June 16, 1964 P. A. JOHNSON 3,137,377

TOTALIZER AND CHANGE-MAKER FOR COIN-OPERATED APPARATUS

Filed July 25, 1958

4 Sheets-Sheet 1

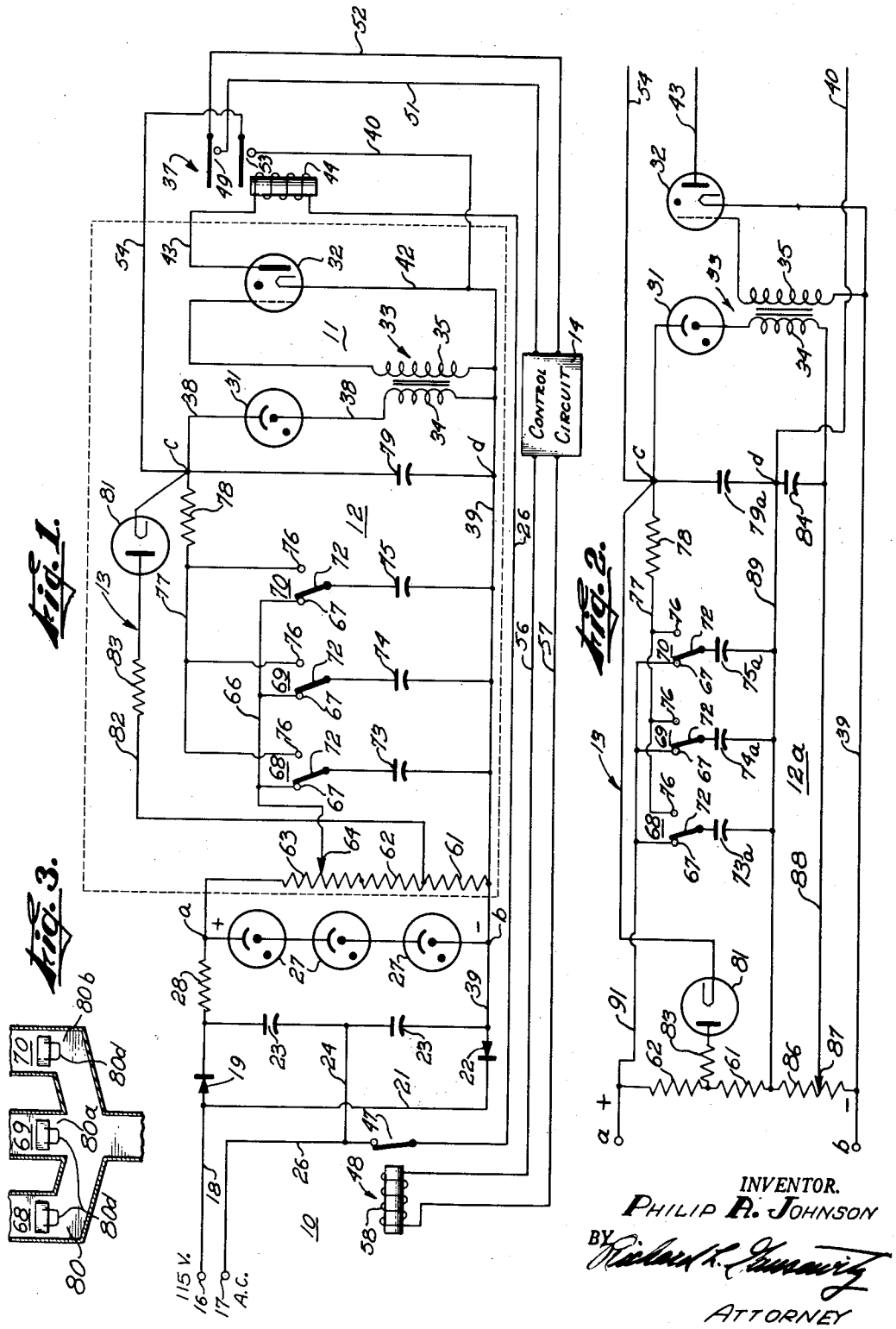

Fig. 1.

Fig. 2.

Fig. 3.

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TOTALIZER AND CHANGE-MAKER FOR COIN-OPERATED APPARATUS

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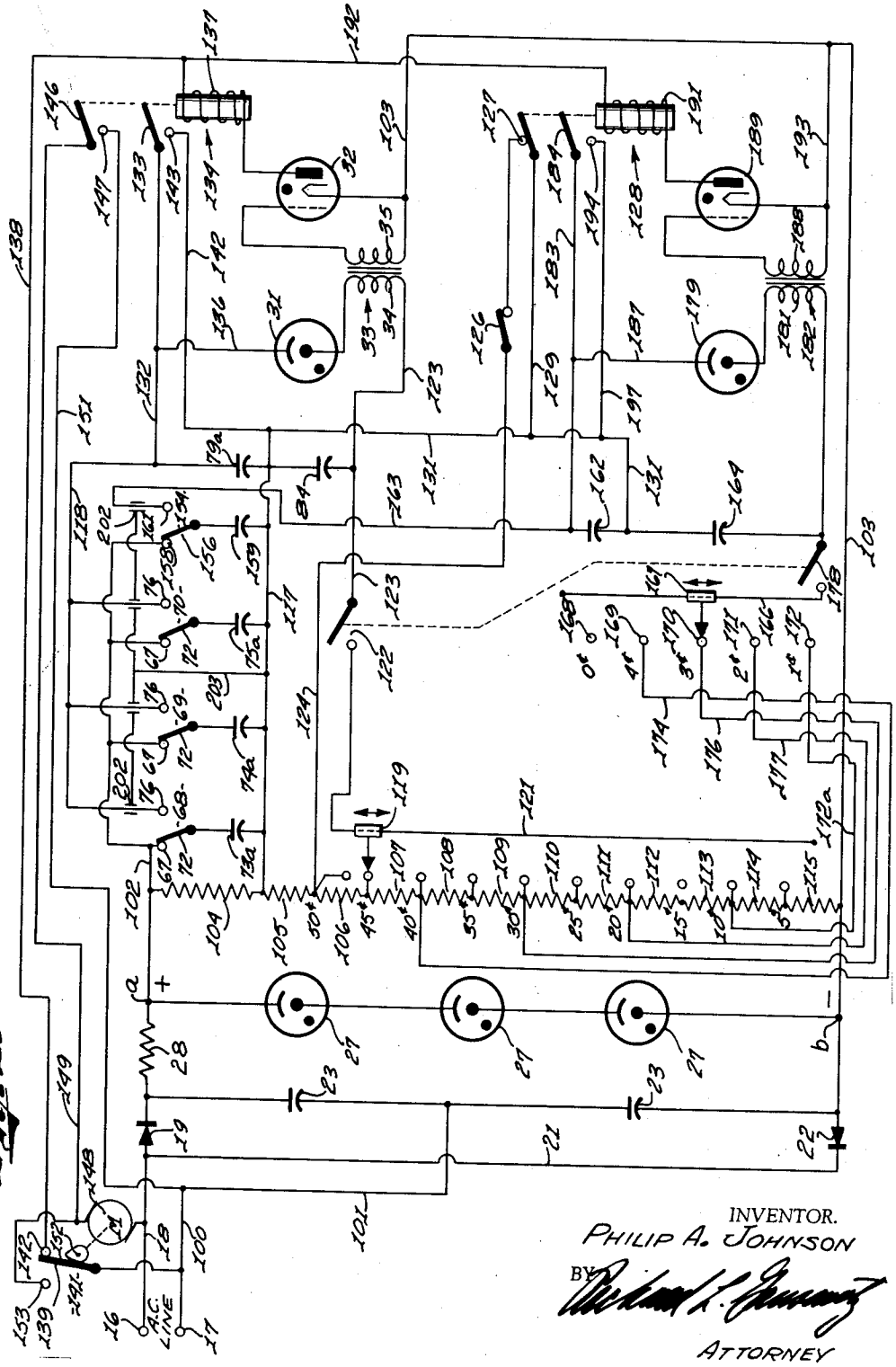

Fig. 1.

