.

A window microswitch 522 is connected in its normally closed position between a lead 523 connected to the normally closed position of A-C microswitch section 189 and a lead 524 which leads to a reverse microswitch 526. The reverse microswitch 526, a normally open type, may be actuated to close lead 524 into contact with lead 500 which is connected to the reverse relay 496. The window

microswitch 522 may be one of the normally open microswitches 144 as shown in FIG. 3 which constitute the window microswitches Nos. 1 and 2 in the previous embodiment. The reverse microswitch 526 may be the pause microswitch (section 187) of the previous embodiment as shown in FIG. 5.

The photosensor circuits 450 are similar to the photosensor circuitry 204 of FIG. 6. Thus, D-C power is supplied between the D-C potential lead 490 and the A-C common lead 434. The microswitch 158, A-C microswitch No. 2, also provides a delayed biasing function with normally closed connection through a lead 532 and a very high resistance 534 for connection to the negative reference input 446. This bias is applied to input lead 446 and it compensates for the inherent time lag of the photocells in photosensor circuit 450 by holding amplifier 438 cut off during the initial energization to prevent false conductive indication from the amplifier circuitry 438.

A filter capacitor 536 is connected across the input power supply to the photosensor circuits 450 and a voltage divider, consisting of series connected resistors 537 and 538, is connected in parallel with a test point TP-1 being provided at the junction. Then, in configuration similar to the photosensor circuitry 204 (FIG. 6), a parallel connected plurality of photo-responsive cells 539, 540, 541 and 542 are connected in series with respective adjusting potentiometers 543, 544, 545 and 546, and a similar type of diode balancing network 547 utilizing plural diodes 548 is employed to provide a balanced output indication between leads 446 and 452. A potentiometer 549 is connected in the output of each photocell channel to provide individual channel sensitivity adjustment similar to that provided by potentiometers 283 in FIG. 6. Also, the FIG. 7 circuitry can be made amplitude sensitive, as described with respect to FIG. 6, by placing one of the photocells in a standard environment as to illumination and paper density. Such provision will allow further adjustment of the rejection tolerance.

In the operation of the "no pause" embodiment employing the circuitry of FIG. 7, a bill to be examined can be inserted in bill tray 22 while depressing bill tray 22 to actuate A-C microswitch No. 1 (154) to enable A-C energization of the electronic circuitry. Also, in the same manner, the bill tray 22 should be held depressed until the bill leading edge is fed in to actuate the A-C microswitch No. 2 (158) whereupon the bill can be released as the bill validating apparatus 10 will continue to wind the bill in around the drum 56.

With the FIG. 7 or "no pause" circuitry, the amplifier circuit 438 is actually biased to a point of nonconduction as the large unbalance signal present across leads 446 and 452 keeps the transistors 456 and 466 out of conduction. The unbalance signal across leads 446 and 452 will be detected across the diode balancing network 547 during all positions of the bill, relative to drum 56 and the fixed position photoelectric scanners, except one preset position where the properly programmed response is detected by the photocells 539-542 and the output across leads 446 and 452 then becomes a balanced or zero relative output with respect to the input of transistor 456. At this preset position a check of bill validity may be detected in the photocell circuit 450 such that the transistors 456 and 466 will be allowed to go into conduction to energize the sense output relay 474. This differs further from the previous embodiment, or electronic circuitry 200 in FIG. 6, in that the sense relay energization no longer denotes a bill rejection but now is indicative of a bill acceptance and initiates circuitry to carry out the acceptance function.

Thus, with bill acceptance recognition and energization of sense output relay 474, the relay contacts 474 are actuated such that positive voltage on lead 480 is conducted through lead 482 to energize the solenoid relay 484. Solenoid relay 484 is locked up by holding contacts 506 while contacts 508 energize the window solenoid 146. If the window solenoid 146 is energized to completely

close the window gate 122, the microswitch 522, a normally closed section of one of the window microswitches 144, is actuated open to remove the A-C connection via lead 523 and lead 524 to the reverse microswitch 502. This removes power from the reverse microswitch 526 such that it cannot actuate the reverse relay 496, in effect disabling the switch 526. Thus, the motor 24 will continue in the forward direction delivering the acceptable bill through the A-C microswitch No. 4 (189) and actuating a payout switch 191 and, thereafter, the bill will be deposited through exit hole 91 into a suitable receptacle placed beneath the bill validating apparatus 10.

