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ELECTRONIC COIN COUNTER

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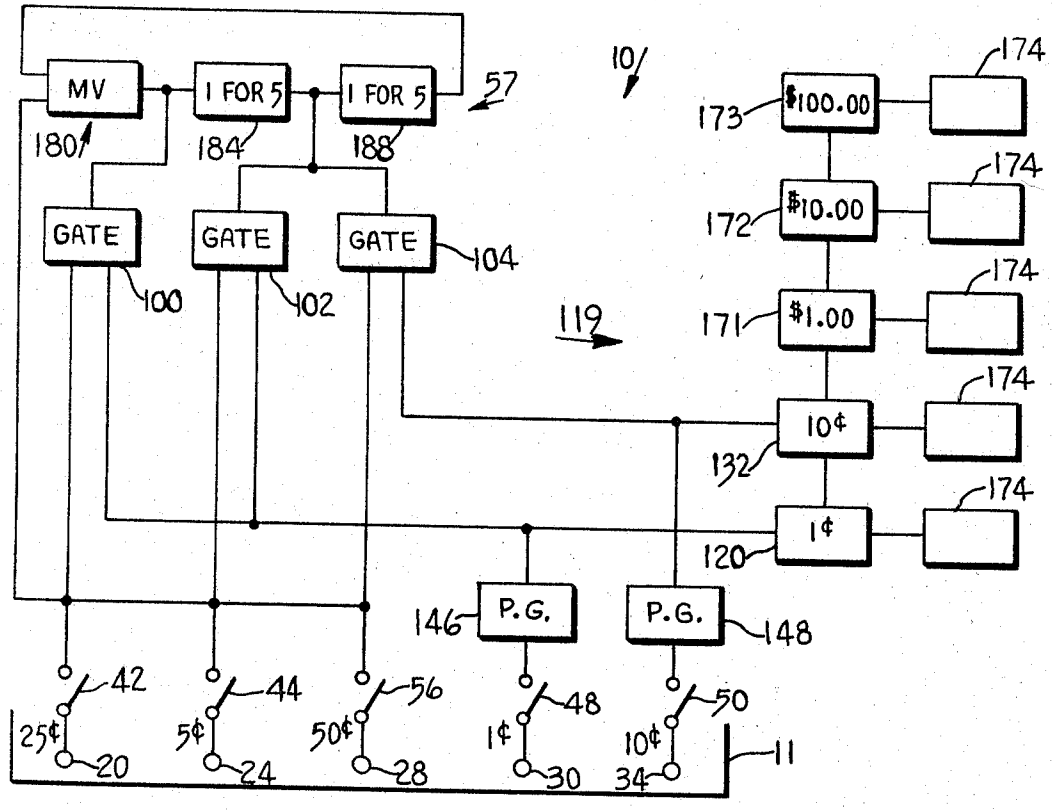


