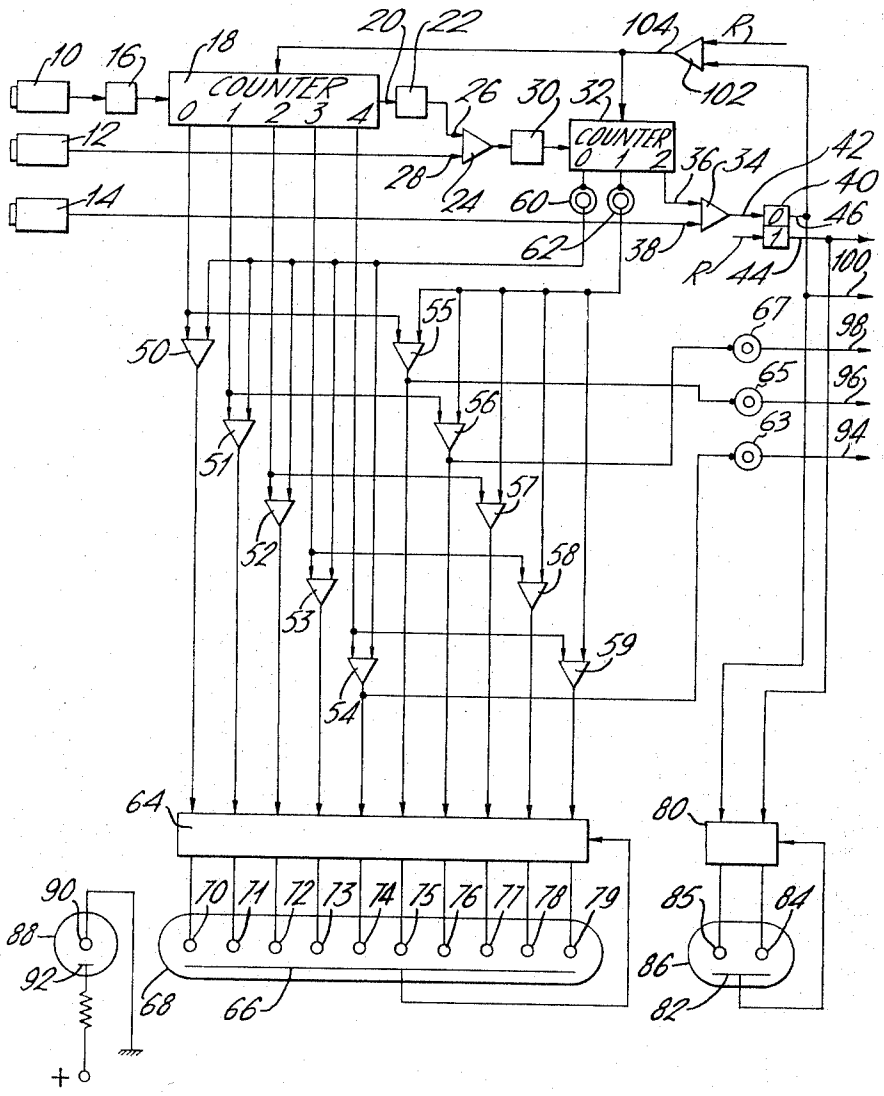
June 6, 1967 AKIRA ABE ETAL 3,323,626

VENDING MACHINE CONTROL SYSTEM

Filed Aug. 9, 1965 2 Sheets-Sheet 1

Fig. 1.



