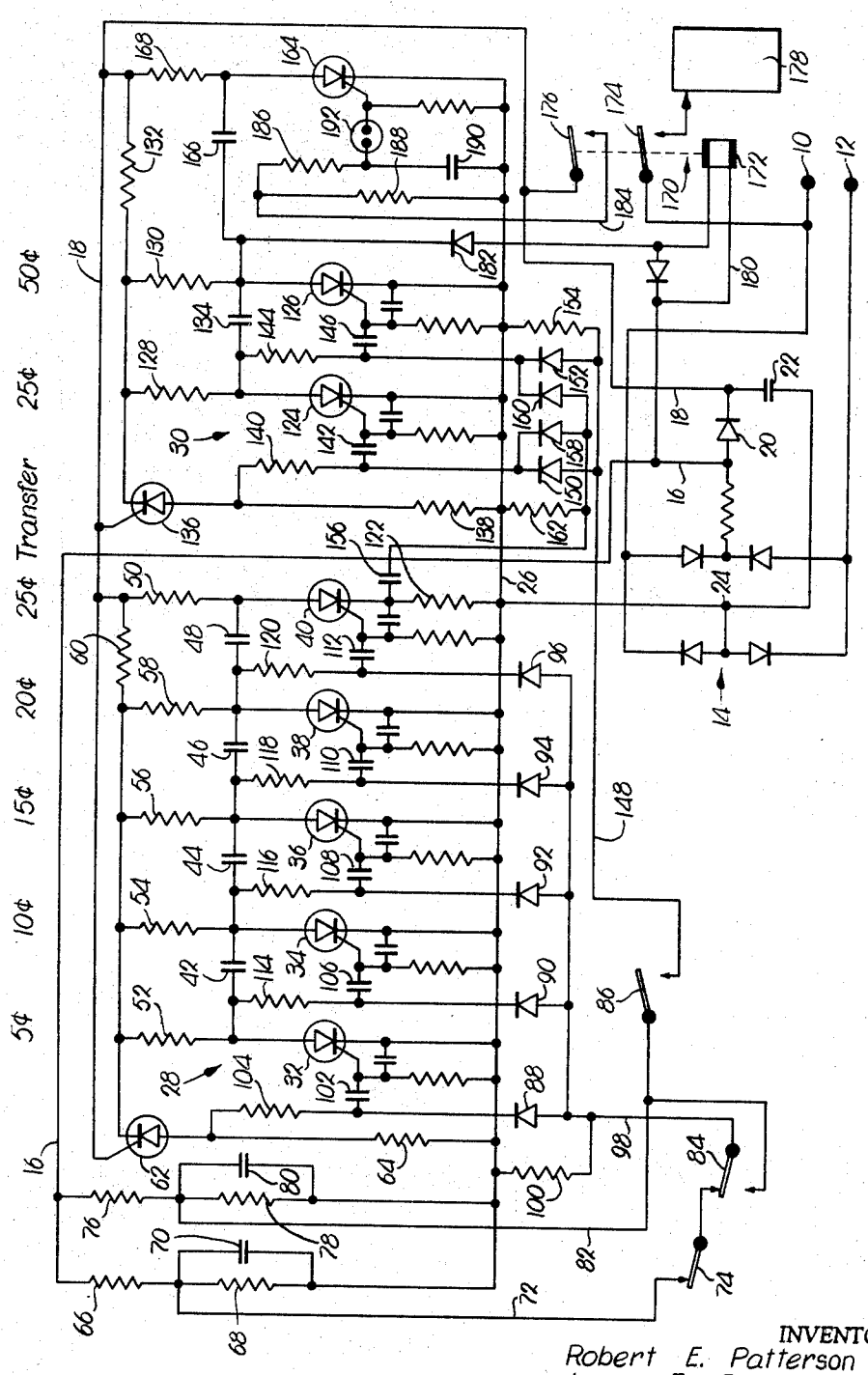
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FIFTY-CENT SOLID-STATE TOTALIZER

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FIFTY-CENT SOLID-STATE TOTALIZER

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ABSTRACT OF THE DISCLOSURE

A solid-state totalizer has a pair of register sections and utilizes silicon controlled rectifiers to count the deposited coinage and register the accumulated credit. The number of counting SCR's in each section depends upon the denominations of the coins to be handled by the totalizer and the maximum credit capacity desired. The first register section responds to the deposit of coins of the lowest denomination and accumulates credit therein by successive firing of the SCR's until the maximum capacity of the first section is reached, whereupon a transfer signal is delivered to the second register section, each counting SCR thereof representing an integer multiple of the maximum credit capacity of the first section. The counting SCR's of the second section are also directly fired by the deposit of coins of the largest denomination handled by the totalizer, such denomination being equal to the maximum credit capacity of the first totalizer section.