FIG. 1

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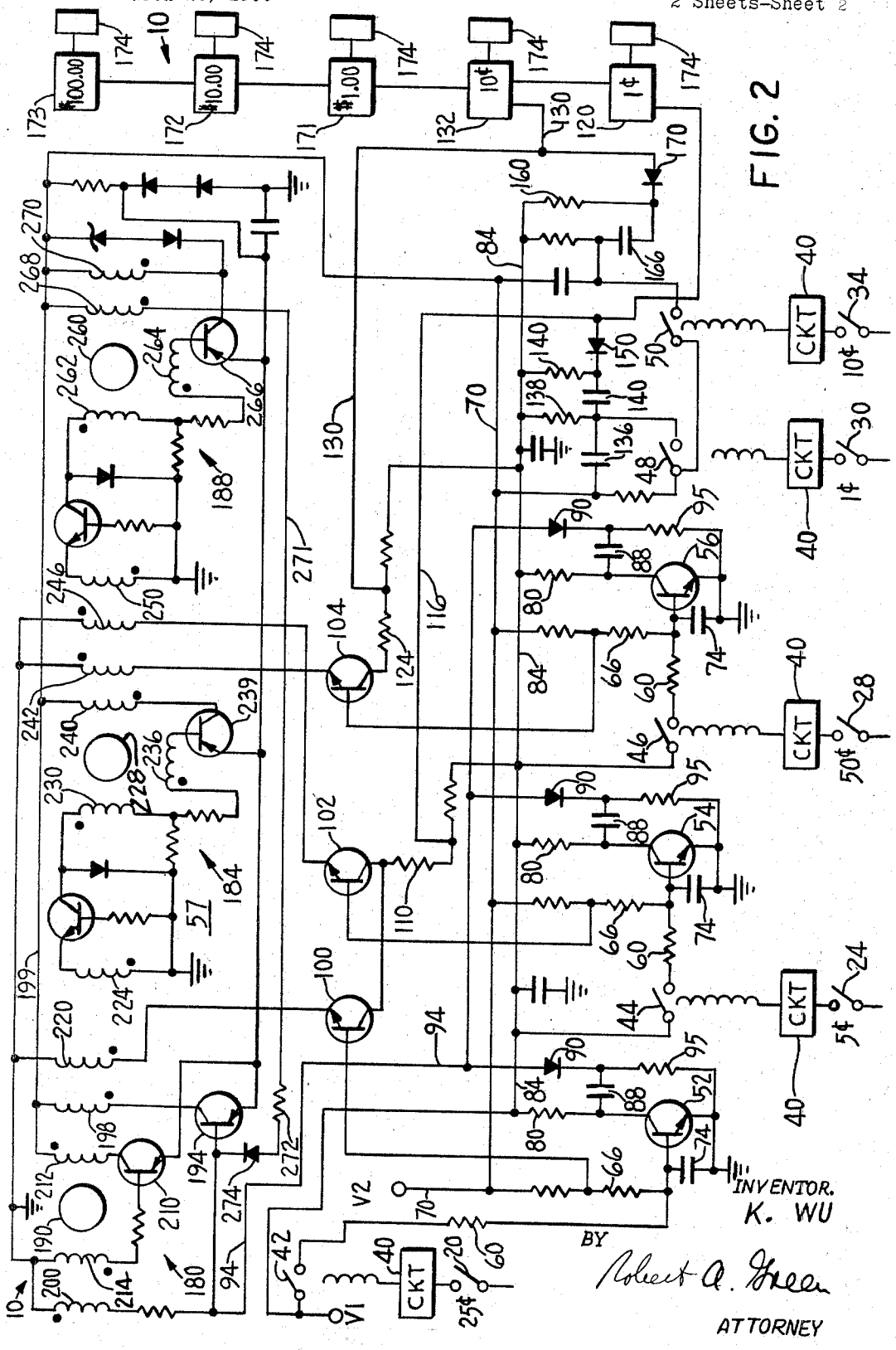


FIG. 2

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ELECTRONIC COIN COUNTER

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This invention relates to coin counters, and particularly, to apparatus for sorting, counting, and displaying a total count for coins of all denominations.

Apparatus is presently available for counting coins; however, this apparatus is electromechanical in nature. Electromechanical apparatus, although it may operate satisfactorily, is generally undesirable because it includes many moving parts which are subject to wear, it is relatively slow in operation, and it is large in size.

Accordingly, the objects of the invention concern the provision of improved coin counting and displaying apparatus which is all-electronic in construction and thus avoids the problems inherent in similar electromechanical apparatus.

Briefly, apparatus embodying the invention includes means for receiving all types of coins, with a separate slot being provided for each coin. The apparatus includes a novel electronic circuit which interrelates the coin slots and a pulse generator to produce different numbers of pulses for the various coins. The circuit also includes an arrangement of flow paths for properly directing the pulses to a register in which the pulses are stored and the total count is displayed.