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TOTALIZER AND CHANGE-MAKER FOR COIN-OPERATED APPARATUS

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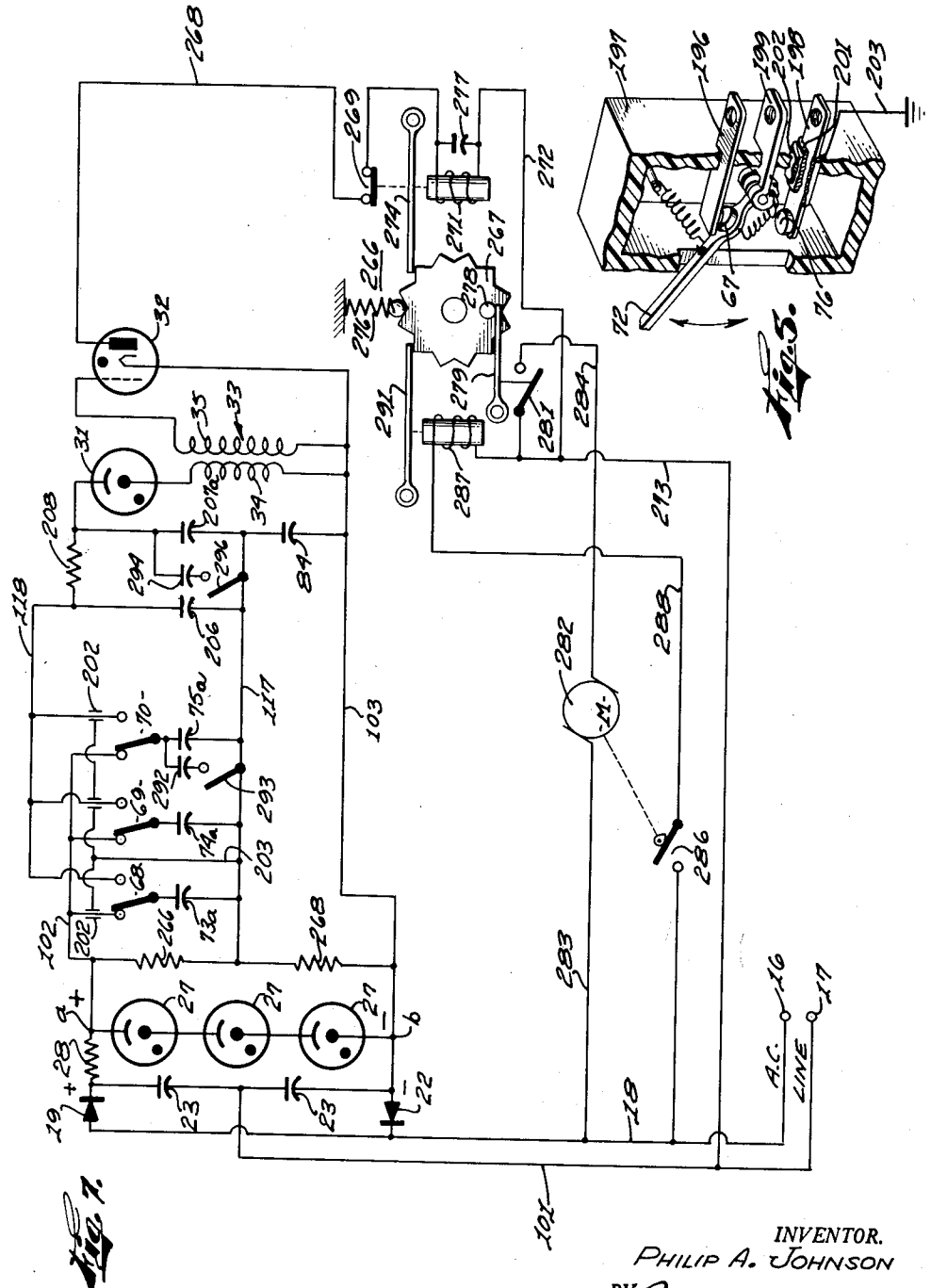

Fig. 7.

Fig. 5.

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TOTALIZER AND CHANGE-MAKER FOR COIN-OPERATED APPARATUS

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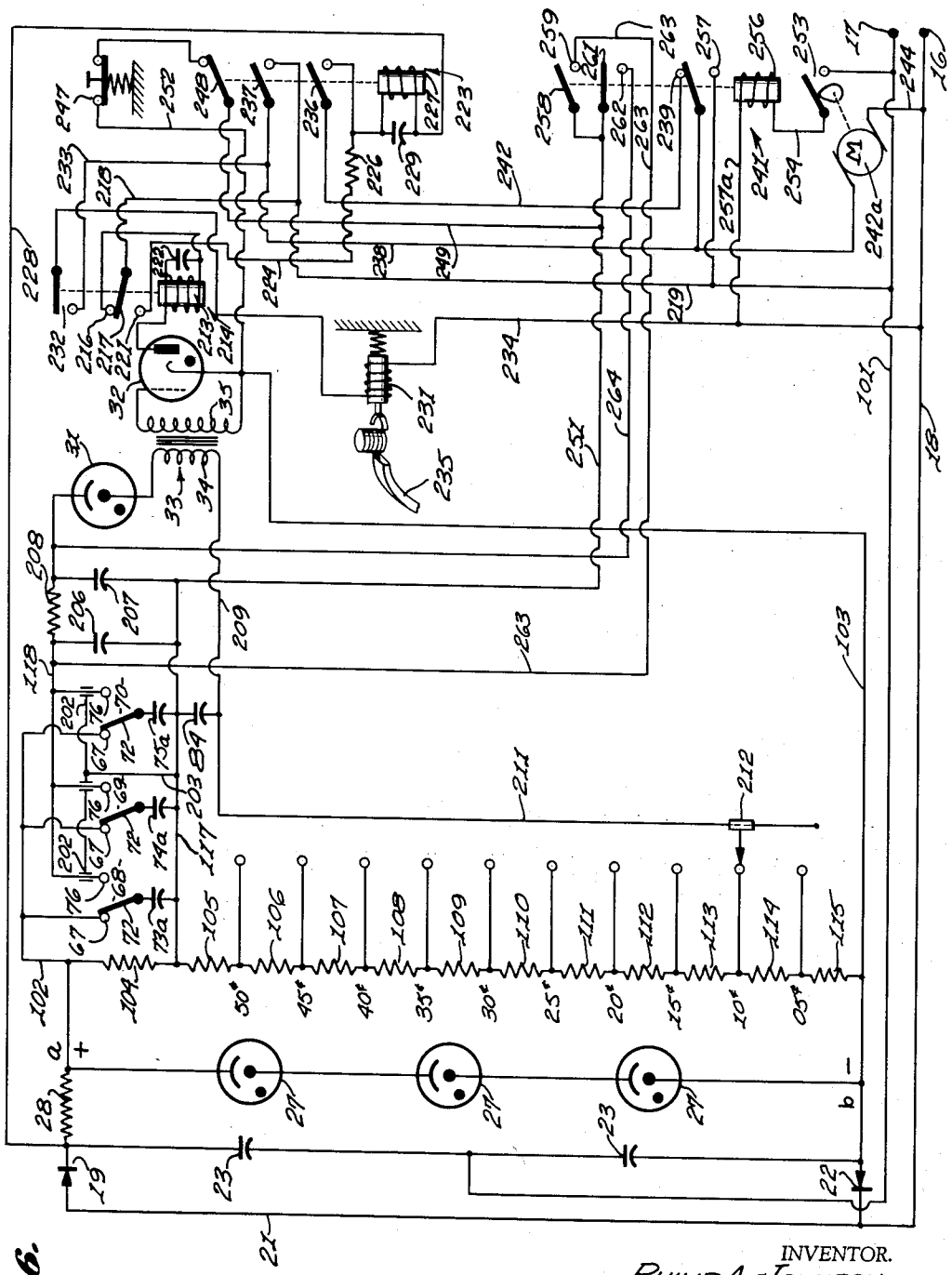

Fig. 6.