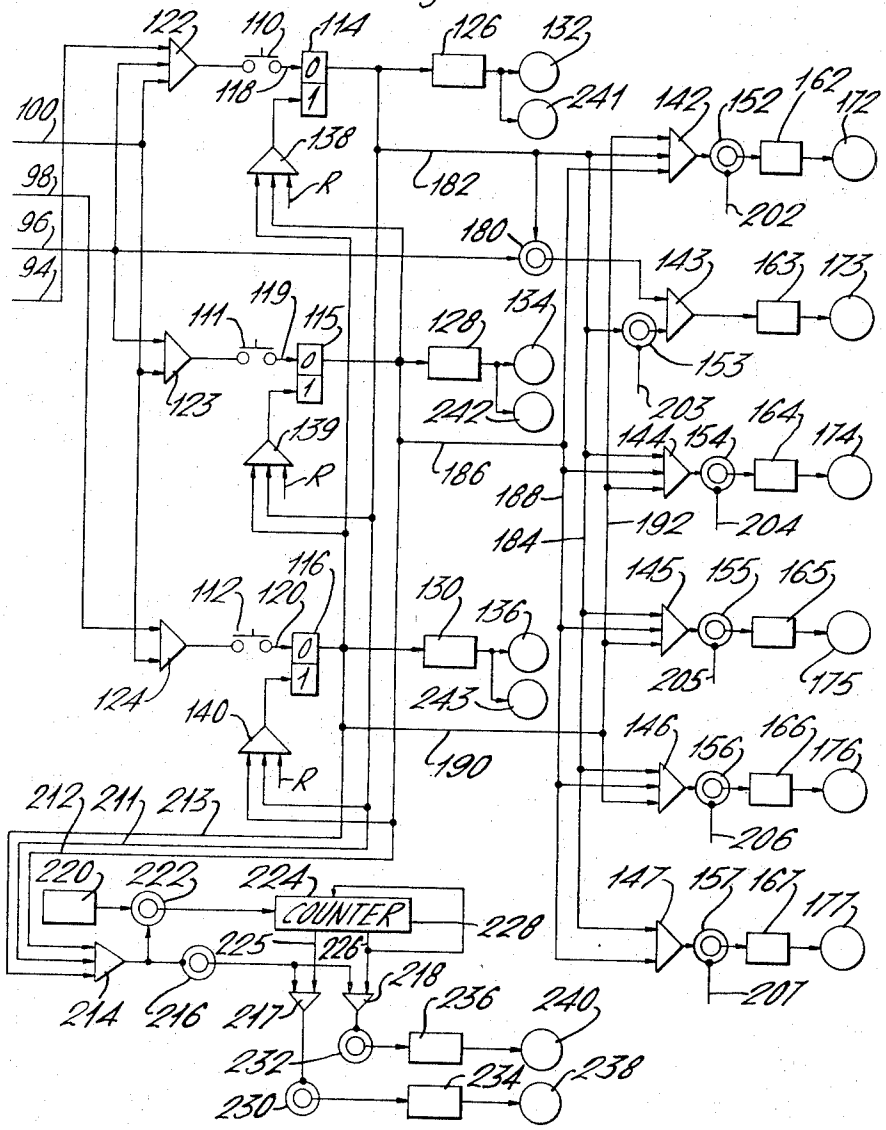
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Fig. 2.



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VENDING MACHINE CONTROL SYSTEM

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7 Claims. (Cl. 194—10)

This invention relates generally to the control art and more particularly to a control system for vending machines actuated by coins, which is capable of counting the value of coins introduced in a vending machine and dispensing an article, together with change, if necessary.

In most of the prior art vending machine control systems of the electrical type, relays and switches having mechanical contacts have been generally employed. Such mechanical constructions with mechanical contacts obviously are inferior to contactless constructions with respect to longevity and accurate operation.

The primary object of the invention is therefore to provide an improved vending machine control system which comprises electrical static components.

Another object of the invention is to provide an improved vending machine control system which counts coins introduced in a vending machine and operates an article dispensing means to dispense an article when the total denomination of the introduced coins amounts to the price of the article to be dispensed.

Another object of the invention is to provide an improved vending machine control system which is capable of automatically returning change to the purchaser when the total denomination of the coins he introduced exceeds the price of the article he selected.

Another object of the invention is to provide an improved vending machine control system which is capable of indicating the total denomination of the introduced coins.