The invention is described in greater detail by reference to the drawing wherein:

FIG. 1 is a block diagram of a system embodying the invention; and

FIG. 2 is a schematic circuit representation of the system of FIG. 1.

The system of the invention **10** is shown in block diagram in FIG. 1 and includes a coin receiver, represented schematically by numeral **11**, which is adapted to receive a quantity of coins of different denominations which are to be counted and totalized. The coin receiver **11** includes a separate slot or chute for each coin denomination to be counted. One suitable coin receiver which may be used in the system of the invention is made by the Sattley Company. This type of coin receiver is well known, and is not shown in detail. Each slot or chute of the receiver **11** is represented by a terminal; terminal **20** for quarters, terminal **24** for nickels, terminal **28** for half dollars, terminal **30** for pennies, and terminal **34** for dimes. Each slot of the coin receiver is associated with a switch circuit which is operated when a coin enters its slot in the receiver.

The system of the invention **10** includes a pulse generating system **57** which comprises a free-running pulse generator or multivibrator **180**, the output of which is coupled to a first pulse generator **184** which generates one pulse for every five pulses received from the multivibrator. The first pulse generator **184** has its output coupled to a second pulse generator **188** which is also adapted to produce one output pulse for each five pulses received from the first pulse generator. The output of the second pulse generator **188** is coupled to the multivibrator **180** so that, after it receives five pulses and generates an output pulse, it automatically turns off the multivibrator.

The system of the invention **10** also includes a cascade

coin register or counter **119** which consists of a first decade counter unit **120** to register cents, a second decade counter unit **132** to register dimes, a third decade counter unit **171** to register dollars, and fourth and fifth decade counter units **172** and **173** to register ten dollar and one hundred dollar quantities. Additional counter units may be included, if required. The counter units of the counter **119** are connected in series in known fashion to provide the correct money total. Each counter unit has its own display device **174**, for example, a type 6844A numerical readout tube for displaying the money total registered therein.

In the system **10**, the terminals **20**, **24**, and **28** representing the 25¢, 5¢, and 50¢ slots in the coin receiver **11** are all coupled to the input of the multivibrator **180** so that when a coin falls into its slot, the associated switch circuit is operated and the multivibrator is turned on and runs freely and generates pulses as it runs. The terminal **20** (25¢ slot) is also coupled to a gate **100** which is normally closed but is adapted to be opened by a coin deposited therein. The gate **100** is coupled between the output of the multivibrator **180** and the input to the cents counter unit **120** of the cascade counter **119**. The terminal **24** (5¢ slot) is similarly coupled to a gate **102** which is normally closed but which is adapted to be opened by a coin deposited therein. The gate **102** is coupled between the output of the first pulse generator **184** and the input of the cents counter unit **120**.

The 50¢ terminal **28** is also coupled to a gate **104** which is normally closed but which is adapted to be opened by a coin deposited therein; and this gate is coupled between the output of the first pulse generator **184** and the input of the dimes counter unit **132** of the cascade counter **119**.

The 1¢ terminal **30** is coupled to a pulse generator **146** which is adapted to generate one pulse for each coin which enters the slot, and this pulse generator is coupled to the input of the cents counter unit **120**. The 10¢ terminal **34** is similarly coupled to a pulse generator **148** which generates one pulse for each coin deposited in the slot and is coupled to the input of the dimes counter unit **132**.

The system **10** operates, briefly, as follows. If a 25¢ piece falls into the slot **20**, it operates its switch circuit **52**, turns on the multivibrator **180**, and opens the gate **100**. The multivibrator generates twenty-five pulses before it is turned off, and these twenty-five pulses are coupled through the gate **100** to the cascade counter **119** wherein the 25¢ is registered. Similarly, if a 5¢ piece enters slot **24**, it operates its switch circuit **54** to turn on the multivibrator **180** and to open the gate **102**. Five pulses appear at the output of the first pulse generator **184**, and these five pulses are coupled through the gate **102** to the first counter unit **120** to register 5¢ therein. If 50¢ enters the slot **28**, the associated switch circuit **56** turns on the multivibrator **180** and opens the gate **104**, and this time, the five pulses which appear at the output of the first pulse generator **184** are coupled into the 10¢ counter unit **132** to register the 50¢ therein.