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3,137,377

TOTALIZER AND CHANGE-MAKER FOR COIN-OPERATED APPARATUS

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Filed July 25, 1958, Ser. No. 751,603
10 Claims. (Cl. 194—10)

This invention relates to a totalizer and a change-maker for coin-operated apparatus, such as vending machines and the like. The present application constitutes a continuation-in-part of my co-pending application, Serial No. 643,298, filed January 15, 1957, for Totalizer for Vending Machines, now abandoned.

Totalizers and change-makers incorporated in present-day vending machines, and other coin-operated apparatus, are frequently mechanical or electro-mechanical in nature. Such totalizers and change-makers may involve close mechanical tolerances, and may require a large amount of maintenance. The defects of such totalizers and change-makers include difficulty of adjustment for vending at different selling prices and burning out of solenoids as a result of sticking of coins in the coin slots of the apparatus.

Further very important limitations and defects of conventional mechanical and electro-mechanical apparatus of the type in question, and also of certain electronic equipment adapted to effect totalizing and change-making functions, include the following: (1) inability or impracticality of totalizing not only nickels, dimes, and quarters, but also pennies, (2) inability to post-select, as well as pre-select, (3) extreme complexity, high cost, large bulk and weight, and relative instability of operation. With relation to factor (1), it is emphasized that there are many situations in which it is desired to effect operation of coin-operated machines at some price, such as thirty-seven cents, which is not a multiple of five. With relation to factor (2), it is emphasized that there are many situations in which it is desirable that the customer insert the coins in the apparatus before he performs an additional function (such as pressing a button) to effect actual vending. This is known as "post-select," since selection of the article to be vended need not occur until after insertion of the coins. It is to be contrasted with conventional "pre-select" situations, in which the article is selected before the coins are inserted.

In view of the above and other factors characteristic of totalizers and change-makers for coin-operated apparatus such as vending machines, it is an object of the present invention to provide an electrical totalizer and change-maker which is simple, reliable and stable in construction and operation, which is adaptable for either pre-select or post-select operations, and which will totalize a variety of coin denominations including pennies.

Another object of the invention is to provide an electrical accumulator and change-maker which is extremely easy to set for vending at various selling prices, which is not subject to burning out as a result of sticking of coins in the coin slots, and which is characterized by low cost of manufacturing and maintenance.

These and other objects and advantages of the invention will be more fully set forth in the following specification and claims, considered in connection with the attached drawings to which they relate.

In the drawings:

FIGURE 1 is a schematic wiring diagram illustrating a first embodiment of the invention;

FIGURE 2 illustrates a second embodiment of the invention, the showing of FIGURE 2 being adapted to be substituted within the dashed-line box of FIGURE 1;

FIGURE 3 is a fragmentary schematic representation of three coin slots and associated switches;

FIGURE 4 is a schematic diagram of a third embodiment of the invention, and including means for adding not only nickels, dimes and quarters, but also pennies;

FIGURE 5 is a fragmentary view illustrating means to prevent building up of charge on the storage capacitor as a result of leakage of current across the coin switches;

FIGURE 6 is a schematic wiring diagram illustrating a fourth embodiment of the invention, which is adapted no only to totalize coins but also to make change; and

FIGURE 7 illustrates a fifth embodiment of the invention, showing the use of the present invention in the vending of music.

Embodiment of FIGURE 1

Referring to FIGURE 1 of the drawings, the circuit may be divided into a means **10** (to the left of points *a* and *b*) for supplying a relatively stable or constant direct voltage, a means **11** (to the right of points *c* and *d*) for initiating a control effect, and a totalizer means **12** (between points *a–b* and *c–d*) for controlling operation of the initiating means **11** in response to the introduction of a certain number of coins into coin slots of the vending machine or other coin-operated apparatus. The totalizer means **12** includes a portion **13** adapted to compensate for the effects of leakage across coin switches, self-charging of capacitors, etc., so that operation of the totalizer means **12** will not be impaired despite non-use of an energized machine for long periods of time. The output side of the initiating means **11** is connected to a control circuit **14**, represented schematically, which is connected to a vending machine, not shown, in order to effect and time a vending cycle in response to actuation by the above-indicated means **10–11**. The control circuit **14** may be of numerous types, and need not be described in detail herein.

The voltage supply means **10** is adapted to be connected to terminals **16** and **17** of a conventional source of 115 volt alternating current by contacts, not shown, on the conventional on-off switch of a vending machine. The use of such a current source is highly important in the vending machine business since it eliminates the necessity for special wiring, for example for 220 volts, at each vending machine location. Terminal **16** is connected through a lead **18** to a suitable half-wave rectifier **19**, and also through a lead **21** to a second half-wave rectifier **22**, the rectifiers **19** and **22** arranged oppositely relative to each other. A pair of capacitors **23** are connected in series-relationship between the outputs of rectifiers **19** and **22**, and a lead **24** is connected from a point intermediate the capacitors **23** to a point on a lead **26** from supply terminal **17**. With the above-described circuit, the two capacitors **23** are charged to the peak voltage of the supply source on alternate half cycles, and the polarities are such that the direct voltages developed across the capacitors add to result in a doubling of the supply voltage.

In order to regulate or stabilize the voltage developed across the capictors **23**, a plurality of cold-cathode gas-filled diodes **27**, preferably type NE–57 neon tubes or equivalent, are series-connected together with a resistor **28** across the rectifier outputs. The result is that the points *a* and *b* (on opposite sides of the neon tubes **27**) are supplied with a regulated voltage which remains substantially constant despite variations in the supply voltage through relatively wide limits, for example from 80 to 130 volts. In the present specification it will be assumed that the components are so connected that point *a* is positive, as indicated, and point *b* negative.

The means **11** for initiating a control effect is illustrated to comprise a cold-cathode gas-filled diode **31**, preferably a type NE–32 neon tube or equivalent, adapted to fire at a predetermined voltage value. Means **11** further comprises a cold-cathode gas-filled triode or thyratron **32**, preferably type 5823 or equivalent, a pulsing

transformer 33 having an input coil 34 and an output coil 35, with a turns ratio from input coil to output coil preferably in the range of 20:1, and a double-pole relay 37.

Neon tube 31 and input coil 34 of pulsing transformer 33 are series-connected in a lead 38 between point *c* and a point on the negative lead 39 which connects to point *b*. The output coil 35 of the pulsing transformer connects at one end to the grid or firing electrode of thyratron 32, and at the other end to lead 39. A lead 42 is employed to connect the cathode of thyratron 32 to lead 39. The plate of the thyratron is connected by a lead 43 to the coil 44 of relay 37. Coil 44 also connects to the lead 26 which runs to the alternating current input terminal 17, there being interposed in such lead the normally-closed contacts 47 of a relay 48.

The first set of contacts 49 of relay 37 are normally open, and connect through leads 51 and 52 to the control circuit 14. The second set of contacts 53 of relay 37, also normally open, connect through a lead 54 to point *c* and through a lead 40 to lead 42.

From the above it will be seen that upon energization of relay 37 to close its contacts 49, the circuit between leads 51 and 52 will be closed. This, in turn, will initiate operation of the control circuit 14 to result in a vending cycle. After a predetermined interval, determined by timing elements in the control circuit 14, a momentary voltage will be impressed by the control circuit 14 across two leads 56 and 57 which connect to the coil 58 of relay 48. This voltage effects momentary opening of the contacts 47 of such relay, and resets the totalizer as will be described subsequently.

Closing of contacts 53 of relay 37 completes a circuit from point *c* through leads 54, 40, 42, and 39 to point *d*. This operates, as will be described hereinafter, to reset the totalizer portion 12 of the circuit so that it may effect accurate accumulating or totalizing during a subsequent operation of the device.

It will be understood that when the predetermined firing voltage of neon tube 31 is impressed across points *c* and *d* (contacts 53 being open), that tube will fire and permit flow of current through the primary 34 of pulsing transformer 33. A voltage will then be induced in the transformer secondary 35, and this will effect firing of thyratron 32. Plate current will then flow in the thyratron through a circuit which may be traced from coil 44 of relay 37 to lead 43, the plate of the thyratron, the cathode of the thyratron, lead 42, lead 39, rectifier 22, lead 21, lead 18, terminal 16 of the voltage source, terminal 17 thereof, lead 26, and back to the other side of relay coil 44.