In the event of a counterfeit bill, no photoelectric check will ever be delivered from the photoresponsive circuits 450 in the form of a balanced output which would enable conduction of transistors 456 and 466 and, therefore, the activation of sense output relay 474. Hence, the solenoid relay 484 would not be energized and eventually the bill would hit the reverse microswitch 526 which would have A-C power on lead 524, since window solenoid 146 was never actuated, and the reverse relay 496 would be energized to reverse the motor 24.

Also, in the event that a valid photoelectric check was obtained but a thread was tied to the bill and trailing outside, solenoid relay 484 would be actuated to actuate window solenoid 146 but the window gate 122 would not be allowed to close sufficiently to actuate the window microswitch 522. Hence, the A-C power on lead 523 to window microswitch 522 (normally closed) and the reverse microswitch 526 would still be present, and actuation of the reverse microswitch by the leading edge of the bill would still result in an energization of the reverse relay 496 and a reversal of the motor 24 to back the bill out of the entry window.

FIG. 8 discloses an additional electronic circuit 550 which can be employed with either of the "pause" or "no pause" validation apparatuses which employ the circuits of either FIG. 6 or FIG. 7. The electronic circuitry 550 constitutes another detection circuit which utilizes R-F energy and which can be used alone or in addition to the photoelectric testing procedures. Such R-F testing circuitry is particularly desirable for checking bills such as Bank of England notes which contain a very fine metallic conductor element embedded in the paper transversely across the bank note. The use of R-F energy is particularly desirable in that the necessity for piercing or otherwise despoiling the currency paper is avoided.

The electronic circuitry 550 consists of an R-F generator 52 which may be one of the well-known, commercially available types providing an R-F energy output on the order of 100 megacycles. It should be understood that a wide variety of generators and frequencies may be employed in such an application. The R-F energy is then present on leads 554 and 556 to a high frequency balancing network 558. Input 554 is applied directly to one side of a variable capacitor 560 and the input lead 556 is connected through a resistance 526-capacitance 564 parallel combination to the positive pole of a diode 566, the negative side of diode 566 being connected to a junction 568 and the remaining connection of variable capacitor 560. The junction 568 is then connected to the positive side of a diode 570 having its negative side connected to an output lead 572. A resistance 574-capacitance 576 parallel combination is connected between output lead 572 and another output lead 578 which is connected to the junction 565.

A lead 580 extending from input lead 554 is connected to a conductive sensing element 582 which is positioned along one side of a bill 584 such as may contain a conductive thread 586 or such extending thereacross. A second similar conductive sensing element 588 is situated to come in proximate positioning to the other side of the bill or bank note 584. Thus, the sensing elements 582 and 588 are fixedly positioned as by suitable insulative supports on opposite sides of the bill traverse path (i.e. about

the drum 56 as moved by the belt 60). The sensing element 588 is connected by lead 590 to a junction 592. Junction 592 is connected to the positive side of a diode 594, its negative side being connected as an output lead 596. Another diode 598 is connected negative-to-positive between lead 592 and the output lead 578. A resistance 600-capacitance 602 parallel combination is then connected across the output leads 596 and 578.

In typical operation, the variable capacitor 560 can be adjusted to provide for a balanced voltage output between the output leads 572 and 596, e.g. with an R-F coupling between conductive sensing elements 582 and 588. Thus, since the voltage output between leads 572 and 596 is adjusted to have a net voltage output equal to zero, voltage outputs taken across either of output leads 572 and 578 or 578 and 596 will yield a voltage output.

When the R-F coupling is removed between the sensing elements 582 and 588 a voltage output will then be present across leads 572 and 596, an opposite indication from the previous shorted sensor condition, and no voltage output will be present across the remaining wire pair 578 and 596 combination. The electronic circuit 550 can be used in either the FIG. 6 or FIG. 7 embodiments simply by selecting the output lead pair for connection to the amplifier circuitry, depending upon whether it depends upon the conduction or no conduction state for its quiescent operation.