If a 1¢ piece enters slot **30**, it operates its switch circuit **48** and pulse generator **146** to generate one pulse which is fed into the 1¢ counter unit **120** to register the 1¢. Similarly, if 10¢ enters slot **34**, it operates its switch circuit **50** and pulse generator **148** to enter one pulse in the 10¢ counter unit **132**.

It can be seen that each coin which enters its slot causes

pulses to be generated which are entered in the appropriate unit of the cascade counter, and the desired total is automatically registered in the counter. A more detailed description of the invention and its operation are set forth below.

In the schematic circuit shown in FIG. 2, each coin-receiving slot or terminal is coupled through suitable electronic circuitry 40 to operate mechanical switches 42, 44, 46, 48, 50 which are adapted to be closed when a coin falls into the proper slot.

The switches 42, 44, 46 associated with the quarter, nickel, and half dollar slots, respectively, are coupled to electronic switches 52, 54, 56, respectively, which operate pulse generating circuit 57 which is adapted to generate numbers of pulses corresponding to the value in cents of the coin in each slot. In the circuit 10, the three switches 52, 54, 56 are NPN transistors. The base or input electrode of each of these switch transistors is coupled through a resistive path 60 and its mechanical switch to a positive D.C. power source V1 which provides a voltage suitable to turn on the switch transistors. Each base electrode is also coupled through a resistive path 66 to a bus 70 which is coupled to a negative D.C. power source V2 which provides a voltage suitable to hold the switch transistors in the off state. The emitter electrodes are connected to ground, and, if necessary, each base electrode is coupled through a capacitor 74 to ground to minimize noise due to mechanical vibration in the switches 42, 44, 46. Each collector or output electrode of the switch transistors 52, 54, 56 is coupled through a resistor 80 to a bus 84 which is connected to the positive D.C. power source V1, and through a capacitor 88 and diode 90 to a bus 94. The resistor 80 and capacitor 88 comprise a differentiating circuit. Each emitter is also connected through a resistive path 95 to the junction of capacitor 88 and diode 90. The bus 94 is coupled to the pulse generating circuit 57.

Each of the 25¢, 5¢ and 50¢ channels includes a separate gate, in this case, a PNP transistor 100, 102, and 104, respectively. Each of these gate transistors has its input or base electrode connected to a point on the resistive path 66 which couples a negative, cut-off bias potential thereto. The emitter electrodes are all connected to portions of the pulse generating circuit 57. The output or collector electrode of the 25¢ gate transistor 100 is coupled to the collector electrode of gate transistor 102, and both collectors are coupled through a resistive path 110 to the bus 84. A point on the resistive path 110 is coupled through a lead 116 to an electronic decade counter 120 for registering pulses, each of which represents one cent. Similarly, the collector of the 50¢ gate transistor 104 is connected through a resistive path 124 to the bus 84, and a point on this path is coupled through a lead 130 to an electronic decade counter 132 for registering pulses, each of which represents dimes or ten cent units.

Referring now to the 1¢ and 10¢ slots, represented by switches 30 and 34, respectively, the 1¢ slot is coupled to switch 48 which is connected in a circuit loop including resistor 134 and capacitor 136 which operate together to limit switch bounce. This first circuit loop is coupled to a second circuit loop including resistor 138, resistor 140, and capacitor 144, the latter two components comprising a differentiating circuit which is coupled through diode 150 to lead 116 into the cents counter 120. The diode 150 is oriented to pass negative pulses generated by the differentiating circuit 140–144 when switch 48 is closed.

The 10¢ coin slot is similarly coupled through switch 50 to a differentiating circuit including resistor 160 and capacitor 166 and through diode 170 to lead 130 into the 10¢ counter 132.