The rectifying action of rectifier 22 and the storage action of capacitor 23 convert the alternating current into direct current having characteristics sufficient to allow closure of the relay contacts 49 and 53 and to maintain them closed until the thyratron 32 is extinguished. Such extinguishment of the thyratron occurs, as previously indicated, as soon as the control circuit 14 operates through relay 48 to momentarily open relay contacts 47 and break the above-described circuit.

The neon tube 31 performs the very desirable function of stabilizing the circuit to compensate for variations in the characteristics of thyratron 32. It follows that the firing voltage for circuit means 11 will remain constant despite changes in such factors as ambient temperatures.

The totalizer means 12 is adapted to impress between points *c* and *d* the firing voltage of neon tube 31 when, and only when, coins have been inserted in the vending machine and which add up to the price of the article being vended. The totalizer includes a voltage adjusting or potentiometer means connected across points *a* and *b*, and which preferably comprises three resistors 61, 62 and 63 arranged in series relationship. Resistor 61 is illustrated as fixed in value and connects at one end to lead 39 and at the other end to resistor 62, the latter also being shown as fixed in value. Resistor 63, which connects between point *a* and resistor 62, has a sliding contact 64 which might, alternatively, be a variable tap. The total current from the power supply through resistors 61, 62 and 63 should be in the order of 0.5 ma., the voltage at the junction of resistors 61 and 62 should approximate 1 volt, and the voltage at the junction of resistors 62 and 63 should be greater than the firing voltage of neon tube 31.

The sliding contact 64 connects through a lead 66 to corresponding contacts 67 of three (or any desired number of) double-throw switches 68–70. The arms 72 of the switches 68–70 connect, respectively, through charging capacitors 73–75 to the negative lead 39. The remaining terminals or contacts 76 of switches 68–70 connect to a lead 77 and thence via a resistor 78 to point *c*. A storage capacitor 79 is connected between points *c* and *d*, the latter point being on lead 39.

The switches 68–70 are coin switches which are associated with the respective coin slots 80, 80*a* and 80*b* (FIGURE 3) of the coin mechanism of a vending machine or other coin-operated apparatus. An actuator 80*d* is provided for each arm 72, and operates to momentarily shift the arm when a coin is inserted in the associated slot. The switches are normally in the positions illustrated, with arms 72 thereof in contact with terminals 67, but upon passing of a coin the arms 72 are momentarily moved (by actuators 80*d*) into contact with terminals 76.

Let it be assumed, for purposes of illustration, that switch 68 is in the 5¢ slot 80 of the coin mechanism, switch 69 in the 10¢ slot 80*a*, and switch 70 in the 25¢ slot 80*b*. Switch 68 will, therefore, be momentarily closed away from terminal 67 to terminal 76 when a five-cent piece is introduced into slot 80 of the vending machine, and switches 69 and 70 will be correspondingly shifted upon introduction of ten or twenty-five cent pieces into the machine.

The charging capacitors 73–75 have different capacitance values adapted to produce an addition effect upon repeated discharge thereof into storage capacitor 79. The relationship between capacitors 73–75 is not linear, but may be discovered by empirical means such as will next be described. Assuming (as above stated) that switch 68 is in the nickel slot, switch 69 in the dime slot, and switch 70 in the quarter slot, a capacitor 73 of suitable size is chosen and is repeatedly charged and discharged ten times into the capacitor 79. This is done by operation of switch 68, and with sliding contact 64 at a predetermined point. It is then determined what resultant voltage is impressed across the capacitor 79. This process is then repeated for capacitor 74, but only for five repeated discharges thereof, and the capacitance value of capacitor 74 is adjusted empirically until the five discharges produce the same resultant voltage across capacitor 79 as did the ten discharges of capacitor 73. The process is then repeated with capacitor 75, except that only two discharges thereof are effected. Since (with the same setting of contact 64) ten discharges of capacitor 73, five discharges of capacitor 74, or two discharges of capacitor 75 each produce the same voltage across capacitor 79, it follows that discharges of various ones of capacitors 73–75 will produce an addition effect as desired.

The discharge of each charging capacitor 73–75 is only partial, since each charging capacitor, when discharging, is in parallel with storage capacitor 79. Throughout this specification and claims, the word "discharge" means partial discharge unless complete discharge is specified (such as with reference to capacitor 79).

Capacitor 79 must be sufficiently large to hold the charge impressed thereon from the respective capacitors 73–75 during an addition or totalizing operation. Normally, the exact capacitance value of a capacitor 79 is adjusted in accordance with the firing voltage of neon tube

31. In one preferred embodiment of FIGURE 1 of the present invention, capacitor 73 has approximately 0.1 mfd. capacitance, capacitor 74 has approximately 0.21 mfd. capacitance, capacitor 75 has approximately 0.56 mfd. capacitance, and capacitor 79 has approximately 0.4 mfd. capacitance.

In the operation of the above-described portion of means 12, all of the charging capacitors 73–75 are initially charged to a voltage determined by the setting of sliding contact 64, through the respective switches 68–70 which are then in the illustrated positions with arms 72 in contact with terminals 67. When a coin is inserted in a coin slot, the corresponding capacitor 73–75 discharges through lead 77 and resistor 78 to effect charging of capacitor 79. Such charging of capacitor 79 will be in an amount determined by the charge on the capacitor 73–75 which was thus partially discharged. When the voltage across capacitor 79 has built up (after repeated coin insertions) to the firing voltage of neon tube 31, such tube fires to initiate the control effect as above described. The resistor 78 serves as a current limiting resistor to insure against mis-operation of the totalizer means 12 due to any inductive surges in the capacitors.

Let it be assumed, merely for purposes of illustration, that the circuit was initially calibrated with sliding contact 64 at a point representing a total price (of the article being vended) of 50¢. This being the case, and with the coin switches and capacitors related as above stated, the neon tube 31 would fire at ten discharges of capacitor 73, five of capacitor 74 or two of capacitor 75. It would also fire at four discharges of capacitor 74 and two of capacitor 73, etc. Assuming that it is then desired to make the neon tube fire at 35¢, the price of the vended article being less, contact 64 is shifted upwardly on resistor 63 so that a lesser number of discharges of capacitors 73–75 will be required to produce the firing voltage of neon tube 31. This is done empirically during calibration of the circuit, with sliding contact 64 first being shifted to a given point, after which capacitor 75 is discharged once and capacitor 74 is also discharged once. Sliding contact 64 is then shifted, both capacitors 75 and 74 are discharged, and the process is repeated until the firing voltage of neon tube 31 is achieved. The same effect would have been produced had capacitor 74 been discharged three times and capacitor 73 once, or had capacitor 73 been discharged seven times, etc. After calibration of the circuit, a scale is provided on resistor 63 to indicate the points to which contact 64 should be shifted in order to produce vending at various article prices.

The portion 13 of means 12, which compensates for effects of leakage across switches 68–70 and also for the effects of self-charging of capacitor 79, comprises a suitable diode vacuum tube 81 having its cathode connected to point *c*. The plate of the diode is connected through a lead 82 to the juncture of resistors 61 and 62 such juncture being substantially more negative in potential than any point to which the sliding contact 64 may be moved. A relatively large resistor 83, preferably of about 10 to 20 megohms, is interposed in lead 82. Resistor 83 limits the current through diode 81; which diode prevents the bleeding off of the charge put on capacitor 79 as the result of shifting of a switch arm 72 to terminal 76.

There is a current leakage across the respective switches 68–70 upon standing of the vending machine for long periods between vending operations. This leakage occurs even with good commercial coin switches, which are well insulated such as with Bakelite. Furthermore, there is a substantial self-charging of capacitor 79, due to dielectric hysteresis, which charging would take place even if the capacitor were disconnected from the circuit and stored away in a box, for example. These effects tend to build up a voltage across capacitor 79 and render the totalizing action of the circuit means 12 inaccurate.