FIG. 9 discloses an alternative embodiment of photoelectric scanning mechanism which may be employed in the bill validating apparatus 10. In this construction the photoelectric circuits are not recessed within the drum 56, but are allowed to ride upon a movable cradle 610 which holds the photoelectric elements in reading contact with the bill traverse path around drum 56. Thus, the cradle 610 may be secured to a hinge member 612 having a hole 614 therethrough and the hole 614 may be pivotally affixed around the transverse shaft 100 (FIG. 3). A suitable tension spring 616 may then be affixed between cradle frame 612 and a selected stationary point about the frame 12 of bill validating apparatus 10 to continually urge the cradle 610 into arcuate engagement about the drum 56.

The cradle 610 then has a plurality of cylindrical encasements secured thereon such as encasements 618, 620, 622, and 624. The encasements 618-624 are adapted to have a photosensing element such as a cadmium sulfide photoconductor positioned therein. Thus, photosensing elements such as photoconductors 66, 68, 70, and 72 of FIG. 6 may be secured as with an epoxy potting compound within the encasement 618-624 in light viewing relationship through cradle 610 to the bill traverse path about the surface of drum 56. A plurality of holes 626, 628, 630 and 632 are provided about the base of the cylindrical casing 618-624 to allow light from the illumination source to be reflected uniformly from the surface of the bill under examination.

Actually, the operation and functional requirements of the light transmission and light reflection photoelectric detector schemes, FIGS. 4 and 9 respectively, are very similar. A particular advantage of the FIG. 4 configuration is the space-saving aspect which becomes especially attractive in an effort to miniaturize the bill validating apparatus 10 as much as possible. Also, as shown in FIG. 9, still additional free space may be utilized by placing the drive motor 24a in space 634 of drum 56. There is a considerable volume of drum 56 which could be so utilized and direct drum drive could be applied by a well-known form of planetary-type or inner ring gearing.

The foregoing discloses novel bill validating apparatus which functions with a high degree of reliability to execute a rapid photoelectric check of a bill or document to be examined. The invention also provides novel electrical circuitry for carrying out an R-F energy check of certain bills or notes containing a conductive element or pattern thereon. The photoelectric circuitry of the present invention is employed in a novel design which renders

the detection circuitry free from drift due to inherent deficiencies of the photoelectric cells such that the detection procedure is rendered a great deal more reliable and more difficult to deceive by counterfeiting or piracy measures. In addition to this, the approval mechanical design is of new and simplified construction such that the bill validating apparatus can be completely packaged in a relatively smaller unit to further enhance its employment in nearly all applications.

Changes may be made in the combination and arrangement of elements as heretofore set forth in the specification and shown in the drawings; it being understood that changes may be made in the embodiments disclosed.

What is claimed is:

1. A paper bill validating device comprising:
 - drum means having a rounded peripheral surface;
 - belt means disposed to move about a portion of the peripheral surface of said drum means;
 - drive motor means reversibly controllable to impart movement to said belt means in either a first or second direction;
 - insertion means which is manually movable and disposed adjacent to said drum means to receive said bill and to be manually actuated to energize and drive motor means such that the bill is gripped by said belt means and moved about the peripheral surface of said drum means;
 - detection means disposed adjacent said drum means peripheral surface for providing a first output in response to detection of predetermined indications on said bill, and for providing a second output in response to non-detection of said indication;
 - bill receptacle means disposed below said drum means;
 - control means activated by said first output to energize said drive motor means to move said bill in the first direction for deposit in said receptacle, and activated by said second output to energize said drive motor means in the second direction to move said bill back to said insertion means.
2. A paper bill validating device as set forth in claim 1 wherein said drum means comprises:
 - a cylindrical structure having a peripheral surface with a central portion adapted for positioning adjacent to said belt means, remaining portions of said peripheral surface having said detection means disposed adjacent thereto.
3. A paper bill validating device as set forth in claim 2 wherein said detection means comprises:
 - electric lamp means disposed above said drum means; and
 - a plurality of photo-electric detectors disposed in recessed position within said drum means to receive illumination transmitted through the bill from said lamp means, said detectors being positioned in predetermined alignment relative to each other.
4. A paper bill validating device as set forth in claim 2 wherein said detection means comprises:
 - lamp means disposed above said drum means to illuminate said bill passing therearound;
 - frame means which is spring biased to rest against said drum means peripheral surface;
 - a plurality of detector means secured in predetermined alignment on said frame means to receive reflected illumination from said bill to generate said detection means output response.
5. A paper bill validating device as set forth in claim 2 which is further characterized to include:
 - first peripheral groove means formed in said drum means adjacent the portion which contacts said belt means;
 - stripper means secured below said drum means and having a finger portion which is adapted to extend up within said peripheral groove to prevent the passage of bills.