The cents counter 120 is suitably coupled to the ten cents counter 132 to provide carry pulses thereto, and one dollar, ten dollar, and 100 dollar counters or registers 171, 172, 173, respectively, are provided in the counting chain. Each counter is provided with a readout device 174 such as a type 6844A indicator tube to display the coin count registered therein.

The pulse generating circuit 57 which is used in the system 10 includes magnetic cores of material having a rectangular hysteresis loop and carrying a plurality of windings. In the following description, it is assumed that current into the dotted end of a winding on a core induces current out of the dotted end of all other windings on the same core. In addition, current flow into the dotted end of a winding tends to set the core, and current into a non-dotted end of a winding tends to reset the core. The cores have two stable operating states, one being the "set" state or the "1" state or the state of positive magnetic remanence, and the other being the "reset" state or the "0" state or the state of negative magnetic remanence.

The pulse generating circuit 57 includes a free-running magnetic core multivibrator 180 which is coupled to first and second counting stages 184 and 188, respectively. The free-running multivibrator is adapted to generate twenty-five output pulses, with the first stage 184 being adapted to provide an output pulse for every five pulses it receives and with the second stage 188 being adapted to generate an output pulse after it receives five pulses from the first stage 184. This output pulse from the second stage is used to turn off the multivibrator 180 after the twenty-five pulses have been generated. The multivibrator 180 includes a core 190 which is in operative relation with a core-setting switching transistor 194 which has its output or collector electrode coupled to one winding 198 on the core and to bus 199 and its input or base electrode coupled through a second winding 200 to ground. The base of transistor 194 is also coupled to bus 94. The core 190 is also in operative relation with a core-resetting switching transistor 120 which has its collector connected to a winding 212 on the core 190 and the bus 199, and its base connected through another winding 214 to ground. The emitters of the two transistors 194 and 210 are connected together. The core 190 also carries a first output winding 220 which is connected between ground and the emitter electrode of 25¢ gate transistor 100.

The core 190 carries a second output winding 224 which is a portion of a coupling loop which is provided between the multivibrator core 190 and core 228 of the first stage 184 of the pulse generator 57. Core 228 carries an input winding 230 which is coupled through the collector-emitter path of a PNP transistor 232 to the second output winding 224 on the first core 190. The second core also carries a winding 236 which is coupled to the input or base of a core-resetting transistor 238, the output or collector of which is coupled to a reset winding 240 on core 228. Core 228 carries a first output winding 242 which is coupled to the emitter of 50¢ gate transistor 104 and a second output winding 246 which is connected to 5¢ gate transistor 102.

Core 228 carries a third output winding 250 which is part of a coupling loop to core 260 of the second counting stage 188 of the pulse generator. The coupling loop is substantially identical to the first coupling loop, and core 260 carries substantially the same windings as the core 228 including an input winding 262, a winding 264 to the input of a reset transistor 266, a reset winding 268, and a feedback winding 270 which is coupled through a lead 271 and resistor 272 and diode 274 to the base transistor 194. This connection is used to couple a negative pulse to transistor 194 to turn off the multivibrator after it has generated twenty-five pulses.

In operation of the invention, initially in multivibrator 180, both transistors 194 and 210 are turned off and core 190 is in the "0" logic state. Transistor 194 is turned on by a pulse applied on line 94, and, as current flows in collector winding 198, a voltage is induced across winding

200 which keeps transistor 194 conducting until core 190 is switched, at which time transistor 194 turns off. At the same time, a voltage appears across winding 214 which prevents transistor 210 from being turned on. As core 190 traverses its hysteresis loop, it reaches a maximum positive flux point and then settles back to the stable set or "1" state. This "flyback" causes a voltage to be induced in winding 214 which turns on transistor 210. Now the above functions are reversed; transistor 210 is held on and transistor 194 is held off until the core switches to the "0" state, at which time the "flyback" from maximum negative flux to the "0" point causes a pulse to appear across winding 200, and this turns on transistor 194. This oscillation continues until a negative pulse is generated across winding 268 and is applied to the base of transistor 194 which is thus prevented from turning on. Output pulses are coupled from multivibrator 180 through winding 224 to core 228.