This invention relates to improvements in vending machine control apparatus of the type shown and described in a copending application of James F. Ptacek, Ser. No. 562,616, filed July 5, 1966, entitled "Solid State Vending Machine Control Apparatus," now Patent No. 3,365,044 and owned by the assignee herein.

The solid-state totalizer disclosed in the aforesaid patent application was developed to meet the need for a vending machine totalizer which would not present the problems of size and reliability which inherently arise in systems employing mechanical components such as electromechanical totalizers. Although the solid-state totalizer of the aforesaid application has proven to be a satisfactory and reliable unit, it is limited to vending applications where credit is accumulated in relatively small amounts by the deposit of coinage of a limited number of denominations.

It is, therefore, the primary object of this invention to provide a vending machine totalizer which does not rely upon the use of electromechanical devices such as stepper relays, and yet is capable of registering relatively large deposits which may be accumulated by the deposit of coins of a number of different denominations.

As a corollary to the foregoing object, it is an important aim of the instant invention to provide such a totalizer that is capable of totalizing the deposited coins regardless of the order in which the same are deposited, yet without materially increasing the size or cost of the totalizer or reducing the reliability thereof.

Another important object of the invention is to provide a totalizer as aforesaid having solid-state components which count command signals produced in response to the deposit of coinage, wherein the number of signals produced is related both to the number of coins deposited and the denominations of the deposited coins, and to provide a totalizer that responds to internally produced credit transfer signals and thereby is capable of registering relatively large amounts of credit with a minimum number of such components.

In the drawing:

The single figure is an electrical schematic diagram

of vending machine control apparatus illustrating the totalizer of the instant invention.

Alternating current line voltage is delivered to a pair of power terminals 10 and 12 connected to the inputs of a bridge rectifier circuit 14. A lead 16 extends from the positive side of the output of bridge rectifier 14, and a second lead 18 also delivers rectified current from the positive side of bridge rectifier 14 through an isolation diode 20, a filter condenser 22 being connected between lead 18 and the negative or common output terminal 24 of bridge rectifier 14. The negative terminal 24 is connected to a common bus 26 which forms the circuit ground of the electrical apparatus to be subsequently described.

The solid-state totalizer includes a low denomination register section 28 and a high denomination register section 30. The low register section 28 has five counting SCR's 32, 34, 36, 38 and 40, their anodes being interconnected by commutating capacitors 42, 44, 46 and 48. The anode of SCR 40 is connected to the positive supply lead 18 by load resistor 50, the anodes of SCR's 32, 34, 36 and 38 being connected to lead 18 by respective load resistors 52, 54, 56 and 58 through a resistor 60 which forms a series connection between load resistors 52–58 and lead 18.

An SCR 62 is employed as a starting component for the counter of register section 28. The SCR 62 has its cathode connected to the common connection of load resistors 52–58 and resistor 60, the gate thereof being connected to the positive supply lead 18. A resistor 64 connects the anode of SCR 62 to the common negative bus 26. In this orientation, the anode of SCR 62 is the collector, the gate is the emitter, and the cathode is the base in transistor nomenclature.

A voltage divider comprising series connected resistors 66 and 68 is connected between lead 16 and bus 26, a capacitor 70 being connected in parallel with resistor 68. A lead 72 extends from the positive side of resistor 68 to a normally closed nickel coin switch 74.

A second voltage divider comprises a pair of series connected resistors 76 and 78 connected between lead 16 and bus 26, a capacitor 80 being connected in parallel with resistor 78. A lead 82 is brought from the positive side of resistor 78 to the normally open contact of a single-pole, double-throw dime coin switch 84, and to the movable pole of a normally open quarter coin switch 86.

The movable pole of switch 74 is connected to the normally closed contact of switch 84, the movable pole of the latter being connected to five diode control gates 88, 90, 92, 94 and 96 by a lead 98. A resistor 100 of relatively low ohmic value is connected between lead 98 (the anodes of diodes 88–96) and common bus 26. The cathode of diode 88 is connected to the control element or gate terminal of SCR 32 through a DC blocking capacitor 102. A resistor 104 is connected between the anode (collector) of SCR 62 and the cathode of diode 88. Similarly, the cathodes of diodes 90, 92, 94 and 96 are connected to the gates of SCR's 34, 36, 38 and 40 by capacitors 106, 108, 110 and 112 respectively, and are connected to the anodes of SCR's 32, 34, 36 and 38 via resistors 114, 116, 118 and 120 respectively.