6. A paper bill validating device as set forth in claim 1 wherein said insertion means comprises:
 tray means disposed adjacent said drum means in hinged, depressable relationship; and
 microswitch means secured beneath said tray means to be actuated thereby upon depression of said tray means to energize said drive means and thus initiate movement of the bill by said belt means.
7. A bill validating device as set forth in claim 1 wherein said control means comprises:
 amplifier means which is held cut off by said first output and rendered conductive by said second output; and
 sense output relay means which is actuated by said conductive amplifier means, said relay means being connected to said control means to energize said drive means for bill acceptance deposit when not actuated and to energize said drive means in the opposite direction for bill rejection when actuated.
8. A bill validating device as set forth in claim 1 wherein said control means comprises:
 amplifier means which is held cut off by said second output and rendered conductive by said first output; and
 sense output relay means which is actuated by said conductive amplifier means, said relay means being connected to said control means to energize said drive means for bill acceptance deposit when actuated and to energize said drive means in the opposite direction for bill rejection when not actuated.
9. A bill validating device as set forth in claim 7 wherein said control means further comprises:
 pause relay means for stopping said drive means when actuated;
 input means enabled by actuation of said pause relay means to conduct said first or second outputs from said detection means to said amplifier means;
 switch means positioned proximate to said drum and actuated by the bill to actuate said pause relay means; and
 reverse relay means actuated by said sense output relay means when it is actuated, said reverse relay means energizing said drive means in the opposite direction.
10. A bill validating device as set forth in claim 8 wherein said control means further comprises:
 reverse relay means which is actuated to energize said drive means in the opposite direction;
 switch means positioned proximate to said drum and actuated by the bill to provide energizing power to said reverse relay means; and
 solenoid relay means which as actuated in response to actuation of said sense output relay means to disable said switch means by disconnecting said energizing power thereby to enable bill acceptance.
11. A bill validating device as set forth in claim 1 which is further characterized to include:
 window gate means disposed to pass between said drum means and said insertion means; and
 switch means actuated only by successful passage of said window gate means to enable said control means for activation by said first output.
12. A bill validating device as set forth in claim 7 which is further characterized to include:
 window gate means disposed to pass between said drum means and said insertion means;
 solenoid means energized to allow said window gate means passage; and
 means enabling energization of said solenoid means only after the bill has passed from said insertion means onto said drum means.
13. A bill validating device as set forth in claim 8 which is further characterized to include:
 window gate means disposed to pass between said drum means and said insertion means;