With respect to the pulse generator 57 and its first stage 184, this stage is arranged so that five pulses received from the multivibrator are sufficient to switch core 228 and to cause it to generate an output pulse, and the second stage 188 is similarly arranged to switch and generate an output pulse after it has received five pulses from stage 184. As is well known, in this type of magnetic core operation, when core 228 receives five pulses and switches states, it is also reset so that the counting operation can be repeated. Each time this core resets, it generates an output pulse which represents an incremental step in operation of core 260 of counter 188. After this core 260 has received five pulses and switches, it generates a reset pulse through transistor 266, and it also generates a cut-off pulse in winding 268 which is coupled through lead 271 to the base of transistor 194 which is prevented from turning on. This action turns off the multivibrator.

Usually, in operation of a coin counter, a mass of coins of all denominations is deposited in the reservoir, and the reservoir rotates continuously, and as it rotates, coins fall into their appropriate slots. Assuming that a 25¢ piece enters its slot, it closes first switch 20, and then switch 42 is closed. With switch 42 closed, a positive potential from power source V1 is applied to the base of switch transistor 52, and it turns on, and the potential at the base electrode of gate transistor 100 rises from the negative D.C. voltage V2 to a voltage which is slightly negative with respect to ground. Thus biased, the gate transistor 100 is ready to turn on when it later receives an input signal from winding 220 in multivibrator core 190 at its emitter electrode.

When switch transistor 52 turns on, a negative pulse is coupled through capacitor 88, diode 90, and lead 94 to the input or base of multivibrator transistor 194 which is turned on thereby. The multivibrator is now set into operation, and the magnetic core 190 is alternately set and reset. Each time the core 190 is reset, it generates an output pulse in winding 224 which is coupled to core 228 of counter stage 184. Five output pulses generated by the multivibrator enter five pulses in counter stage 184. When five pulses are entered in the counter stage 184, the core 228 of this counter stage switches and resets. Each time the core 228 resets, it generates an output pulse in winding 250 which is coupled to core 260 of the second counter stage 188. Thus, it can be seen that twenty-five reset pulses generated by the multivibrator ultimately enter five pulses in counter stage 188 which is then caused to switch and reset and generate an output pulse in winding 268 which is coupled back through lead 271 to multivibrator transistor 194 which is turned off, and the multivibrator itself is turned off. In registering the 25¢ piece, each time that the multivibrator core 190 resets, a pulse is coupled through winding 220 and gate transistor 100 and through path 116 into the cents decade counter 120. Thus, the twenty-five pulses generated are fed into the counter 120, and the counter 120 and 132 operate together to enter 25¢, which is displayed in the associated indicator tubes 174.

Assuming that the 5¢ piece enters its slot and closes switch 24 and switch 44, then switch transistor 54 is turned on, and, as described above, gate transistor 102 is primed to turn on, with input pulses appearing at its emitter electrode. Similarly, when transistor 54 turns on, a pulse is coupled through capacitor 88, diode 90, and lead 94 to turn on transistor 194 and the multivibrator 180. Again, the multivibrator will generate twenty-five output pulses in winding 224, and each time that the core 228 of counter stage 184 resets, a pulse is coupled through winding 246 and gate 102 and lead 116 into the cents counter. In this case, when the multivibrator 180 has generated twenty-five reset pulses, the counter stage 184 has generated five pulses which passed through gate transistor 102 and entered the counter 120, and the five pulses which have been entered in the second counter stage 188 cause this stage to switch and reset and turn off the multivibrator in the manner described above.