The circuit portion 13 prevents or compensates for this building up of voltage across capacitor 79, in the following manner. When the capacitor 79 is completely discharged, due to closing of contact 53 of relay 37, the voltage of point *c* is the same as the voltage at point *d*. Since point *d* is on the negative lead 39, and since the plate of diode 81 is connected through lead 82 to the juncture of resistors 61 and 62, it follows that the plate of the diode is positive with respective to the cathode thereof. The plate being positive, the diode will conduct electron current from point *c* through resistor 83 and lead 82 to resistor 61 and thence to negative lead 39. Such current conduction effects bleeding of the leakage and self-charging current, and obviates objectionable changes in the conditions of capacitor 79 which might otherwise occur during prolonged periods between coin insertions.

The resistor 61 is relatively small, and may have only about one volt voltage drop thereacross. Such voltage is so small that the discharge of any of the capacitors 73–75 will immediately make point *c*, and the cathode of diode 81, positive with respect to the plate. The diode will then cease to conduct, which will permit building up of the voltage across capacitor 79 as is necessary in order to effect firing of neon tube 31.

Operation—FIGURE 1

To summarize briefly the operation of the embodiment of the accumulator or totalizer shown in FIGURE 1, all of the switches and relays are initially in the positions illustrated in the drawing. The voltage doubling and stabilizing circuit 10 operates to supply a substantially constant direct voltage to the points *a* and *b*, point *a* being positive and point *b* negative. The sliding contact 64 of potentiometer 63 is adjusted to such a point, in accordance with a scale made during calibration of the circuit, that the neon tube 31 will fire and result in closing of relay 37 when the voltage between points *c* and *d* corresponds to the insertion of a desired coin total (for example 35¢) in the various coin slots 80, 80*a* and 80*b* (FIGURE 3) of the vending machine with which the circuit is associated.

The arms 72 of the various coin switches 68–70 being closed to terminals 67 as illustrated, the charging capacitors 73–75 will be charged to a voltage determined by the setting of sliding contact 64. When a coin is inserted into the vending machine, the switch 68, 69 or 70 in the slot for the coin of that denomination will close momentarily to terminal 76, resulting in discharge of the associated capacitor 73–75 and in the charging of the storage capacitor 79 by an amount determined by the storage capacity of the capacitor discharged. Repeated insertion of various coins into their coin slots and totalling the predetermined figure will, as above explained, result in firing of neon tube 31.

Upon firing of such tube, the pulsing transformer 33 is energized to effect firing of thyratron 32. This closes the circuit through the coil 44 of relay 37, and maintains the contacts 49 and 53 thereof closed until the thyratron ceases to fire. Closing contacts 49 effects operation of control circuit 14 to effect a vending cycle, at the end of which the relay 48 is energized to momentarily open contacts 47. This causes thyratron 32 to cease firing, and resets the circuit for a new cycle of operation.

Closing of contacts 53 of relay 37 effects complete discharging of capacitor 79 to put such capacitor in condition for a new totalizing operation. The discharge of capacitor 79 also, as above described, makes the plate of diode 81 positive with respect to the cathode thereof and results in bleeding of self-charging and leakage currents from point *c*, so that the voltage across capacitor 79 will remain at zero (or very close to it) until additional coins are inserted. It is pointed out that the firing of neon tube 31 does not completely discharge capacitor 79, but only results in a lowering of the voltage thereacross. Complete discharge of capacitor 79 is not effected until contacts 53 close. For example, if the neon tube 31 fires at 70 volts,

it may cease to fire at about 50 volts. The voltage across the capacitor will then drop from 50 to 0 volts upon closing of the contacts **53**.

Embodiment of FIGURE 2

Referring next to FIGURE 2, there is illustrated a second embodiment of the invention, the showing of FIGURE 2 being adapted to be substituted for the showing enclosed by the dashed line box in FIGURE 1. The elements of FIGURE 1 outside of the dashed line box have corresponding elements in FIGURE 2, but are not shown therein. Elements in FIGURE 2 corresponding to elements within the dashed line box in FIGURE 1 have been given the same reference numerals.

Briefly stated, FIGURE 2 illustrates an embodiment in which the input voltage to the charging capacitors **73***a*, **74***a* and **75***a* is constant instead of variable, as it is in FIGURE 1. Instead, the adjustment factor (for making the vending operation commence when coins totalling different values are inserted) is made by connecting an additional voltage-producing means, preferably a capacitor **84**, whose capacity is preferably more than five times that of capacitor **79***a*, in series with capacitor **79***a* and across the the series combination of the neon tube **31** and transformer primary **34**. The voltage across the additional capacitor **84** is varied by means of a potentiometer **86**, the winding of which is connected in series with resistors **61** and **62** between points *a* and *b*. The sliding contact **87** of potentiometer **86** is connected through a lead **88** to one side of capacitor **84**, the other side thereof being connected to point *d*.

In the present embodiment, point *d* is not on lead **39** but instead is on a lead **89** which connects to the juncture of resistors **61** and **86**, one side of each capacitor **73***a*–**75***a*, and **79***a* being connected to such lead **89**. Point *d* connects, however, to the lead **40**, so that a shorting or discharging circuit for capacitor **79***a* may be completed through lead **40**, contacts **53** of relay **37**, lead **54** and point *c*.

The winding of potentiometer **86** is connected between leads **39** and **89**. Resistor **62** is connected to point *a*, and resistor **61** to lead **89**.

Point *a* connects directly through a lead **91** to the terminals **67** of the various coin switches **68**–**70**. The terminals **76** of switches **68**–**70** connect through the lead **77** and resistor **78** to point *c*. The arms **72** of the switches connect, as in the first embodiment, to the capacitors **73***a*–**75***a* respectively.

The portion **13** of totalizer means **12**, for compensating for the effects of self-charging of capacitor **79***a*, and leakage across switches **68**–**70**, is the same as in the first embodiment.

Operation—FIGURE 2

In the operation of the embodiment shown in FIGURE 2, the voltage applied to each capacitor **73***a*–**75***a* when its associated coin switch **68**–**70** is in the illustrated position, is fixed, and comprises the drop across resistors **61** and **62**. The capacitors **73***a*–**75***a* are related as in the first embodiment, so that momentary shifting of an arm **72** to terminal **76** will result in charging of capacitor **79***a* by an amount determined by the denomination of the coin inserted in the vending machine. It follows that a voltage will build up across capacitor **79***a* between points *c* and *d*, which will represent the price of the article being dispensed by the vending machine. Neon tube **31** will then fire, since the sliding contact **87** is adjusted to such a position that the sum of the voltages across capacitors **79***a* and **84** will be the firing voltage of the neon tube **31** when the desired sum of money has been inserted into the device. When neon tube **31** fires, transformer **33** will be energized and will operate through the grid or trigger electrode of thyratron **32** to fire the thyratron, which will operate as in the first embodiment to energize the relay **37** and initiate a vending cycle.

From the above it will be understood that when the price of the article being vended is relatively small, sliding contact **87** will be shifted relatively far down on resistor **86** to impress a relatively high voltage on capacitor **84**. The additional voltage impressed across capacitor **79***a* due to discharge of the various capacitors **73***a*–**75***a* need not then be great in order to effect firing of neon tube **31**. When the price of the article being dispensed is relatively high, sliding contact **87** is slid upwardly so that little or no voltage is impressed across capacitor **84**. A relatively large number of coins must then be introduced into the vending machine in order to build up a voltage across capacitor **79***a* sufficient to effect firing of neon tube **31**.

Additional theory and methods relative to calibration will be set forth hereinafter, particularly with reference to FIGURE 6.

Embodiment of FIGURE 4, Incorporating a Penny Register

Proceeding next to a description of the embodiment of FIGURE 4, a circuit is illustrated which will not only effect addition of nickels, dimes, and quarters, but also of pennies where the price of the article being vended is not a multiple of five. Thus, a vending machine may be actuated to vend at a purchase price of 38¢, for example, by inserting a quarter, a dime, and three pennies, or seven nickel and three pennies, etc.