Still another object of the invention is to provide an improved vending machine control system having means for operating an electrical register for recording the price of the article dispensed at each sale and at the same time the aggregate sum of the prices of all the sales that have been made.

Other objects, features and advantages of the invention will be apparent from the following description of a preferred embodiment thereof with reference to the accompanying drawings, wherein FIGS. 1 and 2 show a schematic circuit diagram of different portions of one embodiment of the invention, with FIG. 1 being located at the left-hand side of FIG. 2 to complete the whole circuit.

It is assumed in the illustrated embodiment of the invention that three different kinds of articles priced at 40, 50 and 60 cents are sold, and that 10-cent, 50-cent and one-dollar coins are acceptable.

Referring to FIG. 1 there are shown three proximity detectors **10**, **11** and **12** provided in a vending machine for sensing coins of the three different denominations, respectively. When the proximity detector **10** senses a 10-cent coin, it produces a signal which is applied to a Schmitt circuit **16** when the signal has its wave form rendered of a rectangular shape and then applied to a

pulse counter **18** as a pulse signal. The counter **18** is composed of transistors and other statis logic elements and provided with output terminals **0**, **1**, **2**, **3**, **4** and **20**. When there is no input pulse signal applied to the counter, an output appears at the terminals **1**, **2**, **3** and **4**, but not at the terminal **0** (and **20**). When a first input pulse is applied to the counter, an output appears at the terminal **0** and the output at the terminal **1** disappears with the outputs at the terminals **2**, **3** and **3** continuing. Thus, every time one pulse is applied to the counter **18**, the output terminal where there is no output is shifted from the terminal **0** to **1**, **2**, **3** and **4**. When five pulses have been counted, an output appears at the terminal **20** and is applied through a Schmitt circuit **22** to one input terminal **26** of an OR element **24**.

When the proximity detector **12** senses a 50-cent coin, it produces a signal, which is applied to the other input terminal **28** of the OR element **24**. The output signal of the OR element **24** has its wave form rendered of a rectangular shape by a Schmitt circuit **30** and then is applied to a counter **32** provided with three output terminals **0**, **1** and **2**. The counter **32** is such that when there is no input pulse applied to the counter **32**, an output appears at the terminal **0** but no output exists at the other terminals **1** and **2**. When a first input pulse is applied to the counter **32**, the output at the terminal **0** disappears and instead an output appears at the terminal **1**, with no output appearing at the third terminal **2**. When one more pulse is applied to the counter **32**, the output at the terminal **1** disappears with no output existing at the terminal **0** and an output appears at the terminal **2**. The output at the terminal **2** of the counter **32** is applied to one input terminal **36** of an OR element **34**.

When the proximity detector **14** detects a one-dollar coin, it produces an output, which is applied to the other input terminal **38** of the OR element **34**. The output of the OR element **34** is applied to the set input terminal **42** of a MEMORY element **40** such as a "flip-flop." In the drawings, this and other MEMORY elements are shown having two sections labeled with the numerals "0" and "1." Normally, the "1" section produces an output, with no output being produced by the "0" section, but when a set signal is applied to the set terminal connected to the "0" section, the output from the "1" section is discontinued and an output is produced by the "0" section. Under the condition, when a reset signal is applied to the reset input terminal connected to the "1" section, the MEMORY element is restored to the original normal condition. It will be seen that the output at the terminal **44** of the "1" section continues until a set signal is applied to the set terminal **42** of the "0" section, whereupon an output appears at the terminal **46** of the "0" section.

The output terminals **0** through **4** of the counter **18** are connected to one input terminal of OR elements **50** through **54**, respectively. The output terminal **0** of the counter **32** is connected through a NOT element **60** to the other input terminals of the OR elements **50** through **54**. The output terminals **0** through **4** of the counter **18** are also connected to one input terminal of OR elements **55** through **59**, respectively, to the other input terminals of which is connected the output terminal **1** of the counter **32** through a NOT element **62**.