If a 50¢ piece enters its slot, it closes switches 28 and 46 and turns on switching transistor 56, gate transistor 104, and the multivibrator 180. The same action now occurs as occurs for the 5¢ piece. However, in this case, each time core 228 resets, a pulse is coupled by winding 242 through the gate transistor 104 and 130 into the 10¢ counter 132. The five pulses which are generated register fifty cents in the counter 132.

If a 1¢ piece enters its slot, it closes switches 30 and 48. Whereupon capacitor 136 discharges through resistor 134 and the differentiator 140–144 couples a negative pulse through diode 150 to the cents counter 120. Each 1¢ piece thus generates one pulse.

Similarly, a 10¢ piece closes switches 34 and 50 and causes a negative pulse to pass through diode 170 and lead 130 to the ten cent counter 132. Each 10¢ piece causes one pulse to be generated. It is clear that cascade counters of the type shown will automatically add up and display a total count of all coins which fall into the appropriate slots.

It is clear that many modifications may be made in practicing the invention. For example, the multivibrator and counter stages 184 and 188 need not be constructed with magnetic core circuits. Circuits using semiconductor devices or tubes could also be utilized. In addition, of course, transistor types may be interchanged by properly reversing bias potentials and the like, as is well known in the art.

What is claimed is:

1. A coin counter system comprising

a multi-stage pulse generator in which the first stage generates pulses and the second stage generates one pulse for a group of pulses it receives from the first stage and the third stage generates one pulse for a group of pulses it receives from said second stage, said third stage being coupled to said first stage and being adapted to turn off said first stage and thus to turn off said pulse generator after said first stage has generated a predetermined number of pulses,

a counter-register including a plurality of stages and being adapted to register count pulses representing money, and

a plurality of coin receivers each having a current flow path coupled both to said pulse generator to turn it on and to a separate gate, each gate being coupled between a point on said pulse generator and a point on said register whereby it can pass pulses from said pulse generator to said register.

2. The system defined in claim 1 and including additional coin receivers which are coupled through separate pulse generating circuits to said counter-register, each coin receiver being adapted to receive a different coin.

3. The system defined in claim 1 wherein said first stage of said pulse generator is a multivibrator which runs freely and generates pulses continually when it is turned on, and

the second and third stages thereof are electronic circuits which are adapted to provide an output pulse after five input pulses have been received.

4. The system defined in claim 1 wherein said first stage of said pulse generator is a multivibrator which runs freely and generates pulses continually when it is turned on, and the second and third stages thereof are magnetic core circuits which are adapted to provide an output pulse after five input pulses have been received.

5. The system defined in claim 1 wherein the first stage of said pulse generator is a free-running multivibrator which is normally off and each coin receiver is coupled through its current flow path to said multivibrator and is adapted to turn it on and cause it to run freely when a coin is deposited therein.

6. The system defined in claim 1 wherein said first stage of said pulse generator is a multivibrator which runs freely and generates pulses continually when it is turned on, and the second and third stages thereof are magnetic core circuits which are adapted to provide an output pulse after a group of input pulses have been received,

the output of said multivibrator being coupled through a gate to a selected portion of said counter-register, and the output of said second stage being coupled through one gate to said selected portion of said counter-register and through a second gate to another portion of said counter-register.

7. The system defined in claim 1 wherein said first stage of said pulse generator is a multivibrator which runs freely and generates pulses continually when it is turned on, and the second and third stages thereof are magnetic core circuits which are adapted to provide an output pulse after five input pulses have been received,

the output of said multivibrator being coupled through a gate to a selected portion of said counter-register, and the output of said second stage being coupled through one gate to said selected portion of said counter-register and through a second gate to another portion of said counter-register.

8. The system defined in claim 1 wherein said first stage of said pulse generator is a multivibrator which runs freely and generates pulses continually when it is turned on, and the second and third stages thereof are magnetic core circuits which are adapted to provide an output pulse after five input pulses have been received,

the output of said multivibrator being coupled through a gate to a selected portion of said counter-register, and the output of said second stage being coupled through one gate to said selected portion of said counter-register and through a second gate to another portion of said counter-register,

said system also including a first auxiliary coin receiver coupled through a pulse generating circuit to said selected portion of said counter-register, and a second auxiliary coin-receiver coupled through a pulse generating circuit to said other portion of said counter-register.