The cathodes of the counting SCR's 32–38 are directly connected to the common bus 26. However, a resistor 122 is interposed between the cathode of counting SCR 40 and common bus 26 for the purpose of developing a voltage at the cathode of SCR 40 which is utilized as a transfer signal to be discussed more fully hereinafter.

The high denomination register section 30 has a pair of counting SCR's 124 and 126 having their cathodes returned directly to the common bus 26. A pair of load resistors 128 and 139 connect the anodes of SCR's 124 and 126 respectively to the positive supply lead 18 through

a resistor 132. The anodes of SCR's 124 and 126 are interconnected by a commutating capacitor 134, it being appreciated that the configuration of the two counting stages of register section 30 is identical to the counting stages of the low denomination register section 28 as represented by SCR's 32–38.

As in the low denomination section 28, the high denomination section 30 employs an SCR 136 connected as a PNP transistor and utilized as a starting component for the counter. A resistor 138 connects the anode (collector) of SCR 136 to common bus 26, and a resistor 140 connects the collector to the control element or gate terminal of SCR 124 through a series DC blocking capacitor 142. A resistor 144 connects the anode of SCR 124 to the gate of SCR 126 through a DC blocking capacitor 146.

A lead 148 extends from the normally open contact of quarter coin switch 86 to the anodes of a pair of diode control gates 150 and 152, the cathodes thereof being connected to the gate terminals of SCR's 124 and 126 via the blocking capacitors 142 and 146 respectively. A resistor 154 of relatively low ohmic value interconnects lead 148 (the anodes of diodes 150 and 152) and the common bus 26.

As mentioned hereinabove, the cathode resistor 122 associated with SCR 40 in the low denomination register section 28 is utilized to produce a transfer signal. An additional pair of diode control gates 158 and 160 have their cathodes connected to the cathodes of diodes 150 and 152 respectively, the anodes of diodes 158 and 160 being connected to the cathode of SCR 40 (the positive side of resistor 122) by a coupling capacitor 156. The resistor 162 is connected between the anodes 158 and 160 and the common bus 26.

The high denomination register section 30 is also provided with a reset SCR 164 having its anode connected to the anode of SCR 126 by a commutating capacitor 166, and connected to the positive supply lead 18 by a load resistor 168. The cathode of the reset SCR 164 is returned directly to the common bus 26.

A vend relay 170 has a normally de-energized coil 172 and a pair of normally open switches 174 and 176. The movable pole of relay switch 174 is connected to power terminal 10, thus closure of switch 174 delivers a vend pulse to an article dispensing mechanism 178 to initiate a vend cycle. The mechanism 178 may, for example, comprise any of a number of conventional article dispensers which are motor operated; therefore, a closure of switch 174 would commonly cause the energization of a motor relay and operation of the dispensing mechanism would continue until a carry-over switch controlled by the vend motor returned the mechanism to standby at the close of the vend cycle.

A lead 180 interconnects the positive supply lead 16 and one side of relay coil 172, the other side thereof being connected to the anode of SCR 126 via a diode 182 poled in series conducting relationship to SCR 126. The movable pole of relay switch 176 is connected to DC supply lead 18, and the normally open contact thereof is connected by a lead 184 to the junction of a pair of resistors 186 and 188, the latter being returned to the common bus 26. A capacitor 190 is connected to common bus 26 in series with resistor 186, a neon lamp 192 being connected between the junction of these two RC components and the gate terminal of reset SCR 164. The capacitor 190 and the lamp 192, in conjunction with the associated resistive components, form an RC timer which delays the firing of SCR 164 upon closure of relay switch 176.

OPERATION

At the outset, it should be understood that the three coin-operated switches 74, 84 and 86 would be associated with the coin tracks of a coin acceptor (not shown) in a conventional manner such that each is operated by the weight of a gravitating coin of appropriate denomination when such coin is deposited in the acceptor mechanism. After power has been applied to terminals 10 and 12, all of the SCR's are in their nonconductive states and all of the diode gates are back-biased with the exception of diodes 88, 150 and 158. Capacitor 70 is in a substantially uncharged condition when the apparatus is in standby since resistor 100 is very small as compared with resistor 68. Capacitor 80 is charged in standby by the voltage appearing across the resistor 78 of the voltage divider 76, 78.