Stated generally, the circuit of FIGURE 4 is a modification of the circuit of FIGURE 2, described above, and a number of the corresponding circuit elements has been correspondingly numbered. Most of the circuit elements in FIGURE 4 to the left of points *a* and *b* correspond to those shown and described with relation to FIGURE 1. However, in the present embodiment the connection between alternating current source terminal **17** and the circuit point between capacitors **23** is shown as being made by leads **100** and **101**. A direct voltage is thus impressed across the points *a* and *b* as previously described, such voltage being on the order of twice the source voltage. As previously stated, point *a* is represented as being positive, and point *b* negative.

Point *a* connects to a positive lead **102** extending to contacts **67** of coin switches **68**–**70**, inclusive. A negative lead **103** is connected to point *b*, and extends clear to one side of the secondary **35** of transformer **33**. A plurality of resistors (or potentiometer windings) **104**–**115**, inclusive, are series connected between leads **102** and **103**. The first or upper one of such resistors, numbered **104**, may be fixed in value and is connected at its lower end to a lead **117**. Lead **117** extends to the previously described charging capacitors **73***a*–**75***a* and also to the storage capacitor **79***a*. The voltage drop across resistor **104** is thus impressed upon capacitors **73***a*–**75***a* when the coin-switch arms **72** are in the positions illustrated. Upon momentary shifting of one or more coin-switch arms **72** into engagement with contact **76**, the associated charging capacitors **73***a*–**75***a* are discharged through a lead **118** into storage capacitor **79***a*.

In the present illustration, the circuit is adapted to add pennies, nickels, dimes and quarters up to a 50¢ total. This being the case, a tap or contact point connected to the upper end of resistor **106** has been designated 50¢, a tap at the upper end of resistor **107** has been designated 45¢, and so forth down to the point where the tap at the upper end of resistor **115** has been designated 5¢. Such taps or contact points are schematically represented as associated with a slider **119** on a contact bar or lead **121**, the latter being shown as connected through a single-pole single-throw switch **122** to a lead **123** and thus to the primary **34** of transformer **33**. Switch **122** may be termed the post-select switch since it need not be closed by the customer until after insertion of the coins. Such switch may be a push button, for example, having the added function of determining what article is to be vended.

The capacitor **84**, described in connection with FIGURE 2, is connected between leads **117** and **123**, which means that shifting of the slider **119** effects variation of the voltage across capacitor **84**. When the slider **119** is at the lower end of contact bar or lead **121**, the voltage drop across all resistors **105–114** is impressed across capacitor **84**, which means that very little voltage need be impressed across storage capacitor **79***a* in order to effect initiation of a vending cycle through firing of the diode **31**. When the slider **119** is near the upper end of the scale, little or no voltage is impressed across capacitor **84**, and much charging of capacitor **79***a* must be effected before the vending cycle will commence. The slider and contact-point arrangement described above is exemplary of a large number of means for varying the voltage impressed upon capacitor **84** and thus determining the number of coins, and the types of coins, which must be inserted into the coin slots before vending will take place.

Resistor **105** is normally shorted, and thus rendered inoperative, by means of a shorting circuit which comprises a lead **124**, a manual switch **126**, the normally-closed contacts **127** of a relay **128**, a lead **129**, and a lead **131** back to the lead **117**.

The values of the various resistances **105–115**, inclusive, are selected to effect vending at the desired prices. The calibration thereof will be discussed subsequently, in connection with FIGURE 6.

Before proceeding with a description of the penny register portion of the circuit in FIGURE 4, a brief description will be given of the operation of the circuit with nickels, dimes, and quarters only. It is to be understood, of course, that the specification of nickels, dimes, quarters and pennies is representative only, and that various other United States or foreign denominations could be employed. In order to effect operation without pennies, the circiut is set (by the service man) by opening the manual switch **126**, and blocking the penny slot of the coin device.

Let it be assumed that the slider **119** has been set at the 45¢ terminal, as indicated, and that switch **122** is open. Any combination of nickels, dimes, and quarters, totalling 45¢, may then be inserted into the coin slots. The associated capacitors **73***a–75a* are thus discharged into storage capacitor **79***a* which achieves a predetermined voltage after coins totalling the 45¢ have been inserted. Post-select switch **122** is then closed by the customer, causing the voltage drop across resistors **105** and **106** to be impressed upon capacitor **84**, it being remembered that switch **126** is open and that resistor **105** is thus in the circuit (not shorted). The circuit is calibrated so that the combination of a voltage representing 45¢ and impressed across storage capacitor **79***a*, and the voltage drop across resistors **105** and **106** and impressed across capacitor **84**, will total the firing voltage of diode **31**. Such diode therefore fires to effect flow of current through the primary **34** of transformer **33**. This circuit is from capacitor **79***a* through a lead **132**, a lead **136** to the diode **31**, transformer primary **34**, and lead **123** back to the other side of the series combination of capacitors **79***a* and **84**.

The voltage thus induced in the secondary **35** of transformer **33** causes firing of thyratron **32**, and consequent flow of current through the following circuit: Coil **137** of a relay **134**, a lead **138**, contact **142** of a cam switch **141**, arm **139** thereof, lead **100** to terminal **17** of the power source, terminal **16** of the power source, lead **18**, lead **21**, rectifier **22**, lead **103**, and back to the cathode of thyratron **32**.

The resulting energization of relay **134** effects shifting of the contact arms thereof, so that one arm **133** of relay **134** is closed into engagement with contact **143**. This creates a shorting circuit effecting total discharge of storage capacitor **79***a*, such shorting circuit including a lead **142** to lead **117**, also including the lead **132**.

A second contact arm **146** of relay **134** is closed to contact **147**, thus effecting energization of the motor **148** of the vending apparatus with which the totalizer circuit is associated. This circuit is from power terminal **16** through lead **18**, motor **148**, lead **149**, relay arm **146**, contact **147**, and lead **151** back to lead **100** and power terminal **17**. Motor **148** causes the vending machine to go through its cycle. At the end of the cycle, the motor causes operation of a cam **152** to shift switch arm **139** out of engagement with contact **142** and into engagement with contact **153**. The above-described circuit to thyratron **32** is thus broken, so that the thyratron ceases to fire and effects de-energization of relay **134**. The contact arms **146** and **133** then return to their normal (open) positions, shown in the drawings, re-setting the totalizer for another cycle of operation. The closing of arm **139** to terminal **153** completes a second energization circuit for vending machine motor **148**, whereby cam **152** is rotated until switch arm **139** again engages contact **142** and re-sets the circuit for another cycle.

To set up the circuit for penny operation, the service man merely closes switch **126** and removes the plug or block from the penny slot in the vending machine. Resistor **105** is thus shorted, through the above-described circuit including the normally-closed contacts **127** of relay **128**. This means that even though the slider **119** is set at 45¢, for example, vending will not occur unless one of the following occurrences takes place: (*a*) insertion of 50¢ in nickels, dimes, or quarters into the coin slots therefor, or (*b*) insertion of 45¢ plus opening of the shorting circuit for resistor **105**, by energizing relay **128**. Such energizing of relay **128** is effected by inserting pennies into the machine.

A means for energizing relay **128** and thus breaking the shorting circuit for resistor **105**, upon insertion of the required number of pennies into the machine, is provided and will next be described. It is pointed out that, with the illustrated embodiment, no more than four pennies should be inserted for any particular vending cycle, the rest of the total sales price being adapted to be paid by nickels, dimes, and quarters exclusively.

The penny slot of the vending machine has associated therewith a coin switch **154**, the construction of which may correspond to that of switches **68–70**. The arm **156** of such switch is normally closed to terminal **158**, so that the associated charging capacitor **159** is energized, by the voltage drop across resistor **104**, as in the case of capacitors **73***a–75a*. Dropping of a penny into the penny slot causes shifting of arm **156** away from terminal **158** and into contact with terminal **161**, thus causing discharge of capacitor **159** into a second storage capacitor **162**. Such discharge is through a circuit which includes capacitor **159**, switch arm **156**, terminal **161**, a lead **163**, storage capacitor **162**, and lead **131** back to lead **117** and thus to the other side of capacitor **159**.