The output terminals of the OR elements **50** through **59** are connected, respectively, to the ten input terminals of an amplifier **64**, which has ten output terminals corre-

sponding to the input terminals. The amplifier is so designed that an output appears at that output terminal the input terminal corresponding to which receives no input signal.

A digital indicator tube **68** is provided with one anode **66** and ten cathodes **70** through **79**, to which are connected the ten output terminals of the amplifier **64**, respectively. These cathodes are formed into the ten numerals 0 through 9, respectively. As will be described later, when there is no coin introduced in the vending machine, a discharge is taking place between the anode **66** and the cathode **70** only so that the tube expresses the numeral 0.

The output terminals **44** and **46** of the MEMORY element **40** are connected respectively, to the two input terminals of an amplifier **80**, which has two output terminals corresponding to the two input terminals. This implifier is of such a construction similar to the amplifier **64** that an output appears at that output terminal the input terminal corresponding to which receives no input signal. Another digital indicator tube **86** is provided with one anode **82** and two cathodes **84** and **85**, to which are connected the two output terminals of the amplifier **89**, respectively. The cathode **85** is formed into the shape of the numeral 0, while the other cathode **84**, into the shape of the numeral 1.

A third digital indicator tube **88** is provided with a single anode **92** and a single cathode **90**, which latter is formed into the shape of the numeral 0. This tube is so designed that discharge is always taking place between the two electrodes, thereby expressing the numeral 0 at all times.

The three indicator tubes **86**, **68** and **88** may be arranged from left to right in the order given here on the front panel of the vending machine, with the word "cents" being given at the right-hand side of the tube **88**, so that the numerals appearing on the tubes may indicate in cents the donomination of a coin or the total denomination of coins introduced into the vending machine, as will be described later.

Lines **94**, **96** and **98** are connected through NOT elements **63**, **65** and **67** to the output terminals of the OR elements **54**, **55**, **56**, respectively, and a line **100** is connected directly to the output terminal **46** of the "0" section of the MEMORY element **40**. It will be easily seen that a signal appears on these lines **94**, **96**, **98** and **100** when a coin or coins introduced into the machine amount to **40**, **50**, 60 cents and one dollar, respectively.

The output of the "0" section of the MEMORY element **40** is also applied to one of the input terminals of an OR element **102**, whose output is applied through a line **104** to the counters **18** and **32** to reset them with a little time delay by any suitable means.

Referring to FIG. 2, there are show push button switches **110**, **111**, and **112** corresponding to 40-cent, 50-cent and 60-cent articles, respectively. These push buttons may be provided on the front panel of a vending machine, and are inserted between the set input terminals of MEMORY elements **114**, **115** and **116** and the output terminals of OR elements **122**, **123** and **124**, respectively. The line **94** is connected to one input terminal of the OR element **122**; the line **96**, to one input terminal of each of the OR elements **122** and **123**; the line **98**, to one input terminal of the OR element **124**; and the line **100**, to one input terminal of each of the OR elements **122**, **123** and **124**. These connections are made for the purpose of giving a "dispense permission" signal to the article dispensing means.

The outputs of the "0" sections of the MEMORY elements **114**, **115** and **116** are amplified by amplifiers **126**, **128** and **130** and then energize solenoids **132**, **134** and **136**, respectively. These solenoids are utilized to dispense 40-cent, 50-cent and 60-cent articles, respectively. To the reset terminals of the MEMORY **114**, **115** and **116** are applied the output signals of OR elements **138**, **139** and **140**,

respectively. The outputs of the "0" sections of the MEMORY elements **115** and **116** are also applied to the OR element **138**, the outputs of the "0" sections of the MEMORY elements **114** and **116**, to the OR element **139**; and the outputs of the "0" section of the MEMORY elements **114** and **115**, to the OR element **140**. These connections are made for the purpose of insuring that once one of the push buttons **110**, **111** and **112** has been pressed, pressing of another of the push buttons will not result in dispensing of an article corresponding to that other push button. Suppose that the push button switch **110** has first been pressed. The output signal of the MEMORY element **114** is applied through the OR elements **139** and **140** to the reset terminals of the other MEMORY elements **115** and **116** to maintain these elements at the reset condition. Under this condition, if either of the push button switches **111** and **112** is pressed, no output will be produced by its "0" section, so that the solenoids **134** or **136** will not be energized.