The legend along the top of the drawing refers to the credit that may be represented by the various counting SCR's of the two register sections 28 and 30. This will become clear as the discussion of the operation of the apparatus proceeds.

SCR 62 serves as a starting component to control the initiation of the counting SCR's 32–40 of the low denomination register section 28. Specifically, SCR 62 (used here as a PNP transistor) conditions the register section 28 such that only the 5¢ SCR 32 will fire when the first nickel is deposited. Since SCR 62 is nonconducting when the apparatus is in standby, the junction of resistor 104, capacitor 102, and the cathode of diode 88 is held substantially at the potential of common bus 26. Therefore, diode 88 is substantially zero-biased while the other diodes 90–96 are back-biased since their cathodes are maintained substantially at the potential of positive supply lead 18.

Assuming that a nickel is deposited, the nickel switch 74 opens and then recloses to charge and then discharge capacitor 70 through the zero-biased diode 88 to fire the 5¢ SCR 32. Thus, the discharge of capacitor 70 is in the form of a positive pulse which serves as a credit command signal applied to the gate terminal of the 5¢ SCR 32 to render the same conductive and register 5¢ in credit. With SCR 32 now conducting, current flows through resistor 60 and the voltage drop thereacross turns on the starting SCR 62 to, in turn, back-bias diode 88. Additionally, with SCR 32 now conducting, the back-bias is removed from diode 90 to place the same in the zero-biased condition, ready to receive the next command signal from coin switch 74 if another nickel is deposited.

If a dime is now deposited after the deposit of the first nickel, the dime switch 84 closes against its lower contact and then returns to the position illustrated, causing the discharge of capacitor 80 through the lower contact of dime switch 84 and the discharge of capacitor 70 when the movable pole of switch 84 returns to the position illustrated in engagement with its upper contact. Thus, a command signal is obtained from each of the capacitors 70 and 80 when a dime is deposited, and the two pulses are delivered in succession along lead 98 to fire SCR 34 and then SCR 36. Therefore, after the deposit of 15¢, SCR 36 is in conduction and SCR's 32 and 34 are now returned to their nonconductive states by virtue of the action of the commutating capacitors 42 and 44. Thus, only one counting SCR at a time is in the conductive state.

The totalizer illustrated herein is arranged to vend when a deposit of 50¢ is made, regardless of the combination of nickels, dimes and quarters that might be utilized by a customer to form the 50¢ deposit. In the instant example, assuming that two more nickels or another dime are deposited, it will be appreciated that the 25¢ transfer SCR 40 fires, resulting in the production of a credit transfer signal in the form of a pulse which is delivered to the high denomination register section 30 by coupling capacitor 156. At this time, it should also be noted that conduction of SCR 40 returns the starting SCR 62 to its nonconductive state so that the next deposit of a nickel or dime will repeat the firing sequence of the counting SCR's 32–40 just described.

The two counting SCR's 124 and 126 in the high denomination register section 30 operate in a manner analo-

gous to the counting SCR's of the low register. The SCR **136** constitutes the starting component for the highdenomination register section **30** and operates in the same manner as SCR **62** of the low register. Firing of SCR **124** corresponds to a credit of 25¢, while the firing of SCR **126** corresponds to a credit of 50¢.

In the instant example, 25¢ in nickel and dime change has been deposited to cause the mentioned credit transfer signal to be produced by the voltage drop across the cathode resistor **122** of SCR **40**. Since diode **158** is in its zero-biased condition, the transfer signal in the form of a positive pulse is directed through the DC blocking capacitor **142** to the gate terminal of 25¢ SCR **124** to cause the latter to assume its conductive state. This zero-biases diodes **152** and **160** and causes the starting SCR **136** to conduct, thus back-biasing diodes **150** and **158**. The 25¢ SCR **124** remains in its conductive state even though additional nickels and dimes are subsequently deposited to repeat the sequential firing of the SCR's in the low denomination register section **28**. Thus, after the credit transfer from the low register, the 25¢ SCR **124** serves as a credit storage means to hold the accumulated credit during a repeat operation of the low denomination register section **28**.

If, in the instant example, it is assumed that a quarter is deposited after the 25¢ in credit is transferred to the 25¢ SCR **124**, then a command signal is produced by the momentary closure of the quarter coin switch **86** to discharge capacitor **80** and fire the 50¢ SCR **126** via a delivery path for the command signal along lead **148**, through diode **152** and capacitor **146**.