Another capacitor **164**, corresponding in function to capacitor **84**, is connected in series with capacitor **162** and is adapted to be charged with various voltages determining the number of pennies which must be inserted before relay **123** will be energized. The means for impressing the desired voltage on capacitor **164** is illustrated to comprise another contact bar or lead **166** having a slider **167** thereon. The slider is adapted to engage various terminals or contact points **168–172**, inclusive.

Terminal **168** is blind, and may be labelled zero cents, so that the service man will move the slider **167** thereto when the machine is set up (by blocking the penny slot and opening switch **126**, as previously described) for operation without pennies. The second terminal **169** may be connected through a lead **174** to the junction of resistors **107** and **108**, whereas terminal **170** may be connected through lead **176** to the junction of resistors **109** and **110**. Correspondingly, terminal **171** is connected through lead **177** to the junction of resistors **111** and **112**, and terminal

172 is connected through lead 172*a* to the junction of resistors 113 and 114. Terminals 169–172, inclusive, are labelled, respectively, 4¢, 3¢, 2¢ and 1¢.

When slider 167 is set at terminal 170, as illustrated, and when switch 178 is closed, the voltage drop across resistors 106–109, inclusive, is impressed across capacitor 164, it being remembered that resistor 105 is shorted and thus out of the circuit. This circuit may be traced from the lower side of capacitor 164 to a single-pole single-throw switch 178, contact bar or lead 166, slider 167, terminal 170, lead 176, resistor 109, resistor 108, resistor 107, resistor 106, the shorting circuit for resistor 105, and lead 131 back to the other side of capacitor 164. It is pointed out that progressively greater voltage is impressed across capacitor 164 as slider 167 is moved downwardly, which means that less pennies must be inserted into the penny slot to effect operation of the penny register portion of the circuit.

The calibrating of the penny register portion of the circuit of FIGURE 4 is done in relation to the firing voltage of a cold-cathode gas-filled diode 179 which corresponds in function to the diode 31 previously discussed. Diode 179 is connected, in series with the primary 181 of a transformer 182, across the series combination of capacitors 162 and 164. This circuit is from the upper side of capacitor 162 through a lead 183 (leading to an arm 184 of relay 128), thence through a lead 187 to diode 179, and thence through primary 181 to the capacitor 164.

The values of capacitors 159, 162 and 164 are selected to cause firing of the diode 179 when sufficient pennies have been inserted into the penny slot. This applies also to the points of connection of leads 174, 176, 177 and 172*a* to the series-connected resistors. Thus, assuming that the slider 167 is at the point indicated, it is known that when the voltage drop across resistors 106–109 (and thus across capacitor 164) is added to the voltage stored in capacitor 162 as a result of three discharges of capacitor 159, the diode 179 will fire.

Upon firing of diode 179, which cannot occur until closing of switch 178, a voltage is induced into the transformer secondary 188 to result in firing of the thyratron 189, the latter corresponding to thyratron 32. This effects energization of the coil 191 of relay 128 through the following circuit: Coil 191, a lead 192, lead 138 to cam switch 141, lead 100, terminals 17 and 16 of the alternating current supply, lead 18, lead 21, rectifier 22, lead 103, a lead 193 to the cathode of thyratron 189, and the plate of thyratron 189 back to coil 191.

Upon energization of the relay 128, its contacts 127 open to break the shorting circuit for resistor 105. The resulting increased voltage across capacitor 84 operates, as described above, to effect firing of diode 31 and thus initiate a vending cycle. Energization of relay 128 also closes arm 184 into engagement with contact 194, thereby effecting shorting and total discharge of storage capacitor 162 through a circuit including lead 183, and leads 197 and 131. The previously described opening of cam switch 141, at the end of the vending cycle, breaks the circuit to the relay coil 191 and thyratron 189, and re-sets the circuit.

Operation—FIGURE 4

Let it be assumed that the switches and relays are all in their illustrated positions, which are the normal positions between vending operations. The service man adjusts the sliders 119 and 167 until they total the price of the article to be vended. Assuming that the price of the article is 48¢, slider 119 is set to 45¢ and slider 167 to 3¢. The purchaser inserts any combination of nickels, dimes, and quarters, totalling 45¢, into the coin slots therefor, thus effecting operation of the corresponding coin switches 68–70 and consequent charging of capacitor 79*a*. Coins totalling 45¢ will not effect sufficient charging of capacitor 79*a* to cause firing of diode 31, and consequent commencement of a vending cycle, since the shorting of resistor 105 by the circuit including relay contacts 127 prevents the voltage across capacitor 84 from being sufficiently high. However, the shorting circuit for resistor 105 is broken, due to opening of relay contacts 127, when three pennies have been inserted into the penny slot of the machine.

The resulting three operations of penny switch 154, and three discharges of capacitor 159 into storage capacitor 162, create sufficient voltage, in combination with the voltage across capacitor 164, to effect firing of diode 179 and consequent operation of the thyratron 189 and relay 128. As soon as relay 128 is operated to open the shorting circuit for resistor 105, the additional voltage across capacitor 84 causes firing of diode 31, firing of thyratron 32, and energization of relay 134. This closes a circuit to motor 148 of the vending machine. Upon completion of vending, the cam switch 141 is opened away from contact 142 to break the circuits to relays 128 and 134. The circuit is then reset for a subsequent operation, capacitors 79*a* and 162 being totally discharged through completion of shorting circuits therefor when the relays are energized.

In the event the customer inserts an extra nickel into the coin slot so that the nickels, dimes, and quarters total 50¢ in the illustration, vending will occur without insertion of any pennies since the voltage across capacitor 84 and capacitor 79*a* is then sufficient to effect vending regardless of the shorted condition of resistor 105. Should it be desired to set the circuit for vending without pennies, as a multiple of five, for example, the penny coin slot is blocked, switch 126 is opened to remove the short from resistor 105, and slider 167 is set to the blind terminal 168.

It is pointed out that vending does not take place until closing of the post-select switches 122 and 178, which (as previously indicated) may be done by means of a push button or other device operated by the customer after the coins have been inserted. The totalizer is thus of the post-select type. Alternatively, the totalizer may be of the pre-select type by merely maintaining switches 122 and 178 closed at all times. The totalizer may thus be either post-select or pre-select, as desired for the particular use.

With more complicated switching means than the slider or potentiometer devices specified herein, the same totalizer may be employed (without adjustment by a service man) to effect vending at different prices, in accordance with the article selected by the particular customer. For example, in a sandwich vending machine, different sandwiches may be vended at different prices. Each sandwich is represented by a switch set to contact suitable taps on the potentiometer 105–115, such taps corresponding to the sales price of the selected sandwich. Then, after selection of the particular sandwich, and after insertion of the requisite coins into the coin slots, closing of switches 122 and 178 results in vending of the desired sandwich.

Description of Means Employed in the Circuits of FIGURES 4, 6, 7, for Nullifying the Effects of Current Leakage across the coin switches

In the circuits of FIGURES 1 and 2, the means 13 was employed to compensate for the effects of leakage across the coin switches, and self-charging of the capacitors. In the circuits of FIGURES 4, 6, and 7, means 13 is eliminated and a special shielding or bleed means, illustrated in FIGURE 5, is employed. The coin switch shown in FIGURE 5 is representative of all coin switches which may be employed in the circuits of FIGURES 4, 6, and 7 (or in the circuits of FIGURES 1 and 2, if desired). Each such switch has arm 72 which is inserted in the desired coin slot for downward movement upon passing of a coin through the coin slot. Such arm is spring biased so that its contact is normally in engagement with the upper contact 67, the latter being mounted on an arm or post 196 supported in a casing 197. Casing 197 is formed of a good insulator, but some leakage of current nevertheless takes place therethrough.

The contact 76 of the coin switch is mounted on a post

198, on the opposite side from post 196 of the pivot post 199 for arm 72. Post 198 is mounted in casing 197 by a means which comprises a layer 201 of insulating material provided around the post, and a metal ring 202 mounted around the insulating layer 201 and supported in the casing 197. The ring 202 is connected to the negative terminals of capacitors 79*a* and 162, that is to say connected to the lead 117. Such connection is indicated by the lead 203 in FIGURES 4, 6, and 7.

