

[54] **PRODUCT RELEASE CONTROL FOR A VENDING MACHINE**

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[56] **References Cited**

UNITED STATES PATENTS

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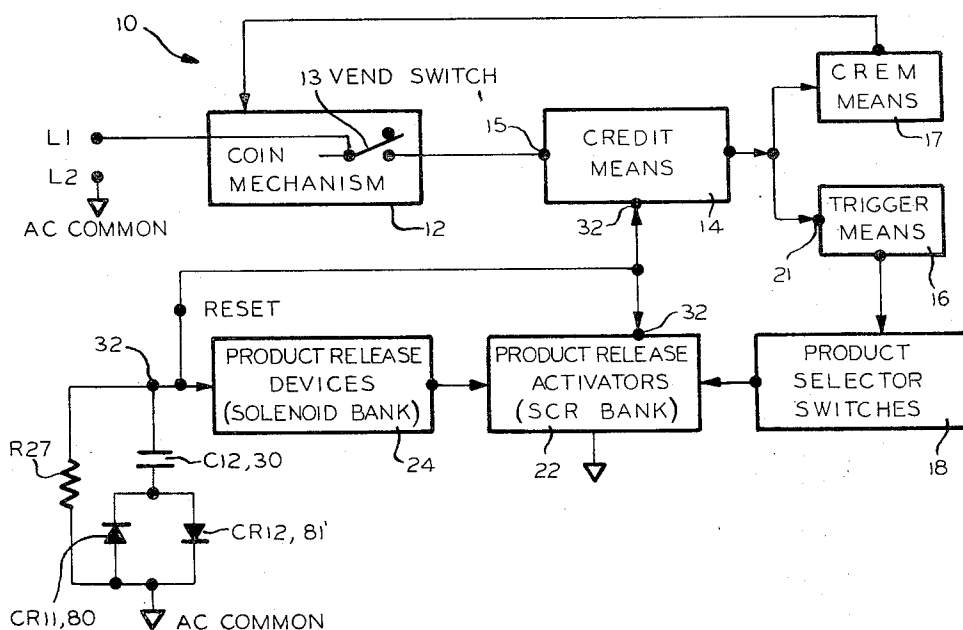
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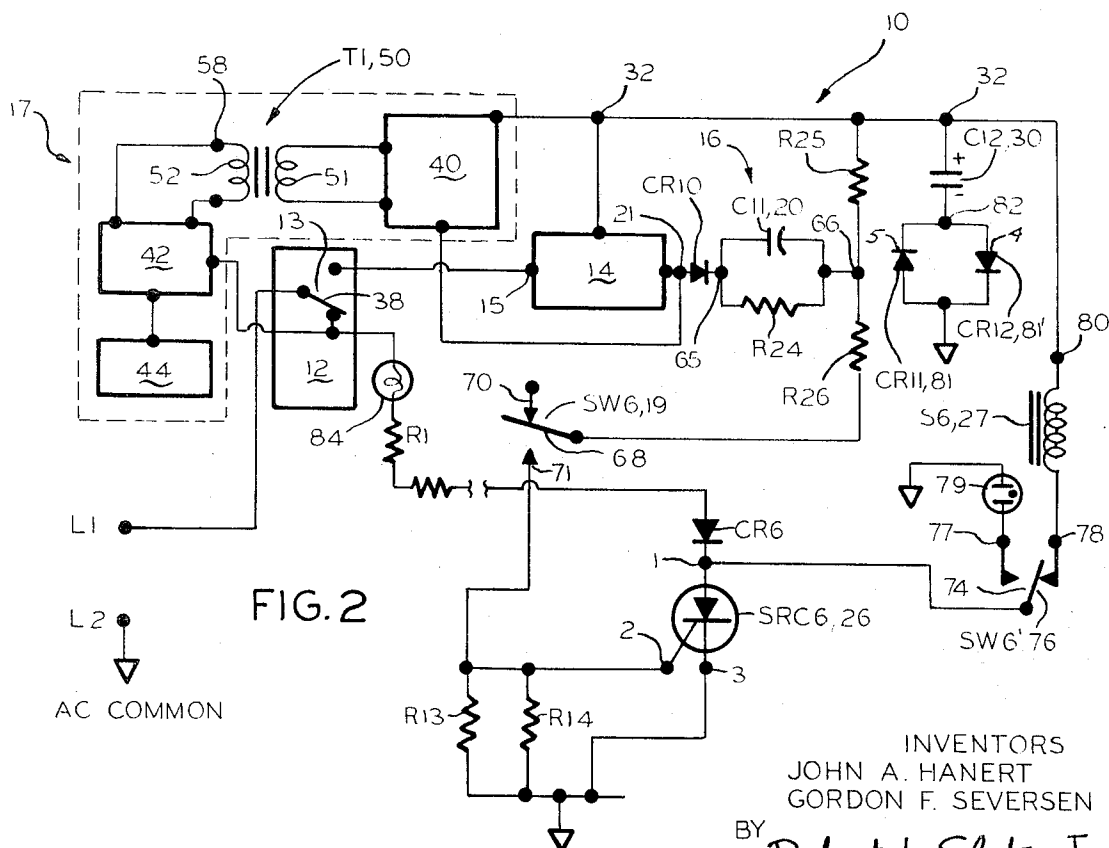
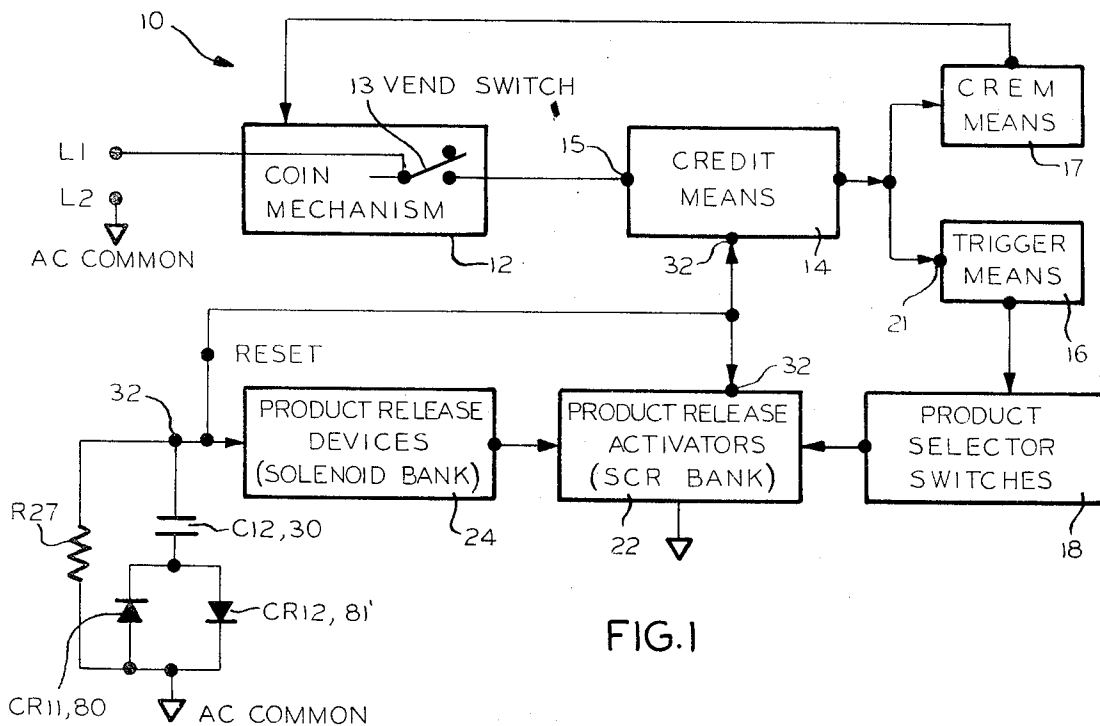
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ABSTRACT