It is necessary to deliver change when the coin or coins introduced exceed the price of the article to be dispensed. Such change delivery means is shown in FIG. 2 comprising OR elements **142** through **147**, INHIBIT elements **152** through **157**, amplifiers **162** through **167**, solenoids **172** through **177** and an AND element **180**. The output signal of the MEMORY element **114** is applied through lines **182** and **184** to one input terminal of each of the OR elements **142**, **144** through **147**; the output signal of the MEMORY element **115**, through lines **186** and **188** to a second input terminal of each of the OR elements **142**, **144** through **147**; and the output signal of the MEMORY element **116**, through lines **190** and **192** to a third terminal of each of the OR elements **142**, **144** through **146**. The AND element **180** has its two inputs connected to the line **96** and the output of the MEMORY element **114**, and has its output connected to one input terminal of the OR element **143**, to the other input terminal of which is applied the output of the INHIBIT element **153**, to the input terminal of which is applied a signal on the line **184**. The INHIBIT elements **152**, **154** through **157** have their input terminals connected to the output terminals of the OR elements **142**, **144** through **147**, respectively, and have their outputs amplified by the amplifiers **162**, **164** through **167** and then applied to the solenoids **172**, **174** through **177**, respectively. The output of the OR element **143** is amplified by the amplifier **163** and applied to the solenoid **173**. Upon energization, these solenoids **172**, **174** through 177 each dispense one 10-cent coin. The INHIBIT elements **152** through **157** have their respective inhibit terminals **202** through **207** connected to the output terminal **44** of the MEMORY element **40**, so that an inhibit signal is normally applied to these inhibit terminals. This inhibit signal is removed only when a 1-dollar coin or coins amounting to one dollar have been introduced.

The output signals of the MEMORY elements **114**, **115** and **116** are also applied through lines **211**, **212** and **213** to an OR element **214**, the output of which is applied to one of the two input terminals of an AND element **222**, and also through a NOT element **216** to one input terminal of each of OR elements **217** and **218**. A pulse generator **220** is provided to apply pulses to the other input terminal of the AND element **222**, the output pulses of which are applied to a pulse counter **224** functioning as a delay element. This counter is provided with a pair of output terminals **225** and **226**, at both of which an output is normally present. When a predetermined number of pulses have been counted by the counter **224**, the output at the terminal **225** only disappears until the next pulse arrives. When an additional predetermined number of pulses have been counted, the output at the terminal **226** disappears. The outputs at the terminals **225** and **226** are applied to the other input terminals of the OR elements **217** and **218**, respectively, and the output at the latter terminal **226** is applied through a line **228** to the

counter **224** as a reset signal. The output signals of the OR elements **217** and **218** are applied through NOT elements **230** and **232** and amplifiers **234** and **236** to solenoids **238** and **240**, respectively. A register (not shown) is provided having a predetermined number of keys for impressing the numerals 0, 4, 5 and 6 and the period (.). When energized, the solenoid **238** operates the key for impressing the numeral 0 which expresses the figure in the first place of the price of an article that has been selected. When energized, the solenoid **240** operates the key for impressing the period (.) which expresses the end of a recording of the price at each sale, and separates recordings made of successive sales. Solenoids **241**, **242** and **243** are energized by the outputs of the amplifiers **126**, **128** and **130**, respectively, to operate the keys for impressing the numerals 4, 5 and 6, respectively. These numerals express a figure in the second place of the price of an article that has been selected.

The input terminal of each of the OR elements **102**, **138**, **139**, **140** and the MEMORY element **40** that is designated by the reference symbol R is supplied with a signal when one cycle of operation of the system has been completed or when a cancel push button (not shown) has been pressed. The purchaser who wishes to refrain from the purchase may press the cancel push button after introduction of coins before pressing of the push button **110**, **111** or **112**.