From the foregoing, it may be appreciated that 50¢ in accumulated credit may ultimately be registered by the totalizer regardless of the combination of nickels, dimes and quarters inserted in the coin acceptor. The high denomination register section **30** is responsive to either direct firing of its SCR's **124** and **126** by the deposit of quarters or operation of such SCR's by the production of a transfer signal delivered by the transfer output of the low denomination register section **28**.

When the 50¢ SCR **126** is placed in its conductive state, the vend relay coil **172** is energized by a circuit traceable along supply lead **16**, lead **180**, relay coil **172**, diode **182**, and SCR **126** to the common bus **26**. This closes relay switch **174** to deliver the vend pulse to its dispensing mechanism **178**. Additionally, closure of relay switch **176** places the RC timer in operation and commences the charging of capacitor **190**. When the voltage at the junction of the neon lamp **192**, resistor **186**, and capacitor **190** reaches the ignition voltage of the neon lamp **192**, the latter fires to deliver a pulse to the gate terminal of the reset SCR **164**. As the reset SCR **164** conducts, it commutates the 50¢ SCR **126** off and also returns the starting SCR **136** to its nonconductive state. The apparatus is now in standby with the vend relay coil **172** de-energized. The purpose of the time delay is to permit the dispensing mechanism **178** to respond to the vend pulse before resetting of the totalizer. The resistor **188** provides a path for the complate discharge of capacitor **190**.

It is noteworthy that in the illustrated embodiment of the instant invention the 25¢ transfer SCR **40** and the reset SCR **164** remain conducting until either power is interrupted or coins are deposited to initiate a subsequent vend cycle. Thus, these SCR's **40** and **164** can be either nonconducting or conducting at the start of a vend cycle, there being no necessity to provide the usual additional circuit elements for returning these components to a single normal condition as is commonly encountered in other solid state counting circuitry.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. In a vending machine:

coin-actuated means for sensing the deposit of coins of a predetermined denomination and for delivering a command signal in response to each deposit;

a plurality of bistate, credit registering devices equal in number to the number of integer multiples of said denomination from one through a predetermined integer multiple of said denomination,

each device having a first, standby state and a second, credit representing state, and being provided with an electrically responsive control element for changing the state thereof from said first to said second state;

circuitry intercoupling said devices and said coin-actuated means for directing successive command signals to the control element of a different device to cause the devices to sequentially change from the first to the second states thereof in a predetermined order, thus a deposit of said coins equal in value to said predetermined integer multiple of said denomination causes the last device of said order to change from its first to its second state,

said circuitry being responsive to the change of state of said last device for effecting a repeat of the sequence of excitation of the control elements of said devices if additional coins are deposited;

credit storage means coupled with said last device and responsive to said change of state thereof for registering the credit represented by the change of state of said last device and holding the registered credit during a repeat of the sequence of excitation of the control elements of said devices; and

means for dispensing an article in response to the registering of credit equal to a selected integer multiple of said denomination.

2. The invention of claim **1**,

there being second coin-actuated means for sensing the deposit of a coin of a second, greater denomination equal in value to said predetermined integer multiple of the first mentioned, lesser denomination, and for delivering a second command signal in response to the deposit of said coin of said second denomination,

said credit storage means being coupled with said second coin-actuated means and responsive to said second command signal for registering credit equal to said second denomination, whereby either the deposit of sufficient coins of the lesser denomination or a coin of the second, greater denomination is effective to establish credit in said credit storage means in an amount equal to said second denomination.

3. The invention of claim **1**,

said circuitry normally maintaining each of said devices in the first state thereof, and cooperating with said devices during deposit of said coins to direct said successive command signals to said devices in said order and to return each operated device to its first state when another device subsequently changes from the first to the second state thereof, whereby only one of said devices is in its second state at a given time.

4. The invention of claim **3**,

said circuitry including an electrically responsive control gate operably coupled with the control element of each gate operably coupled with the control element of each of said devices respectively, and a starting component normally maintaining the gate associated with the first device of said order exclusively in a condition to conduct the command signal produced by the first coin to be deposited.

5. The invention of claim **4**,

said component having a first state maintaining said control gate associated with said first device in said condition, and a second state preventing conduction of command signals by the last-mentioned gate,

said circuitry further including means coupling said first device with said component for changing the state of the latter from said first to said second state thereof in response to a change-of-state of said first device effected by the first-produced command signal.