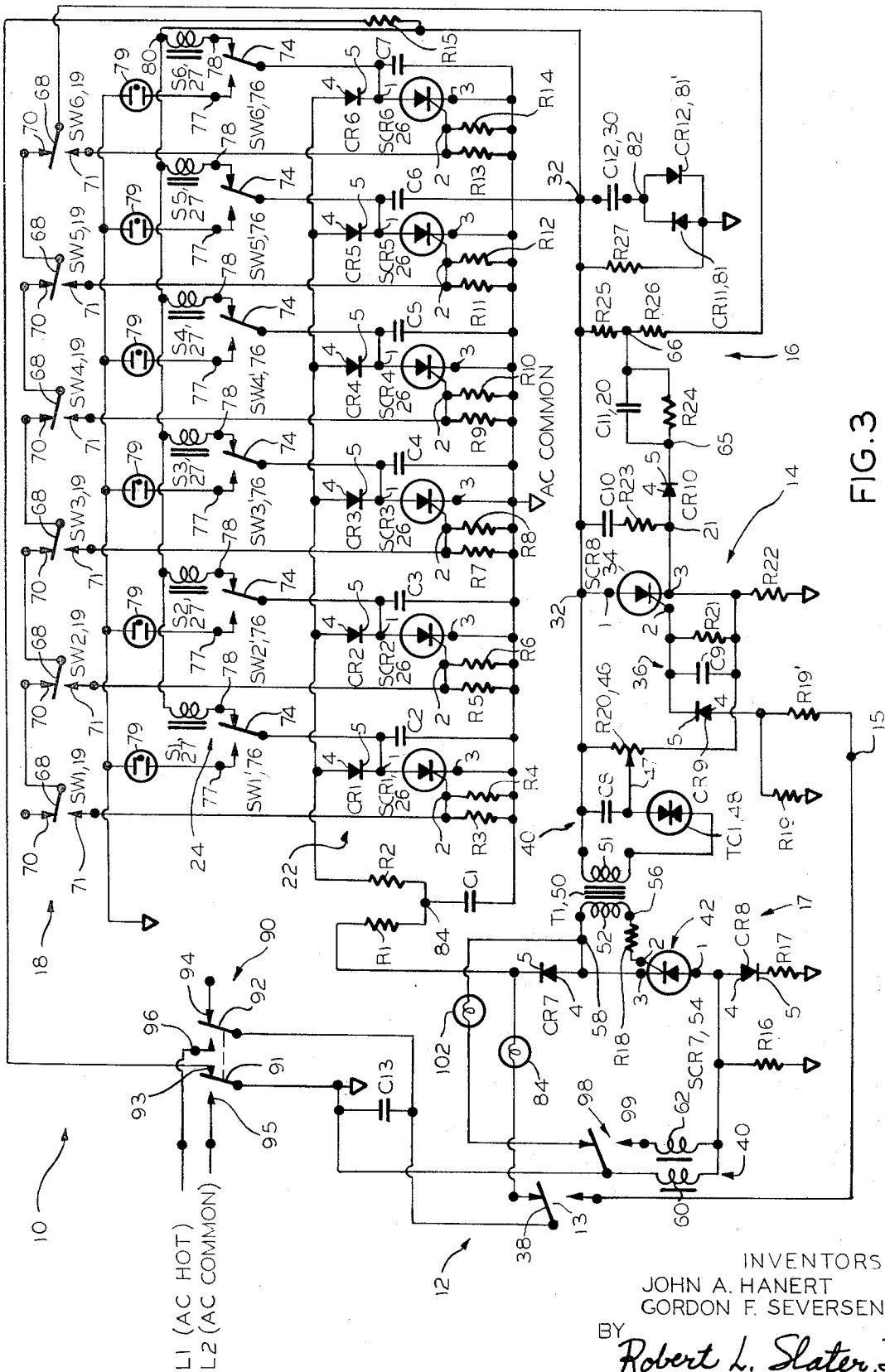
A product release control means for a coin operated vending machine comprises a trigger capacitor which is charged, after the proper coins have been accepted by the machine and a product has been selected, to apply a turn-on firing voltage across the gate of a thyristor switch. A storage capacitor is then discharged, causing the energizing of a product release solenoid for dispensing the selected product.

23 Claims, 3 Drawing Figures





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PRODUCT RELEASE CONTROL FOR A VENDING MACHINE

BACKGROUND OF THE INVENTION

The invention relates generally to a coin operated vending machine for dispensing more than one product, and more particularly relates to the control means for releasing a selected product from a coin operated vending machine; and still more particularly, the subject invention relates to a solid state control means for a vending machine.

Many of the prior solid state control systems for vending machines, comprised a low direct current (DC) power supply to power low voltage circuitry, used throughout the control system. The subject invention has eliminated such previously used low voltage circuitry, and hence does not require a conventional low voltage DC power supply.

The prior vending machine control systems also utilized many transistor type circuits to provide the desired triggering and drive signals. For example, a two-transistor bi-stable circuit was used to generate a credit signal after the proper coin(s) were accepted by the machine. However, the subject invention has replaced transistor circuits, primarily with more simplified thyristor type circuits.

SUMMARY OF THE INVENTION

The product release control for a coin operated vending machine of the subject invention comprises a trigger capacitor which becomes charged after the proper coins have been inserted into the machine and a product selection has been made, to cause a thyristor switch to close; thereby providing a path through the corresponding product release solenoid for discharging a storage capacitor. The solenoid energizes, causing a release mechanism to be activated to dispense the product.

A credit signal is produced after the proper coin(s) are accepted by the vending machine to cause a credit-thyristor to switch from an off-state to an on-state. Reset means is provided to appreciably reduce or remove anode current flow near the end of the discharge of the storage capacitor, to cause the credit-thyristor to switch back to the off-state and the thyristor switch to open.

A resistive means is associated with the trigger capacitor to provide a discharge path after the capacitor has been charged. The time constant of the trigger capacitor and the resistive means is long enough to preclude more than one charging of the capacitor during the time period that the credit-thyristor is in the on-state; thereby preventing dual vends and "jackpotting."

When coins are accepted by the machine, a coin return electro-magnetic (CREM) coil(s) is being energized through a path including a thyristor switch triggered "on" by an oscillator means. Upon receipt of the proper coins, the switching of the credit-thyristor causes the oscillator to turn "off" and sever the energizing path of the CREM coil, and thereby preventing acceptance of additional coins. After a product has been dispensed, the start-up of the oscillator is delayed until the storage capacitor has sufficiently charged to provide another vend.

BRIEF DESCRIPTION OF THE DRAWINGS

Referring to the drawings in which the same charac-

ters of reference are employed to indicate corresponding or similar parts throughout the several figures of the drawings.

FIG. 1 is the block diagram of a product control system embodying the principles of the invention;

FIG. 2 is a combination electrical schematic and block diagram of the control system and showing the circuitry for dispensing a single product; and

FIG. 3 is an electrical schematic of the product control system; and showing circuitry for dispensing six products.

BRIEF DESCRIPTION

Referring now to the several figures of the drawings, the reference numeral 10 indicates generally a product selection system for a coin operated vending machine. The selection system 10 comprises a coin mechanism 12 which switches a vend switch 13 to produce a "credit" signal upon acceptance of the proper coinage inserted into the vending machine.

The credit signal is applied to a credit means 14 at an input point 15, causing the credit means to switch from a normally off-state to an on-state. The credit means 14 is connected to a trigger means 16 and to a coin return electromagnetic (CREM) means 17. The trigger means 16 is connected to a bank of mechanical product selector switches indicated generally by the reference numeral 18 and including switches SW1 to SW6, 19, having an off-position and a product select-position. The trigger means include a trigger capacitor C11, 20.

When the credit means 14 switches to the on-state, it causes the de-activation of the CREM means 17 to prevent the machine from accepting additional coins, and also applies a go-voltage to the trigger means 16 at a point 21. At this time, system 10 is in a credit condition ready for a product selection.

A bank of product release activators indicated generally by the reference numeral 22 is provided to cause the energizing of product release devices indicated generally by the reference numeral 24. The product release activators comprise vend thyristors, such as silicon controlled rectifiers SCR1 to SCR6, 26, which function as on-off solid state static switches; and the product release devices 24 comprise product release solenoids S1 to S6, 27 (FIG. 3).

When a product is selected by switching one of the product selector switches 19, the go-voltage appearing at point 21 causes a trigger signal to be impressed across the gate of the vend SCR 26 corresponding to the activated selector switch, as the trigger capacitor C11, 20 is being charged; which fires the vend SCR "on." When the SCR is "on," a path is provided for the discharge current of a storage capacitor C12, 30 from a point 32 through the corresponding solenoid 27, for energizing the solenoid and causing the dispensing of the selected product.

After a sufficient amount of current from the storage capacitor C12, 30 has been discharged through the solenoid 27, a reduced voltage appearing at point 32 causes the credit means 14 to switch back to the off-state, and to turn "off" the vend SCR 26 corresponding to the selected product. When the credit means 14 is "off," the CREM means 17 becomes reactivated after the storage capacitor C12, 30 has been recharged; and the vending machine is now ready to accept coins for another vend.

DETAILED DESCRIPTION

Referring now more particularly to FIGS. 2 and 3, the credit means 14 includes a thyristor SCR8,34 having an anode 1 connected to the point 32; a gate 2 connected to a gate circuit 36; and a cathode 3 connected to AC common via resistor R22. A capacitor C10 in series with a resistor R23 is connected between the anode 1 and cathode 3 of the SCR8,34. The gate circuit 36 includes a resistor R21 and capacitor C9 connected in parallel between the gate 2 and cathode 3. The cathode 5 of a diode CR9 is connected to gate 2, and the anode 4 thereof is connected to resistors R19 and R19'. The opposite end of R19 is connected to AC common, and the opposite end of R19' (point 15) is connected to vend switch 13.

The vend switch 13 includes a movable arm 38 for switching the AC hot line L1 from the normal position shown in the figures to a vend-position in contact with point 15 for triggering the credit SCR8,34 into the on-state. During the charging of storage capacitor C12,30, the vend switch 13 is in the normal-position. A capacitor C13 is connected from the movable arm 38 of vend switch 13 of vend switch 13 to the AC common.

The coin return electromagnetic (CREM) means 17 includes a relaxation oscillator means 40, a static switch means 42 and coin return electromagnetic (CREM) coils indicated generally by the numeral 44. The oscillator means 40 comprises a variable resistor R20,46 having one end connected to a capacitor C8 and the anode 1 (point 32), and the opposite end to the cathode 3 of SCR8, 34. The opposite end of capacitor C8 is connected to the variable arm 47 of the resistor R20,46 and to one side of a bilateral trigger diode TC1,48 (FIG. 3).

A transformer T1,50 having a primary side 51 and a secondary side 52 couples the oscillator means 40 to the static switch means 42. Capacitor C8 and bilateral trigger diode TC1,48 are connected across the primary side 51.

The static switch means 42 includes a thyristor SCR7,54 having a gate 2 connected to end 56 of the transformer secondary 52 via resistor R18; a cathode 3 connected to end 58 of the transformer secondary 52 and anode 4 of diode CR7; and an anode 1 connected to the anode 4 of a diode CR8 and to resistor R16 and one end of a 5-10 cent coil 60 and a 20-5 cent coil 62. The opposite end of R16 is connected to AC common, and the cathode 5 of CR8 is connected to AC common via a resistor R17.

When credit-thyristor SCR8,34 conducts and is in the on-state, the direct current (DC) voltage at point 32 is substantially at point 21 to provide the go-voltage for the trigger means 16. Also, in the on-state of SCR8 the oscillator 40 of the CREM means 17 is shorted out to remove the trigger signal from the gate 2 of SCR7,54, and the SCR is unable to turn "on" in the negative portion of the AC cycle; and, therefore, the CREM coils 60,62 cannot become energized.

The trigger means 16 includes the trigger capacitor C11,20 in parallel with a resistor R24 connected between points 65 and 66. The anode 4 of a diode CR10 is connected to cathode 3 of SCR8,34 (point 21), and the cathode 5 thereof is connected to point 65. Resistors R25 and R26 include one end connected to point 66; the opposite end of R25 being connected to point 32 and the opposite end of R26 connected to switch

arm 68 of the product selector switch SW6,19. Capacitor C11,20 is charged when one of the selector switches 19 is closed, to provide a negative charging path from the AC common to point 66 via resistor R26, the closed switch 19 and the gate circuit of the corresponding vend thyristor 26.

The product selector switches SW1 to SW6,19 each includes a contact 70 corresponding to the off-position and contact 71 corresponding to the product select-position. In FIG. 3, the selector switches are shown in the off-position and the arms 68 are, therefore, connected together in series.

The thyristor circuits for vend SCR1 to SCR6,26 of the product release activators 22 are substantially identical (FIG. 3). The gate circuit for each vend SCR26 includes a pair of resistors connected between gate 2 and AC common, and identified R3 and R4 for SCR1, R5 and R6 for SCR2, R7 and R8 for SCR3, R9 and R10 for SCR4, R11 and R12 for SCR5, and R13 and R14 for SCR6. The anodes 1 of SCR1 to SCR6 are each connected respectively to capacitor C2, C3, C4, C5, C6 and C7 (the opposite end of the capacitors are connected to AC common), to cathode 5 of diodes CR1, CR2, CR3, CR4, CR5 and CR6, and to switch arm 74 of empty switches SW1' to SW6', 76.

Empty switches SW1' to SW6', 76 each includes a contact 77 corresponding to an empty position and a contact 78 corresponding to a product-position. The thyristor SCR1 to SCR6,26 will fire only if the corresponding switch arm 74 of the empty switches is in the product-position. The switch arm 74 automatically switches to the empty-position when the corresponding product has been fully dispensed. An empty lamp 79 is turned on when the switch arm 74 switches to contact 77.

The product release devices 24 comprise solenoids S1 to S6,27, each having one end 80 connected together and to the storage capacitor C12,30, and the opposite end connected to contact 78 of the corresponding empty switch SW1' to SW6', 76.

The storage capacitor C12,30 has a positive end connected to the point 32 and a negative end connected to a pair of oppositely connected diodes CR11,81 and CR12,81'. The cathode 5 of CR11 and the anode 4 of CR12 are connected to the negative end 82 of capacitor C12,30 and the opposite ends of CR11 and CR12 are connected to AC common. A resistor R27 is connected between point 32 and AC common.

The storage capacitor C12,30 is charged to a positive voltage from the AC Hot Line L1, through vend switch 13, a ballast lamp 84, resistors R1 and R2, diodes CR1 to CR6, the empty switches SW1' to SW6', 76, and the vend solenoids S1 to S6,27. A capacitor C1 is connected between the junction point of resistors R1 and R2 and AC common.

A double-pole double-throw (dpdt) power switch 90 includes an on-position and an off-position. Switch arms 91 and 92 are connected respectively to contacts 93 and 94 in the off-position and contacts 95 and 96 in the on-position. The AC line L1 (hot line) is connected to contact 96 and the AC line L2 (AC common) is connected to contact 95. A resistor R15 is connected between point 32 and the contact 93.

The coin mechanism 12 includes a coin tube switch 98 for connecting the AC common to end 99 of the CREM coil 62 or to a correct change lamp 102. When the common is connected to CREM coil 62, it becomes

energized and the machine will accept 25-cent coins and provide change. When the common is connected to lamp 102, the lamp lights indicating that the machine will only accept the correct change for the product in nickels or dimes.

CIRCUIT OPERATION

Referring now specifically to FIGS. 2 and 3, the circuit operation will be described with more particularity. When the vending machine is "on" and ready to accept coins for a vend, the mechanical switches SW1 to SW6,19 are in the off-position. The vend thyristors SCR1 to SCR6,26 are "off;" the SCR8,34 of the credit means 14 is in the off-state; the SCR7,54 of static switch means 42 is being triggered "on" by the oscillator means 40 to energize CREM coils 60 and/or 62; the storage capacitor C12,30 is charged to a positive DC voltage for energizing the solenoids S1 to S6,27; and the trigger capacitor C11,20 is discharged.

After the vending machine has accepted the proper coin(s) the vend switch 13 switches from the normal-position to the vend-position to apply the credit signal to the gate circuit 36 of SCR8,34 at point 15. Diode CR9 protects SCR8 from excessive negative gate voltage which could inadvertently turn SCR8 off by increasing its holding current requirement. The credit signal causes SCR8,34 to fire into the on-state, so that point 21 is at substantially the same voltage as point 32. At this time, the trigger capacitor C11,20 of the trigger means 16 is in a go-condition, ready to be charged, thereby providing a trigger voltage at the gate of any one of the vend SCRs 26; and the oscillator means is "off" and the CREM coils 60,62 de-energized, and the machine, therefore, will not accept additional coins.

When one of the selector switches 19 is activated, the arm 68 switches to the product select-position (contact 71) to provide a charging path for the trigger capacitor C11,20, through the gate resistors of the corresponding vend SCR 26, the selector switch 19 and resistor R26 to point 66. Thus, a positive voltage pulse with respect to the cathode of the vend SCR 26 is applied to the gate, which fires the vend SCR "on." The "on" SCR 26 provides a path for discharging the storage capacitor C12,30, through the corresponding solenoid 27, the empty switch 76, and to AC common via the "on" SCR26. The discharge current energizes the solenoid 27 and the selected product is released.

When storage capacitor C12,30 is charged, point 82 is held at approximately minus one-half volt due to the forward drop of CR11,81.

When the storage capacitor C12,30 is being discharged, current flows through the credit SCR8,34 and the selected vend SCR26. SCR8,34 turns off first due to resistor R22 which limits the current through SCR8,34 to a value below holding before the discharge of C12 has been completed. Near the end of the discharge pulse, the forward voltage drop across the selected vend SCR26, is reduced to a level too low to maintain SCR holding current and it turns off. Turn off is assured by the turn off diode CR11,81 which maintains point 82 at a negative average potential with reference to the cathodes of the credit and vend SCRs.

The trigger capacitor C11,20 discharges primarily through resistor R24, since diode CR10 presents a high resistance to the discharge current. CR10 also prevents positive voltage spikes from turning SCR8 "off." The discharge time constant of capacitor C11,20 and resis-

tor R24 is of sufficient duration so that the trigger capacitor is unable to provide a second trigger voltage for another vend SCR during the period that the credit SCR8,34 is in the on-state. This discharge time constant together with the very short duration of the vend pulse determined by capacitor C11,20 and resistor R26, afford a safeguard against dual vends and "jack potting," in the event the selector switches 19 are rapidly manipulated.

After the credit SCR8,34 and vend SCR 26 are switched "off" by the reduced voltage at their respective anodes 1 (point 32), there is a delay period prior to the start-up of the oscillator means 40, which is of greater time duration than the period required for sufficiently recharging the storage capacity C12,30 to provide another vend.

Relaxation oscillator means 40 begins operating when capacitor C8 has charged to a voltage sufficient to breakover the bilateral trigger diode TC1,48. When this occurs, a firing voltage is applied at the gate 2 of SCR7,54 to switch the SCR "on," causing the CREM coils 60 and/or 62 to become energized. The coin mechanism 12 is again ready to accept coins for another vend. The voltage divider consisting primarily of variable resistor R20,46 is adjusted to insure sufficient time for proper recharging of the storage capacitor C12,30, before the breakover voltage of the trigger diode TC1,48 is reached.

The storage capacitor C12,30 is charged through vend switch 13, the ballast lamp 84, a noise filter consisting of resistors R1 and R2 and capacitor C1, diodes CR1 to CR6, the empty switches SW1' to SW6',76, the vend solenoids S1 to S6,27 and diode CR12,81'. When all the empty switches 76 are in the empty position the charging path of the storage capacitor C12,30 is severed. Therefore, under the completely product-empty condition, no coins will be accepted by the machine, since the CREM coils will be de-energized.

The ballast lamp 84 limits the charging current to a controlled value to prevent energizing of the solenoids 27 even if all product columns are empty except one. The ballast lamp also isolates the selection system 10 from the input power line, limits any fault current to a predetermined magnitude and gives a visual indication of the fault condition; and further, it eliminates the need for fusing and flashes each time the storage capacitor C12,30 is charged to indicate normal operation.

The thyristor SCR7,54 is triggered "on" by the oscillator means 40 during the negative portion of the L1 to L2 AC voltage cycle when a negative DC voltage is impressed at the cathode 3 via diode CR7; and is switched "off" during the positive portion of the cycle when a negative DC voltage is impressed at the anode 1 via resistor R17 and diode CR8, and CREM coils 60 and 62.

The gate resistors R3 through R14 are of sufficiently small value to desensitize the vend SCR1 to SCR6,26 so that they are virtually immune to gate noise triggering. The gate resistance for each vend SCR is approximately one-half ohm.

The hot line L1 is connected into the system When the Vend switch 13 is in the normal-position. Therefore, if a defect occurs and the vend switch 13 does not return to the normal position, the machine will not accept coins since the storage capacitor C12,30 will be discharged, and hence the CREM coils will be de-energized.

Safety interlock switch 90 serves to prevent accidental shock to unauthorized personnel by breaking the input circuit to the control when an access door is opened. The stored voltage on capacitor C12,30 is rapidly discharged through resistor R15 and contact 91,93 5 when the interlock switch is released.

Capacitor C13 serves as a line filter preventing excessive line disturbance from entering the input power line.

Lamp 102 is a "correct change only" lamp operated 10 by tube switch 98. It lights when there is not sufficient change in the payout tubes, thus requiring exact change when operating the machine. At this time the circuit to the 25 cent CREM coil 62, is broken, thereby preventing insertion of quarters. 15

Diode CR7 prevents full reverse line voltage from appearing across SCR7,54 which could be detrimental to an SCR when a drive signal is being applied at its gate.

The foregoing specification and description are intended as illustrative of the invention, the scope of which is defined in the following claims.

We claim:

1. A vending machine comprising:

a credit means for producing a credit signal, after a predetermined amount of money is accepted by the machine;

an oscillator means having an on-condition for generating a turn-on voltage and an off-condition, said oscillator being associated with said credit means so that said credit signal causes the oscillator to switch from the on to the off-condition; 30

a switch member switched on by the turn-on voltage of said oscillator means, said switch member being "off" when said oscillator is in the off-condition; 35 and

means to enable said machine to receive money when said switch member is "on" and to reject money when said switch member is "off."

2. A vending machine comprising: 40

a product release means including a solenoid, the energizing of said solenoid causing said product to be released;

a vend-thyristor having an on-condition and an off-condition; 45

trigger means for switching said vend-thyristor from the off to the on-condition;

a product selector switch having an on-position and an off-position, said selector being associated with said trigger means; 50

a storage capacitor; and

an empty switch having a product-position and an empty-position, said storage capacitor charging through said empty switch when in the product position, said vend-thyristor being switched into the on condition when the selector switch is switched to the on-position to cause said storage capacitor to discharge, said empty switch switching to the empty-position when all the products in the machine have been dispensed to prevent charging of said storage capacitor. 60

3. The vending machine of claim 2, wherein said trigger means includes a trigger capacitor and said machine further includes:

credit means to provide a credit signal when a predetermined amount of money is accepted by the machine; and 65

reset means to remove said credit signal and switch said vend-thyristor to the off-condition during discharge of said storage capacitor, said trigger capacitor charging to cause said vend-thyristor to switch to the on-condition after the selector switch is switched to the on-position.

4. A vending machine for dispensing a selected product comprising:

a credit means for producing a credit signal after a predetermined amount of money is accepted by the machine;

reset means to provide a reset signal for removing said credit signal; and

trigger means for starting the dispensing of said product when said credit signal is present and after said product is selected, and for preventing the dispensing of a second said product prior to the removal of said credit signal.

5. The vending machine of claim 4, wherein said credit means includes a credit-thyristor having an on-condition and an off-condition, said credit-thyristor being on one of said conditions when providing said credit signal, said credit-thyristor being switched into the other condition by said reset signal to remove said credit signal. 25

6. The vending machine of claim 4 includes a money control means comprising:

an oscillator means having an on-condition for generating a turn-on voltage and an off-condition, said oscillator being associated with said credit means so that said credit signal causes the oscillator to switch from the on to the off-condition;

a switch member switched "on" by said oscillator turn-on voltage, said switch member being "off" when said oscillator is in the off-condition; and means to enable said machine to receive money when said switch member is "on" and to reject money when said switch member is "off."

7. The vending machine of claim 6, wherein said oscillator means further includes:

a delay means to prevent the oscillator from switching "on" until said storage capacitor has been recharged to provide another vend.

8. The vending machine of claim 6, wherein said switch member further includes:

a thyristor switch having an on-state and an off-state said oscillator generating a trigger voltage to fire said thyristor switch "on" during one part of each cycle of the input alternating current (AC) voltage to said machine; and 50

means for switching said thyristor switch "off" during another part of said AC voltage cycle.

9. The vending machine of claim 4, wherein said trigger means includes:

a trigger capacitor, said trigger capacitor electrically charging to cause said starting of said dispensing of the product, said trigger capacitor when charged preventing said dispensing of said second product. 55

10. The vending machine of claim 9, wherein said trigger means includes:

a discharge resistive means associated with the trigger capacitor for providing a discharge path for the trigger capacitor, the time constant of the discharge resistive means and the trigger capacitor being sufficiently long to prevent more than one charging of the trigger capacitor when said credit signal is present. 65

11. The vending machine of claim 9, wherein said credit signal is coupled to one side of said trigger capacitor, to cause said charging of the trigger capacitor when said product is selected.

12. The vending machine of claim 11, includes a uni-directional means to provide a low impedance path in one direction for coupling said credit signal to the trigger capacitor and a high impedance path in the opposite direction of said uni-directional means.

13. The vending machine of claim 9, wherein said trigger means includes:

a charging resistive means associated with the trigger capacitor for providing a charging path for the capacitor, the time constant of the resistive means and the trigger capacitor being sufficiently short, to prevent starting of the dispensing of more products than said first mentioned selected product when said credit signal is present.

14. The vending machine of claim 13 includes:

an actuator means having an on-state and an off-state;

a product release means, said product being dispensed by said product release means after said actuator is switched from the off to the on-state, said actuator means including a vend-thyristor having an on-condition and an off-condition, said vend-thyristor being associated with said charging resistor means of the trigger capacitor, said vend-thyristor being switched from the off to the on-condition during charging of said trigger capacitor.

15. The vending machine of claim 14, wherein said reset means is associated with said vend-thyristor for switching said vend-thyristor from the on to the off-condition simultaneously when removing said credit signal.

16. The vending machine of claim 4 includes:

a storage capacitor for discharging an electrical charge to cause said dispensing of said product after said trigger means has started said dispensing, said storage capacitor when being discharged cooperating with said reset means to cause said reset signal.

17. The vending machine of claim 16 includes:

an empty switch for preventing said storage capacitor from charging when all the products in the machine have been dispensed.

18. The vending machine of claim 16 further includes:

a ballast lamp disposed in the charging path of said storage capacitor for limiting the charging current

of the storage capacitor.

19. The vending machine of claim 16 further includes a diode to provide a low impedance charging path for said storage capacitor and a high impedance with respect to discharge of the storage capacitor.

20. The vending machine of claim 16 includes:

a product release means including a solenoid, the energizing of said solenoid causing said product to be released;

a vend-thyristor having an on-condition and an off-condition;

a product selector switch having an on-position and an off-position, said selector switch being associated with said trigger means;

a product empty switch having a product-position and an empty-position; and

a diode interposed between a voltage source and said solenoid to present a low impedance when the storage capacitor is charging and a high impedance when the storage capacitor is discharging, the charging path of said storage capacitor including said diode and said empty switch when in the product-position and said solenoid, said vend-thyristor being switched to the on-condition when the selector switch is switched into the on-position to cause said storage capacitor to discharge via said solenoid and said empty switch when in the product-position and said vend-thyristor, said solenoid being energized when said storage capacitor is discharged.

21. The vending machine of claim 16 wherein said reset means is associated with said storage capacitor to provide a reset signal when the capacitor is being discharged, said reset signal being of opposite polarity as compared with the charged voltage of the storage capacitor.

22. The vending machine of claim 21, wherein said reset means comprises a first diode and a second diode, one of said diodes providing a low impedance charge path and a high impedance discharge path for said storage capacitor, the other of said diodes providing a low impedance discharge path and a high impedance charge path for said storage capacitor, said other diode providing said opposite polarity signal near the end of the discharge of said storage capacitor.

23. The vending machine of claim 21, wherein said credit means is associated with one side of said storage capacitor and said first and second diodes are associated with the other side of the capacitor.

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