In operation, when there is no coin introduced, the counter **18** produces no output at its terminal **0**, while the counter **32** produces an output at its **0** terminal so that no output is produced by the NOT element **60**. As a result, the OR element **50** receives no input signal at its two input terminals and consequently produces no output. The other OR elements **51** through **59** produce an output because of the persence of output signals at the terminals **1** through **4** of the counter **18** and also at the output terminal of the NOT element **62**. The MEMORY element **40** produces no output at the terminal **46**. As will be easily seen, these conditions result in the indication of the figure "0" by each of the indicator tubes **86**, **68** and **88**.

Suppose then that one 10-cent coin has been introduced into the machine. The proximity detector **10** detects the coin and applies one pulse to the counter **18**, whereupon the existing output at the terminal **1** disappears so that the discharge in the tube **68** is shifted from between the anode **66** and the cathode **70** to between the anode **66** and the cathode **71**, thereby indicating the numeral 1. The indications on the tubes **68** and **88** are combined to express the numeral 10. Thus, as one coin is added, the discharge in the tube **68** is shifted and consequently the indication on the tubes is changed from 10 to 20, 30 and 40.

When five 10-cent coins or one 50-cent coin has been introduced, the OR element **24** produces an output, which is applied to the counter **32**, so that an output is produced at the terminal **1** of the counter **32**. This causes the NOT element **62** to be deprived of the existing output. With no output existing at the terminal **0** of the counter **18** at this time, the OR element **55** is deprived of its two input signals, so that a discharge is caused between the anode **66** and the cathode **75** of the tube **68**, thereby indicating the numeral "5." Under this condition, if one more 10-cent coin has been introduced, the output at the terminal **1** of the counter **18** disappears so that the OR element **56** receives no signal at both its input terminals and the discharge in the tube **68** is shifted from between the anode **66** and the cathode **75** to between the anode **66** and the cathode **76**, thereby indicating the numeral "6." It will be easily seen that as one 10-cent coin is added, the indication on the tube **68** is changed until the numeral 7 is indicated.

When ten 10-cent coins, two 50-cent coins or one 1-dollar coin has been introduced, the OR element **34** produces an output, which is applied to the set terminal **42** of

the MEMORY element **40**, whereby the element produces an output at the terminal **46**. As a result, the discharge in the tube **86** is shifted from between the anode **82** and the cathode **85** to between the anode **82** and the cathode **84**, whereupon the indication on the tube is changed from the numeral "0" to the numeral "1." At this time, both the tubes **68** and **88** express "0," so that the indications on the three tubes **86**, **68** and **88** are combined to express the numeral "100." Thus, the value of the coin or the total value of the coins introduced is indicated as 100 cents.

The purchaser who has introduced the required number of coins then presses that one of the push button switches **110**, **111** and **112** which corresponds to the kind of an article he wishes to buy. Mention has been made that upon introduction of coins, a signal appears on any one of the lines **94**, **96**, **98** or **100** in accordance with the value of the coin or the total value of the coins introduced. If the coins introduced amount to one dollar, any of the MEMORY elements **114**, **115** and **116** may be set by pressing the corresponding one of the push button switches **110**, **112** and **113**; if the coins introduced amount to 60 cents, the MEMORY element **116** only may be set by pressing the corresponding push button switch **112**; if the coins introduced amount to 50 cents, either one of the MEMORY elements **114** and **115** may be set by pressing the corresponding one of the push button switches **110** and **111**; and if the coins introduced amount to 40 cents, the MEMORY element **114** only may be set by pressing the corresponding push button switch **110**.