6. The invention of claim **5**,

each of said control gates comprising a diode having a cathode connection and an anode connection,

each of said devices comprising a silicon controlled rectifier having a cathode and an anode in addition to the control element thereof,

said circuitry further including a capacitor intercoupling each pair of anodes, respectively, of adjacent rectifiers of said order, means coupling one of said connections of each diode to said coin-actuated means, means coupling the other connection of each diode to the control element of a corresponding device, and means coupling the anode of each lower order rectifier to the other connection of the diode coupled with the control element of the next higher order rectifier for maintaining each of such other connections at substantially the potential of the rectifier anode coupled thereto,

said component in the first state thereof maintaining the other connection of the diode associated with said first device at a potential less than the potential of command signals delivered by said coin-actuated means and, in the second state thereof, raising the potential of the last mentioned connection to a level greater than said potential of the command signals.

7. In a vending machine:

first coin-actuated means for sensing the deposit of coins of a first denomination and for delivering a first command signal in response to each deposit;

a first totalizer register section having a first plurality of bistate, credit registering devices equal in number to the number of integer multiples of said first denomination in a coin of a second, larger denomination;

second coin-actuated means for sensing the deposit of coins of said second denomination and for delivering a second command signal in response to each deposit of a coin of said second denomination;

a second totalizer register section having a second plurality of bistate, credit registering devices each representing a different integer multiple of said second denomination beginning with one,

each device of said first and second pluralities of devices having a first, standby state and a second, credit representing state, and being provided with an electrically reponsive control element for changing the state thereof from said first to said second state;

first circuitry intercoupling the devices of said first section and said first coin-actuated means for directing successive first command signals to the control element of a different device of said first section to cause the devices thereof to sequentially change from their first to their second states in a predetermined order, thus a deposit of said coins of said first denomination equal in value to said second denomination causes the last device of said order to change from its first to its second state,

said first circuitry being responsive to the change of state of said last device for effecting a repeat of the sequence of excitation of the control elements of the devices of said first section if additional coins of said first denomination are deposited;

credit transfer means coupled with said last device for delivering a transfer signal when said last device undergoes a change from the first to the second state thereof;

second circuitry intercoupling the devices of said second section, said second coin-actuated means, and said credit transfer means for receiving each second command signal and each transfer signal and for directing such signals as successively received to the control element of a different device of said second section to cause the devices thereof to change from their first to their second states in a sequence corresponding to the multiples of said second denomination represented by the devices of said second section; and

means for dispensing an article in response to the registering of credit equal to a selected integer multiple of said first denomination.

8. The invention of claim 7,

said first circuitry normally maintaining each of said devices of said first section in the first state thereof, and cooperating with said devices of the first section during deposit of coins of said first denomination to direct said successive first command signals to said devices of the first section in said order and to return each operated device to its first state when another device of said first section subsequently changes from the first to the second state thereof, whereby only one of the devices of said first section is in its second state at a given time,

said second circuitry normally maintaining each of said devices of said second section in the first state thereof, and cooperating with said devices of the second section during deposit of coins of said second denomination or transfer of credit from said first section to direct successive second command and transfer signals to said devices of the second section representing progressively higher integer multiples of said second denomination and to return each operated device to its first state when another device of said second section subsequently changes from the first to the second state thereof, whereby only one of the devices of said second section is in its second state at a given time.

9. The invention of claim 7,

there being a third coin-actuated means for sensing the deposit of coins of a third denomination intermediate said first and second denominations and equal to an integer multiple of said first denomination, and for delivering a plurality of third command signals in succession equal in number to the last mentioned integer in response to each deposit of a coin of said third denomination,

said first circuitry being coupled with said third coin-actuated means for receiving said third command signals and directing the latter to the control elements of said devices of said first section to cause sequential change from their first to their second states in said order.

10. The invention of claim 7,

there being electrically responsive operating means coupled with the device of said second section representing the highest multiple of said second denomination and said dispensing means for actuating the latter in response to a change from the first to the second state of the last mentioned device, whereby to effect vending of said article,

said second circuitry having reset means responsive to operation of said operating means for conditioning the devices of said second section for change from their first to their second states in the same sequence as before in response to each second command signal and each transfer signal of the next vend cycle.

11. The invention of claim 7,

there being electrically responsive operating means coupled with the device of said second section representing the highest multiple of said second denomination and said dispensing means for actuating the latter in response to a change from the first to the second state of the last mentioned device, whereby to effect vending of said article,

said second circuitry having reset means responsive to operation of said operating means for returning said last mentioned device to its first state to thereby terminate operation of said operating means.

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