9. A coin counting system comprising

a combination pulse generator and counter of the type which includes a plurality of stages with the first stage comprising a free-running multivibrator which feeds pulses into the second stage, the second stage feeding one pulse out to the third stage for every five pulses it receives, said third stage being coupled to said multivibrator to turn it off after it has received five pulses which occurs after said multivibrator has generated twenty-five pulses.

a counter-register including a plurality of series-connected stages which register, in order, cents, dimes, dollars, tens of dollars, etc., and includes a sufficient number of stages to register the highest expected total coin count,

a coin reservoir including a separate coin receiving slot for 25¢, 5¢, 50¢, 1¢ and 10¢ pieces,

an electronic circuit path coupled to each slot,

said 25¢ slot being coupled through its circuit path to said multivibrator which it turns on and to a 25¢ gate which it primes to transmit pulses, said 25¢ gate being coupled between the output of said multivibrator and the 1¢ stage of said counter register,

said 5¢ slot being coupled through its circuit path both to the multivibrator which it is adapted to turn on and to a 5¢ gate which it primes for passing pulses, said 5¢ gate being coupled between the output of the second stage of said counter and said 1¢ stage of said register,

said 50¢ slot being coupled through its circuit path to said multivibrator which it is adapted to turn on and a 50¢ gate which it primes to pass pulses, said 50¢ gate being coupled between the output of said second stage of said counter and the 10¢ stage of said register,

said 1¢ slot being coupled directly through a pulse generating circuit to said 1¢ stage, and

said 10¢ slot being coupled directly through a pulse generating circuit to said 10¢ stage.

10. A coin counting system comprising

a pulse generator,

a cascade counter,

a plurality of gate circuits which are normally closed,

a plurality of coin receivers, each coin receiver being coupled to said pulse generator and to one of said gate circuits whereby a coin deposited in its coin receiver can turn on said pulse generator and can open its associated gate circuit,

the output of said pulse generator being coupled through said gate circuits to said cascade counter.

11. The circuit defined in claim 10 wherein each coin receiver is coupled to a different gate and each gate is connected to a different portion of said pulse generator at which different numbers of pulses appear.

12. The circuit defined in claim 10 wherein each coin receiver is coupled to a different gate and each gate is connected to a different portion of said cascade counter, each portion of said counter registering a different quantity of money with each pulse received from said pulse generator through a gate.

13. The circuit defined in claim 10 wherein each coin receiver is coupled to a different gate and one gate is connected between one portion of said pulse generator and one portion of said cascade counter, and a second gate is connected between a second portion of said pulse generator and a second portion of said counter.

14. The circuit defined in claim 10 wherein each coin receiver is coupled to a different gate and one gate is connected between one portion of said pulse generator and one portion of said cascade counter, a second gate is connected between a second portion of said pulse generator and a second portion of said counter, and a third coin receiver is coupled to said first portion of said counter.

15. The circuit defined in claim 10 wherein each coin receiver is coupled to a different gate, one gate being connected between one portion of said pulse generator and one portion of said cascade counter, a second gate being connected between a second portion of said pulse generator and a second portion of said counter, a third coin receiver being connected to said first portion of said counter, and a fourth coin receiver being connected to said second portion of said counter.

16. The circuit defined in claim 10 wherein each coin receiver is coupled to a different gate, one gate being connected between one portion of said pulse generator and one portion of said cascade counter, a second gate being connected between a second portion of said pulse generator and a second portion of said counter, a third coin receiver being connected to said first portion of said counter, and a fourth coin receiver being connected to said second portion of said counter, said third and fourth

coin receivers being coupled through separate pulse generating circuits to the cascade counter.

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SAMUEL F. COLEMAN, *Primary Examiner.*