Let it be assumed that a 1-dollar coin has been introduced and that the push button switch **110** has been pressed. Upon closing of the switch **110**, the MEMORY element **114** is set to produce an output, which is applied through the amplifier **126** to the solenoid **132**, whereupon a 40-cent article is dispensed. At the same time, the output of the MEMORY element **114** is applied to the lines **182** and **184** and, since no inhibit signal is applied to INHIBIT elements **152** through **157** at this time as was previously mentioned, further to all of the solenoids **172** through **177** to energize them, whereupon each of the solenoids dispenses one 10-cent coin. Since the number of the solenoids is six, six 10-cent coins are delivered out as change to be given to the purchaser.

Suppose that the push button **111** has been pushed, with a signal existing on the line **100**. The solenoid **134** is energized, and at the same time the solenoids **172**, **174** through **177** are also energized through the lines **186** and **188**, so that five 10-cent coins are delivered out as change. In a similar manner, when the push button **112** has been pressed, the solenoid **136** is energized and at the same time, the solenoids **172**, **174** through **176** are energized through the lines **190** and **192**, so that four 10-cent coins are delivered.

When a signal is on the line **98**, that is, coins amounting to 60 cents have been introduced, only the solenoid **136** is energized by closing the switch **112**. In this case, no amount of change need be returned.

When a signal is on the line **96** due to introduction of a 50-cent coin or five 10-cent coins, closing the switch **110** or **111** will result in energization of the solenoid **132** or **134**. Upon closing of the switch **110** corresponding to 40-cent articles, the AND element **180** has both its input terminals supplied with a signal and produces an output to energize the solenoid **173**, whereupon one 10-cent coin is sent out as change. However, the other solenoids **172**, **174** through **177** are not energized because at this time an inhibit signal is applied to each of the INHIBIT elements **152**, **154** through **157**. It will be easily seen that the closing of the switch **111** will not energize any of the solenoids **172** through **177**, because the INHIBIT elements **152**, **154** through **157** are supplied with an inhibit signal and the AND element **180** has only one of its input terminals supplied with a signal.

When a signal is on the line 94 due to the introduction of four 10-cent coins, the closing of the switch 110 will result in energization of the solenoid 132 only, with all the solenoids 172 through 177 remaining deenergized.

When one of the push button switches 110 through 112 has been pressed, the corresponding one of the solenoids 132, 134 and 136 is energized. At the same time, the corresponding one of the solenoids 241 through 243 is energized, whereby the corresponding one of the keys of the register for impressing the numerals 4, 5 and 6 is actuated to print one of the numerals on a sheet of paper. It will be seen that the closing of the switch 110, 111 or 112 also causes a signal to appear on the line 211, 212 or 213. This signal is applied to the OR element 214, the output of which is in turn applied to the NOT element 216. As a result, the input signal to the OR elements 217 and 218 connected to the output of the NOT element 216 is removed. The output of the OR element 214 is also applied to one of the two input terminals of the AND element 222. Under this condition, every time one pulse is supplied from the pulse generator 220 to the other input terminal of the AND element 222, one output pulse is produced by the AND element to be supplied to the counter 224. When the counter 224 has counted a predetermined number of input pulses, the output at the terminal 225 disappears so that the OR element 217 is deprived of both its input signals. This causes the NOT element 230 to produce an output to energize the solenoid 238 to strike the key for impressing the numeral 0. The arrangement is such that the numeral 0 is impressed at the right-hand side of the numeral 4, 5 or 6 previously impressed. Thereafter, when an additional predetermined number of pulses have been counted, the other OR element 218 is deprived of both its input signals, so that the NOT element 232 produces an output to energize the solenoid 240 to operate the key for impressing the period (.) at the right-hand side of the numeral 0 previously impressed, thereby indicating the end of the recording of the price at one sale. The arrangement is such that when a period (.) has been impressed, the recording for the next sale is impressed on the next line in order to prevent mixing up of the numerals impressed at successive recordings, and such that when the period has been impressed, at the same time the aggregate sum of the price that has just been recorded and the previously recorded aggregate sum of the prices is recorded.

The removal of the signal from the output terminal 226 of the counter 224 and consequently the line 228 causes the counter to be reset.