- solenoid means energized to allow said window gate means passage; and
 relay means for energizing said solenoid means upon actuation of said sense output relay means.
14. A bill validating device as set forth in claim 1 wherein said detection means comprises:
 plural photoresponsive means disposed in light viewing relationship to predetermined indications on said bill;
 plural potentiometers, each connected in series with each photoresponsive means to adjust their respective resistance ratios;
 an isolating diode network connected in parallel between each photoresponsive means and potentiometer to provide an output variation proportional to variations from said predetermined indications.
15. A bill validating device as set forth in claim 1 wherein said detection means comprises:
 a source of D-C power;
 plural photoconductive means having first and second terminals, each disposed in light viewing relationship to a predetermined indication on the bill;
 a first lead connected to common and to each of said first terminals;
 plural variable resistors each having first and second ends and having their respective first ends connected to said photoconductive means second terminals to form respective output junctions;
 a second energizing lead connected to said source of D-C power and each of said variable resistor second ends;
 a first output lead;
 a second output lead;
 a plurality of diodes each connected in first polarity to one of said junctions and said first output lead; and
 a second plurality of diodes each connected in opposite polarity to one of said junctions and said second output lead.
16. A bill validating device as set forth in claim 1 wherein said detection means comprises:
 R-F generator means;
 a pair of conducting sensing elements disposed proximate said drum means on each side of said peripheral surface;
 reactance means receiving the output from said R-F generator means at its input and applying R-F energy across said sensing elements to provide said first output in response to detection of a conductive element across said bill and to provide said second output in response to non-detection.
17. A paper bill validating device comprising:
 drum means having a rounded peripheral surface;
 belt means disposed in contact with a portion of the peripheral surface of said drum means and being movable therewith;
 drive motor means reversibly controllable to impart movement to said drum means;
 insertion means which is manually movable and disposed adjacent to said drum means and being responsive to said manual movement to energize said drive motor means such that the bill is gripped by said belt means and moved about the peripheral surface of said drum means;
 detection means disposed adjacent said drum means peripheral surface for providing a first output in response to detection of predetermined indications on said bill, and for providing a second output in response to non-detection of said indications;
 bill receptacle means disposed below said drum means;
 control means activated by said first output to energize said motor means to move said bill for deposit in said receptacle, and activated by said second output to energize said drive motor means in the opposite direction to move said bill back to said insertion means.

19

18. A paper bill validating device as set forth in claim 17 wherein said insertion means comprises:

tray means disposed adjacent said drum means in hinged, depressable relationship; and
microswitch means secured beneath said tray means to be actuated thereby upon depression of said tray means to energize said drive means and thus initiate movement of the bill by said drum means and belt means.

19. A bill validating device as set forth in claim 17 wherein said control means comprises:

amplifier means which is held cut off by said first output and rendered conductive by said second output; and

sense output relay means which is actuated by said conductive amplifier means, said relay means being connected to said control means to energize said drive means for bill acceptance deposit when not actuated and to energize said drive means in the opposite direction for bill rejection when actuated.

20. A bill validating device as set forth in claim 17 wherein said control means comprises:

amplifier means which is held cut off by said second output and rendered conductive by said first output; and

sense output relay means which is actuated by said conductive amplifier means, said relay means being connected to said control means to energize said drive means for bill acceptance deposit when actuated and to energize said drive means in the opposite direction for bill rejection when not actuated.

21. A bill validating device as set forth in claim 19 wherein said control means further comprises:

pause relay means for stopping said drive means when actuated;

input means enabled by actuation of said pause relay means to conduct said first or second outputs from said detection means to said amplifier means;

20

switch means positioned proximate to said drum and actuated by the bill to actuate said pause relay means; and

reverse relay means actuated by said sense output relay means when it is actuated, said reverse relay means energizing said drive means in the opposite direction.

22. A bill validating device as set forth in claim 20 wherein said control means further comprises:

reverse relay means which is actuated to energize said drive means in the opposite direction;

switch means positioned proximate to said drum and actuated by the bill to provide energizing power to said reverse relay means; and

solenoid relay means which is actuated in response to actuation of said sense output relay means to disable said switch means by disconnecting said energizing power thereby to enable bill acceptance.

23. A bill validating device as set forth in claim 17 which is further characterized to include:

window gate means disposed to pass between said drum means and said insertion means; and

switch means actuated only by successful passage of said window gate means to enable said control means for activation by said first output.

References Cited

UNITED STATES PATENTS

2,995,976	8/1961	Weingart.	
3,245,533	4/1966	Rottmann	209—111.7
3,293,543	12/1966	Nelson et al.	209—111.8 X

ALLEN N. KNOWLES, Primary Examiner

U.S. Cl. X.R.

209—74, 111.7, 111.8

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTIONPatent No. 3,481,464 Dated December 15, 1969Inventor(x) Francis E. Townsend

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In column 3, line 65, "traverse" should be --transverse--
Patent Application, page 8, line 9

In column 11, line 6, "77" should be --72--
Patent Application, page 28, line 7

In column 16, line 24, "and" should be --said--
Patent Application, claim 1, line 7

In column 18, line 42, "conducting" should be --conductive--
Patent Application, claim 16, line 4

In column 19, line 29, "deposit" should be --deposit--
Patent Application, claim 20, line 9

SIGNED AND
SEALED

APR 28 1970

(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents