

SPECIFICATION

Vending control apparatus

- 5 This invention relates to vending machine control systems for controlling actuators used in dispensing customer selected products. In a typical vending machine the selected product is dispensed by activating an actuator, such as a motor or relay,
- 10 when various vend criteria such as product availability, customer payment, and correct change availability have been satisfied. The control system is used to identify which product has been selected, ascertain whether the vend criteria have been
- 15 satisfied, and to accordingly cause the activation of the corresponding actuator to dispense the desired product.

- According to the present invention there is provided a control apparatus for a vending
- 20 apparatus comprising a plurality of electrical actuators, each actuator being individually controllable for the dispensing of a customer's selected product, a power supply network for the actuators including a power supply, and a plurality
- 25 of selection switches in the power supply network for selective activation by a customer in selecting a desired product, the control apparatus comprising selection circuit means for connection between one side of the actuator and one of the power output
- 30 terminals of the power supply so as to be responsive to activation of a selection switch for generating a selection signal indicating the product selected, credit indicating means for producing a signal indicative of the credit to be accorded to the
- 35 customer, price indicating means for producing a signal indicative of the price of the customer's selected product, a calculating section responsive to the credit indicating means and the price indicating means for comparing the amount of customer credit
- 40 with the price of the selected product and for generating a vend signal in response to a sufficient credit for the price, and actuator control means responsive to the vend signal from the calculating section for activating the actuator corresponding to
- 45 the selected product to dispense that product, the actuator control means including a plurality of electronic power switches also for connection between the said one side of the actuators and the said power output terminal, for in each case
- 50 activating the corresponding actuator.

- In putting the invention into effect control apparatus is presented for use in a vending machine having a plurality of actuators individually controlled for the dispensing of customer selected products
- 55 and having selection switches which generate which switch signals in response to customer selection of the desired product. In the control apparatus, the selection circuit indicates to the rest of the control circuit which product category was selected; the credit indicating section produces a signal indicative of the credit to be accorded to the customer; the
- 60 price indicating section produces a signal indicative of the price of the customer selected product category; the calculating section compares the
- 65 amount of customer credit with the price of the

selected product category; and the actuator control causes the corresponding actuator to become activated and dispense the selected product.

- In systems ("non-isolated" systems) employing
- 70 no relays, optical couplers or other isolating means to isolate the control apparatus electrically from the actuators, alternating current actuators can be used with an alternating current power supply having its first output terminal connectable by each selection
- 75 switch to a corresponding actuator and its second output terminal connected to a common terminal. In such non-isolated systems, the actuator control includes an electronic power switch which activates the corresponding actuator by connecting the
- 80 actuator to the common terminal, thereby completing its connections to the power supply.

- One form of selection circuit for use in non-isolated systems contains a plurality of comparator circuits in forming a latching system.
- 85 The system generates a selection signal indicative of which product category is to be dispensed in response to the first switch signal received, and is thereafter latched against generating any subsequent signals until the machine is prepared for
- 90 another selection.

- Another selection circuit for use in either isolated or non-isolated systems contains a pulse step counter for generating a selection signal in response to the first switch signal received. A clock signal
- 95 sequentially activates the plurality of output terminals of the step counter until the output terminal corresponding to the selected product category is reached. A detector, such as an optical coupler, generates a signal indicating that the
- 100 corresponding output terminal has been activated and halting the stepping of the counter.

- This vending control apparatus can be employed in association with the exact change indicator described in our co-pending application No.
- 105 7840989, (Serial No. 2006501) filed on the same date as this application, 18th October 1978.

- For a better understanding of the invention and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawings, in which:-
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Figure 1 shows a vending machine including a control apparatus 12 generally in block diagram, with an alternating current power supply, selection switches, and electric motor;

- 115 *Figure 2* is a schematic diagram of a latching selection circuit 122 having a plurality of comparators, which can be used as the selection circuit 22 of the control apparatus of *Figure 1*;

- 120 *Figure 3* is a schematic diagram of a step counter selection circuit 222 having a pulse counter, which can be used as the selection circuit 22 of the control apparatus of *Figure 1*;

- 125 *Figure 4* is a schematic diagram of a selection circuit 322, a variation of the step counter selector circuit 222 of *Figure 3*; and

Figure 5 shows a vending machine including a control apparatus 512 which can employ one of the selection circuits 222 or 322.

Detailed description of the invention

Figure 1 illustrates a vending machine 2 having an alternating current power supply 4 in the form of a step-down line transformer, a plurality of selection switches 6 (a-n), a plurality of actuators 8 (a-n) here in the form of alternating current electric motors, a matrix box 10 and control apparatus 12 for controlling the actuators to dispense the selected product.

The control apparatus 12 has a price indicating means 14 here in the form of a pricing circuit, for producing a signal indicative of the price of the customer selected product; a calculating section 16, here in the form of a totalizer 18 and a vend processing circuit 20, for comparing the amount of customer credit with the price of the selected product; a selection circuit 22 for generating a selection signal indicating which product category was selected; actuator controls 24 (a-n) for activating the actuator 8 (a-n) corresponding to the selected product to dispense the product; and a vending monitor circuit 50 for indicating when the vending operation is taking place.

In operation, a selection switch, such as switch 6a of Figure 1, generates a switch signal in response to selection by a customer of a desired product. While a conventional pushbutton switch is illustrated in the embodiment of Figure 1, other types of switches and other switching apparatus could be used. The switch signal is carried into an optional matrix box 10 of conventional design wherein the switches 6 (a-n) and actuators 8 (a-n) for products of a common category can be connected to a common output, the outputs carried along lines 28 (a-n). For example, in the illustrated embodiment the actuators 8a and 8a' for products selling for the same price are interconnected within the matrix to a common output, with those actuators associated with a first price being connected to line 28a. Actuator 8n, associated with a second price, is connected to line 28n. Wiring the switches 6 (a-n) in series precludes a customer from deceiving the machine into vending too many products of the same category, since the pressing of one button severs the remainder of the buttons from the series circuit.

The product category switch signals along lines 28 (a-n) are carried to the actuator control circuits 24 (a-n) and to the selection circuit 22. The selection circuit 22 receives the switch signal at inputs 21 (a-n) and in response generates a selection signal at outputs 23 (a-n) along lines 30 (a-n) indicative of the category of the selected product. This selection signal is received by the pricing circuit 14 which in response produces a signal indicative of the price of the selected product along line 32 to the totalizer 18. The selection circuit 22 also generates a selection made signal along line 34 to the vend processing circuit 20, indicating that a selection has been made without indication of the nature of the selection.

In the calculating section 16, the vend processing circuit 20 receives the selection made signal from the selection circuit 22 and in response transmits a signal via line 36 to the totalizer 18. In response, the totalizer 18 operates conventionally to calculate the

customer credit as, for example, by recording the money paid into the machine or by other means of receiving a credit indication. The credit indicating means is indicated schematically at 15 in the drawings. The totalizer further compares the amount of customer credit with the price of the selected product received from the pricing circuit 14, and, if sufficient, transmits a signal via line 36 to the vend processing circuit 20. In response, the vend processing circuit 20 transmits a vend signal along line 38 to the actuator circuits 24 (a-n).

In the Figure 1 embodiment, the actuator controls 24 (a-n) each comprise an electronic power switch 40 (a-n) and a NAND gate 42 (a-n). The combination of the vend signal on line 38 from the calculating section 16 and the selection signal on one of the lines 30 (a-n) from the selection circuit 22 switches the corresponding NAND gate 42 (a-n) and activates the corresponding power switch 40 (a-n). For example, a selection signal on line 30a from output 23a of the selection circuit 22 and a vend signal on line 38 would switch NAND gate 42a, causing the activation of the power switch 40a, activating one of the corresponding actuators 8 (a-n) as explained below.

In the illustrated system, the actuators 8 (a-n) are not electrically isolated from the control system 12, and all these elements are powered by the alternating current power supply illustrated as a step down line transformer 4. First output terminal 48 of the transformer output is connected to a common terminal 5, such as to a ground. Similarly, the electronic power switches 40 (a-n) are connected on one side to the common terminal 5 by lines 49 (a-n). Second output terminal 44 of the transformer output is connected by switches 6 (a-n) and, as explained below, by switches 46 (a-n) to the actuators 8 (a-n). When a power switch, such as 40a, is activated by the switching of its NAND gate, 42a in this example, the corresponding actuator 8a is thereby connected to the common terminal through lines 28a and 49a and the interconnections in the matrix box 10. Assuming that actuator 8a' corresponds through the matrix box to power switch 40a, the activation of power switch 40a in the above example would activate actuator 8a' by completing the electrical connection through the matrix box 10, the actuator 8a', and switch 6a' to output terminal 44 of the power supply. Once the actuator is activated, the corresponding switch 46 (a-n) is mechanically activated by a cam or other conventional means to maintain the electrical connection between the actuator and terminal 44 even after the selected switch among switches 6 (a-n) is released by the customer and returns to its normal position. For example, once actuator 8a' is activated as a result of the customer pressing switch 6a', switch 46a' is activated by the actuator and the actuator 8a' continues to be powered even though the customer thereafter releases switch 6a'.

During the period when the actuator is operating, the vending monitor circuit 50 conventionally by means of relay 51 produces a vending-in-progress signal along line 52 to the vend processing circuit 20 in the calculating section 16. In response, the vend

(17)

processing circuit 20 instructs the totalizer 18 along line 54 to collect the price of the product being vended and to return any appropriate change. The continuation of the vending-in-progress and

5 selection made signals causes the vend processing circuit 20 to continue to generate the vend signal on line 38 until the product has been completely vended. When the vending is completed, the vending-in-progress signal is terminated, the vend
10 signal along line 38 is terminated, and the activated power switch 40 (a-n) is deactivated. Also, while the power switch 40 (a-n) was activated, the corresponding line of lines 28 (a-n) had been connected to ground, maintaining a ground input
15 into the corresponding terminal 21 (a-n) of the selection circuit 22, thereby maintaining the selection and selection made outputs from the selection circuit 22. When the activated power switch is deactivated at the end of vending, the signal is
20 removed from the corresponding line of lines 28 (a-n), thereby causing the selection circuit 22 to terminate the selection and selection made outputs and preparing the control apparatus 12 to process a new selection.

25 Several possible circuits can perform the selection circuit 22 function of receiving the switch signals and in response generating a selection signal indicating which product category was selected and a selection made signal indicating that a selection has been
30 made. Three preferred embodiments are illustrated in Figures 2, 3 and 4.

In Figure 2, a selection circuit 122 has selection circuit inputs 121 (a-n) corresponding to inputs 21 (a-n), selection signal outputs 123 (a-n)
35 corresponding to outputs 23 (a-n) and selection made output line 134 corresponding to output line 34. The circuit 122 comprises a plurality of comparator circuits 124 (a-n), each comparator circuit having a first, positive input 126, a second,
40 negative input 128 and an output 130.

Before a selection is made by the customer, inputs 121 (a-n) are all open circuited. In this condition the bias current at the negative inputs 128 (a-n) of the comparators resulting from the 1.5 megohm
45 resistors to ground dominates and the comparators 124 (a-n) each produce a low signal at their outputs 130 (a-n), in this embodiment a -12 volts D.C. output.

When a switch 6 (a-n) is activated by a customer in
50 selecting a product, the resultant product category switch signal at the corresponding selection circuit input 121 (a-n) grounds that input and causes the corresponding comparator to generate a selection signal by altering its output from a first level of
55 output, to a second level of output. In the embodiment illustrated, the output at corresponding terminal 130 (a-n) goes from the initial low of -12 volts D.C. to a high ground, which is the same as the ground of the vending section 3. Specifically, when a
60 switch signal at input 121a, for example, drives that input to ground, the two 470 kilohm resistors and the one μ fd capacitor form a filter which blocks alternating current from reaching the comparator 124a. Since the 940 kilohm total resistance to ground
65 on the positive input 126a of the comparator is less

than the 1.5 megohm resistance to ground on its other input 128a, the bias current on the positive input 126a of that comparator dominates and the signal at the output 130a switches to a high signal of
70 ground potential. This output over line 123a constitutes a selection signal for the remainder of the control apparatus 12 and also adds additional bias via the 1 megohm resistors to both the positive input 126a and the negative input 128a of the
75 comparator 124a. This output over line 134 constitutes a selection made signal.

This change in the output of the first comparator to receive a switch signal inhibits the other comparator circuits from generating any further selection signals
80 since the outputs 130 (a-n) of the comparator circuits are interconnected with their second inputs 128 (a-n). Specifically, in the above example the high signal at output 130a is transmitted to all second inputs 128 (b-n) of the other comparators via
85 line 132, resulting in additional bias at those inputs. The first inputs 126 (b-n) of the other comparators are blocked from receiving the additional bias by blocking diodes 136 (a-n). Overall, the additional bias on the negative inputs 128 (b-n) of the
90 remaining comparators provided via line 132 blocks them from operation in the event that a subsequent switch signal is received on any of their corresponding inputs 121 (b-n) because the bias provided by connecting a 1 megohm and a 1.5
95 megohm resistor to ground will dominate over the 940 kilohm bias which would be provided if an additional switch 6 (b-n) were activated after an initial selection had been made.

In Figure 3, a selection circuit 222 has selection circuit inputs 221 (a-n) corresponding to inputs 21 (a-n) selection circuit outputs 223 (a-n)
100 corresponding to outputs 23 (a-n) and a selection made output line 234 corresponding to output line 34. The circuit 222 comprises a step counter 224 here in the form of a pulse counter with a plurality of
105 output terminals 226 (a-n) sequentially activated in response to a clock signal input at clock terminal 228. The pulse counter 224 of the illustrated embodiment is of the type 4017 10 stage CMOS counter as made by RCA, Motorola and others.

Each selection circuit input 221 (a-n) has a corresponding optical coupler 229 (a-n) of a light emitting diode (LED) emitter 230 (a-n) and a photo transistor detector 232 (a-n). When a selection
115 switch 6 (a-n) is activated by a customer, the resultant product category switch signal at the corresponding input 221 (a-n) connects that input to one side of the alternating current supply and causes alternating current from wire 235 to flow through an
120 LED portion of a clock optical coupler 236 and through the LED portion 230 (a-n) of the corresponding selection optical coupler, causing both of these LED's to flash at the frequency of the alternating current. The detector portion of the clock
125 optical coupler 236 responds by periodically switching on its transistor portion which functions as a clock pulse source for the counter 224, with the clock pulses at input 228 driving the counter 224 up one number for each cycle of the alternating current.

130 When the counter 224 counts, it connects its

outputs 226 (a-n) to the one side of the alternating current supply in sequence from their normally low, negative voltage state. When the counter 224 reaches its output corresponding to the coupler 229 5 (a-n) whose LED portion 230 (a-n) is being activated by the presence of a switch signal, a pulse is produced on line 238. This pulse is stretched to approximately 0.1 second in duration by the RC circuit of a 1 megohm series resistor and a 0.1 ufd 10 capacitor to a -12 volt source.

This 0.1 second stretched pulse on line 238 is applied to the positive input of a selection made comparator 240 which causes a high signal to appear at the comparator output as the selection 15 made signal on line 234. Specifically, since the 1 megohm resistor in the positive input of the comparator 240 is smaller than the 1.5 megohm resistor from its negative input to ground, the bias on the positive input dominates and the output goes 20 high. A 2 megohm feedback resistor is provided around the comparator to reduce sensitivity to electrical noise.

The selection made signal on line 234 is also carried on line 242 to enable input 244 of the counter, 25 causing it to stop counting and held at the count corresponding to the selection made. Accordingly, the selection signal at the held terminal 226 (a-n) appears as a high signal on the corresponding line 223 (a-n).

30 The selection circuit 222 will generate the selection made signal on line 234 and selection signal on one of lines 223 (a-n) so long as one of lines 221 (a-n) remains connected to one side of the alternating current supply. This happens when either a selection 35 switch 6 (a-n) remains activated or an actuator activated switch 26 (a-n) remains activated during the dispensing of the product. When no line 221 (a-n) is connected to one side of the alternating current supply, the selection made and selection 40 signals are terminated and the counter 224 is reset by an input at reset terminal 246 through the operation of reset coupler 248.

Figure 4 shows a selection circuit 322 which is a variation of the selection circuit 222 of Figure 3.

45 Elements in the circuit of Figure 4 which correspond to those in Figure 3 are similarly numbered except for the substitutions of the prefix "3" for the prefix "2". Since the selection circuit 222 has already been described, only the principal differences between circuit 222 and circuit 322 will be discussed here, as 50 the remainder will be clear from the drawings.

In circuit 322, AND gates 399a-399n have been added between counter outputs 326a-326n and wires 323a-323n to provide a stronger output signal 55 on wires 323a-323n and improve the signal to noise ratio.

The 120 kilohm resistor and 2.2 ufd capacitor connected in parallel from one input of each of the AND gates 399a-399n form peak detectors which 60 provide a direct current signal to an AND gate input terminal when the corresponding vending machine selection switch 6a-6n is closed. When an output is provided from the counter 322 to the other input of the same AND gate, that AND gate produces an 65 output signal.

The functions of the optical couplers 329a-329n and 336 in the circuit 322 is analogous to that of the optical couplers 229a-229n and 236 in circuit 222.

The output of each of the AND gates 399a-399n is 70 connected to one diode of a set of diodes Da-Dn, which together with the associated 10K resistor to -12 volts form an OR gate. The output of this OR gate is connected by wire 342 to the enable input 344 of the counter 324, and to the negative input of the 75 selection made comparator 340 in a filter comprising a 0.1 ufd capacitor and a 470 kilohm resistor. The connection between the 0.1 ufd capacitor and the 470 kilohm resistor to -12 volts includes a diode Ds to protect the comparator 340. The diode De at the 80 output of the comparator 340 is a blocking diode used to keep the comparator 340 from loading other signals within the calculating section 16.

Additional power and fast rise time clock pulses are provided in the clock section by the addition of 85 an amplifier comprising comparator 349 operating as a buffer amplifier, and a transistor Q (such as a type 2N4424) following the clock optical coupler 336. The clock input 328 of the counter 324 is isolated from the reset input 346 by blocking diode Dr. The 1 90 megohm resistor and .47 ufd capacitor in parallel from the reset input 346 to ground act to stretch the clock pulse as applied to the reset terminal 344, and serves to prevent accidental activation by noise or activation of numerous selection switches.

95 Figure 5 shows a vending machine 502 similar to the vending machine 2 shown in Figure 1. The vending section 503, unlike the vending section 4 of vending machine 3, operates directly from the alternating current line without the isolation and reduction of voltage afforded by transformer 4. The 100 control apparatus 512 is therefore protected from the high voltage in the vending section 503 by the isolation provided in the selection circuit 522 and in the actuator control circuits 524a-524n. The selection circuit 522 can be the same as selection circuit 222 or 105 322, as described above. The remaining elements of the control apparatus 512 can be substantially the same as the corresponding element of the control apparatus 12 of Figure 1, applying electrical isolation in the known manner when connections are made 110 between the vending section 523 and the control apparatus 512.

The actuator control circuits 524a-524n employ optical couplers 543a-543n to isolate the NAND 115 gates 542a-542n, corresponding to NAND gates 42a-42n, from the switching devices 540a-540n. When one of the NAND gates 542a-542n produces a signal, it drives the corresponding optical coupler 543a-543n which in turn drives the corresponding transistor 544a-544n which triggers the 120 corresponding switching device 540a-540n.

With reference to certain aspects of the Figures 1 and 2 and Figures 1, 3 and 4 embodiments, attention is directed to our co-pending applications 8100753 and 8100754.

125 With reference to certain aspects of the Figures 1 and 2 and Figures 1, 3 and 4 embodiments, attention is directed to our co-pending applications 8100753 and 8100754 (Patent Nos. _____ and _____).