A suitable means (not shown) may be provided for generating a signal upon completion of the recording by the register, to be applied as a reset signal to the OR elements 102, 138 through 140 and the MEMORY element 40 so as to reset these elemtns, thereby completing one cycle of operation of the system.

A preferred embodiment of the invention having been illustrated and described, it should be noted that the embodiment is merely illustrative and that various modifications and changes may be made without departing from the true scope and spirit of the invention as defined in the appended claims.

What we claim is:

1. An electronic control system for vending machines actuated by deposit of coins of different denominations to dispense articles of different prices, comprising:

(a) a plurality of detectors adapted respectively to detect deposit of coins of different denominations, each detector being operable to produce a pulse upon deposit of each coin of denomination corresponding thereto;

(b) a plurality of article selection switches operable for selection of articles of different prices;

(c) a plurality of article dispensing means respectively coupled to said switches;

(d) electronic coin value counting means having a plurality of output terminals coupled to said switches, said counting means including first and second pulse counters coupled respectively to receive pulses from first and second coin deposit detectors corresponding to lower and higher denominations, respectively, said second pulse counter being also coupled to receive a pulse from the first pulse counter upon deposit of the number of lower denomination coins equivalent to the higher denomination, and means coupled to said pulse counters and to said output terminals to provide dispense signals preconditioning only those output terminals coupled to switches corresponding to articles of price equal to or less than the coin value deposited, whereby upon subsequent actuation of one of said preconditioned switches the dispensing means coupled thereto is operated to release the selected article in response to the applied dispense signal; and

(e) change dispensing means coupled to said switches and to said counting means and operable to dispense the correct change upon actuation of said preconditioned switch when it corresponds to an article of price less than the coin value represented by said pulses.

2. The control system defined in claim 1, wherein said change dispensing means comprises a plurality of release means for dispensing coins of the same denomination, each release means being adapted to dispense one coin upon each energization thereof; a plurality of OR elements each for energizing one of said release means; and means for applying an input signal to the same number of said OR elements as the number of coins required to dispense the correct change.

3. The system defining claim 1 wherein said means for providing dispense signals includes a plurality of OR elements coupled respectively to said counting means output terminals, each of said OR elements having a plurality of inputs respectively coupled to receive from said pulse counters a preconditioning signal upon deposit of coins of value equal to or greater than the price of the article selectable by means of the switch coupled to said OR element.

4. The system defined in claim 1 wherein said article dispensing means include respective flip-flop elements each have a SET input responsive to the associated article selection switch, and a SET output, and a RESET input; a plurality of OR elements, each having its output coupled to one of said RESET inputs and having inputs responsive to the SET outputs of all of said flip-flop elements other than the flip-flop element to which its own output is coupled; whereby upon actuation of any one of said switches actuation of the remaining switches is rendered ineffective; and individual article release means responsive to said SET outputs respectively.

5. The system defined in claim 1 including means for recording multiple digit prices of articles sold, said recording means including individual first digit recording means each coupled to one of said article selection switches to record the digit corresponding to the first digit of the price of the article selectable by said switch, and second digit recording means having an input OR element responsive to all of said article selection switches and operable in response to actuation of a preconditioned one thereof to record a "0" as the second digit of said price.

6. The system defined in claim 1 wherein each of said pulse counters includes a plurality of outputs electrically conditioned successively by successively applied pulses, and wherein the means for providing dispense signals comprises first and second series of OR elements, each OR element having first and second inputs, the first inputs of said OR elements being responsive to respectively different outputs of the first pulse counter, the second inputs of the first series OR elements being responsive

to one output of the second pulse counter and the second inputs of the second series OR elements being responsive to another output of the second pulse counter, the first output terminal of said counting means being responsive to an OR element in the first series and the second output terminal of said counting means being responsive to an OR element in the second series.

7. The system defined in claim 6 further including coin value indicating means comprising a plurality of indicators responsively coupled to be actuated respectively by different OR elements in said first and second series

to indicate the total value of coins introduced prior to selection of an article.

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