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CLAIMS

1. A control apparatus for vending apparatus comprising a plurality of electrical actuators, each
5 actuator being individually controllable for the dispensing of a customer's selected product, a power supply network for the actuators including a power supply, and a plurality of selection switches in the power supply network for selective activation by
10 a customer in selecting a desired product, the control apparatus comprising selection circuit means for connection between one side of the actuator and one of the power output terminals of the power supply so as to be responsive to activation
15 of a selection switch for generating a selection signal indicating the product selection, credit indicating means for producing a signal indicative of the credit to be accorded to the customer, price indicating means for producing a signal indicative of the price
20 of the customer's selected product, a calculating section responsive to the credit indicating means and the price indicating means for comparing the amount of customer credit with the price of the selected product and for generating a vend signal in
25 response to a sufficient credit for the price, and actuator control means responsive to the vend signal from the calculating section for activating the actuator corresponding to the selected product to dispense that product, the actuator control means
30 including a plurality of electronic power switches also for connection between the said one side of the actuators and the said power output terminal, for in each case activating the corresponding actuator.

2. A vending apparatus comprising a plurality of
35 electrical actuators, each actuator being individually controllable for the dispensing of a customer's selected product, a power supply network for the actuator including a power supply, and a plurality of selection switches in the power supply network for
40 selective activation by a customer in selecting a desired product, the vending apparatus having control apparatus comprising selection circuit means connected between one side of the actuators and one of the power output terminals of the power
45 supply so as to be responsive to activation of a selection switch for generating a selection signal indicating the product selected, credit indicating means for producing a signal indicative of the credit to be accorded to the customer, price indicating
50 means for producing a signal indicative of the price of the customer's selected product, a calculating section responsive to the credit indicating means and the price indicating means for comparing the amount of customer credit with the price of the
55 selected product and for generating a vend signal in response to a sufficient credit for the price and actuator control means responsive to the vend signal from the calculating section for activating the actuator corresponding to the selected product to
60 dispense that product, the actuator control means including a plurality of electronic power switches also connected between the said one side of the actuators and the said power output terminal, for in each case activating the corresponding actuator.

3. Apparatus according to claim 1 or claim 2, in

which the selection circuit means comprises a plurality of comparator circuits, each comparator circuit including a first input and a second input and an output, with each comparator circuit responsive
70 at its first input to a switch signal indicating activation of a selection switch and causing the comparator circuit to generate a selection signal by altering its output from a first level of output to a second level of output, and the output of each
75 comparator circuit being inter-connected with the second inputs of the remaining comparator circuits so as to inhibit those comparator circuits from generating any further selection signals when that output is at the second level.

4. Apparatus according to claim 1 or 2, wherein the selection circuit means comprises a pulse counter with a plurality of output terminals each
80 corresponding with a selection switch of the vending apparatus, the output terminals being arranged to be sequentially activated in response to the pulses of a clock signal, and the selection circuit means further comprising a detecting means associated with the
85 pulse counter output terminals for detecting simultaneous activation of one of the pulse counter output terminals and its corresponding selection switch so as to cause a selection signal to be
90 produced in respect of that output terminal and so as also to halt the pulse counter and thereby maintain the activation of that one output terminal.

5. Apparatus according to claim 4, wherein the detecting means associated with the pulse counter comprises a plurality of optical couplers, with each pulse counter output terminal having an associated
95 optical coupler with an optical emitter responsive to actuation of a selection switch of the vending apparatus and a detector responsive to activation of the emitter and to the activation of the associated output terminal to generate a selection-made signal for halting the pulse counter.

6. Apparatus according to any preceding claim wherein the vending apparatus actuators and the power supply network are alternating current
100 operated with the said one power output terminal connected to a common terminal, and the selection circuit means is energized by a direct current power source having one of its output terminals serving for connecting the selection circuit means to the said one power output terminal of the power supply through said common terminal.

7. Apparatus according to claim 8 wherein the vending apparatus alternating current power supply comprises a power transformer having at least one output winding one of whose ends constitutes the
115 said one power output terminal of the power supply.

8. Apparatus according to claim 6 or 7 in which the alternating current power supply for the actuators has a second output terminal selectively connectable to each actuator by the selection switches.

9. A control apparatus substantially as hereinbefore described with reference to the accompanying drawings.

10. A vending apparatus substantially as hereinbefore described with reference to the accompanying drawings.

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