With the described arrangement, leakage current from posts 196 and 199 flows through casing 197 to the region of post 198, but does not reach such post since it is collected by the ring 202 and conducted to the negative terminals of capacitors 79*a* and 162 through lead 203. It follows that the post 198 for contact 76 does not receive any leakage current, which means that there is no build up of charge across storage capacitors 79*a* and 162 due to leakage across the coin switches. Self-charging of the capacitors 79*a* and 162 may be rendered negligible through the use of special capacitors having low dielectric absorption.

Description of the Circuit of FIGURE 6, Incorporating Change-Making Means

The circuit of FIGURE 6 incorporates may of the components previously described, and many such components have been given the same reference numerals as before. Thus, for example, the voltage doubling and rectifying circuit is generally the same as was described in connection with FIGURE 4, except that lead 101 is connected directly to terminal 17 instead of through the lead 100. The resistors, or potentiometer windings, in the voltage dividers have again been numbered 104–115.

Stated generally, the change-making circuit of FIGURE 6 incorporates means to generate a number of pulses corresponding to the over-charge on the storage capacitor means which was numbered 79*a* in previous embodiments. Such over-charge is created by an excessive discharge of voltage from capacitors 73*a*–75*a*, due to insertion of a coin or coins totalling more than the price of the article being vended. The pulses resulting from the over-charge on the storage capacitor are employed to effect repeated or sequential energization of a discharge device, which device pays to the customer one coin for each energization.

To accomplish the above, the storage capacitor 79 and 79*a* of previous embodiments is replaced by two capacitors 206 and 207 which are connected in parallel between leads 118 and 117. These capacitors have capacitance values which total approximately the same value as capacitor 79*a* (assuming the same values of capacitors 73*a*–75*a*, inclusive) and are separated by a high resistance 208 which is interposed in lead 118. Resistor 208 is connected to the gas-filled diode 31 which is, in turn, connected through transformer primary 34 to a lead 209. Lead 209 is connected both to capacitor 84 (the other side of which is connected to lead 117) and to a contact bar or lead 211 having a slider 212 thereon. Such slider, as in the previous embodiment, is adapted to be selectively connected to points between the various resistors 105–115, such points having been numbered 5¢–50¢. Various amounts of voltage may be impressed across capacitor 84 in accordance with the position of the slider, it being remembered that capacitor 84 is connected through lead 117 to the upper side of resistor 105.

The voltage supplied to capacitor 206 leaks through the high resistor 208 and builds up (across capacitor 207) to a point where it, in combination with the voltage across capacitor 84, is sufficient to effect firing of diode 31. Diode 31 then fires to deliver a pulse to the secondary of transformer 33. As above indicated, the diode 31 fires and extinguishes repeatedly, the number of such firings depending upon the amount of overcharge on the parallel capacitors 206 and 207 caused by insertion into the machine of an excess coin total.

Each pulse thus delivered to transformer secondary 35 causes firing of thyratron 32. This causes energization of the coil 213, preferably a shaded pole type coil, of a pulsing relay 214, through a circuit which may be traced as follows: Coil 213, contact 216 of the pulsing relay, arm 217 thereof, lead 218, lead 219, lead 101 to source terminal 17, source terminal 16, lead 18, rectifier 22, a lead 103, and thyratron 32 back to relay coil 213.

As soon as pulsing relay 214 is thus energized, arm 217 shifts away from contact 216 and into engagement with contact 221. The above-described energizing circuit through relay coil 213 is thus broken, causing de-energization of the pulsing relay 214, and extinguishment of the thyratron. However, a capacitor 222, preferably having approximately from 4 to 8 mfd. capacitance, connected in parallel with coil 213, maintains the pulsing relay energized sufficiently long to effect closing of arm 217 to the contact 221.

Closing of arm 217 to contact 221 completes an energizing circuit to an operating relay 223, as follows: Contact 221, a lead 224, a resistor 226, coil 227 of the operating relay, a lead 228, rectifier 19, lead 21, lead 18, power source terminal 16, power source terminal 17, lead 101, lead 219, lead 218, and back to arm 217 of the pulsing relay 214.

The resistor 226 in the above-described circuit co-operates with a capacitor 229 (shunted across coil 227) to delay or time the shifting of operating relay 223 until after pulsing relay 214 has resumed its initial condition illustrated in the drawing. In other words, the various circuit elements 222, 226, and 229 are so adjusted that pulsing relay 214 will operate and then resume its initial position before operating relay 223 actually shifts. The purpose of this is to prevent completion of an energizing circuit to the solenoid 231 of the pay-out device upon the first pulse, but to permit energization of solenoid 231 for the second and each subsequent pulse.

The circuit to the pay-out solenoid 231, which discharges one coin (normally a nickel) for each energization thereof, may be traced as follows: Solenoid 231, contacts 232 of pulsing relay 214, a lead 233, contacts 237 of operating relay 223, lead 219, lead 101, terminal 17, terminal 16, lead 18, and a lead 234 back to the pay-out solenoid 231. The pay-out device may be of any suitable type, and may include a nickel-discharge chute 235.

To summarize the above-described relationships between relays 214 and 223, it is pointed out that the contacts 232 and 237 are in series, so that both must be closed at the same time before the pay-out solenoid 231 will be momentarily energized. The first pulse does not cause simultaneous closing of contacts 232 and 237, since contacts 232 open before contacts 237 close. However, as soon as the operating relay 223 has been energized by the first pulse, it remains closed (during the entire period of operation of the vending machine) because of completion of a self-holding circuit which may be traced as follows: Normally-open contacts 236 of operating relay 223, coil 227 of the operating relay, lead 228, rectifier 19, lead 21, lead 18, source terminal 16, source terminal 18, lead 101, lead 219, contacts 237 of operating relay 223 (such contacts then being closed), a lead 238, normally-closed contacts 239 of a stopping relay 241, and a lead 242 back to the contacts 236 of the operating relay. Each subsequent pulse thus causes contacts 232 and 237 to be closed at the same time, energizing pay-out solenoid 231.

Operating relay 223, which is maintained in shifted position as above described, serves to effect energization of the vending machine motor 242*a* so that the vending cycle takes place. This circuit is as follows: Motor 242*a*, lead 238, contacts 237 of operating relay 223, lead 219, power source terminals 17 and 16, and back through a lead 244 to the motor 242*a*.

The continued closed condition of operating relay 223 also serves to maintain an open circuit across the portion

of the voltage divider which includes resistors **105–115**, inclusive. These resistors are normally shorted out by a post-select switch **247** until after the coins have been inserted into the unit, and until the post-select switch **247** has been pressed (opened) by the customer to cause the first pulse as will be described hereinafter. In order to maintain the post-select circuit open after the customer releases the switch **247**, which is normally a push button, the normally-closed contacts **248** are provided on operating relay **223**, such contacts remaining open after the operating relay is shifted as above described. The shorting circuit for resistors **105–115**, and through the switch **247** and contacts **248**, may be traced as follows: Switch **247**, contacts **248**, a lead **249**, a lead **251**, lead **117**, resistors **105–115**, inclusive, lead **103**, and a lead **252** back to the post-select switch **247**.

The length of the vending cycle is adjusted, through proper selection and gearing of the motor **242***a* and other elements, so that the cycle is not over until all of the change has been paid out to the customer. At the end of the vending cycle, vending motor **242***a* effects closing of a cam switch **253** and thus causes energization of the stopping relay **241**. This circuit is from power terminal **17** through switch **253**, a lead **254**, coil **256** of the stopping relay, lead **257***a*, lead **234**, and lead **18** back to source terminal **16**.

Energization of stopping relay **241** opens the contacts **239** and thus breaks the holding circuit to operating relay **223**, so that such relay resumes its initial condition illustrated in the drawing. When the stopping relay arm shifts to break contacts **239**, it closes contacts **257** of such relay to maintain the vending motor energized until cam switch **253** has again opened. This circuit is through contacts **257**, lead **219**, lead **101**, source terminals **17** and **16**, lead **244**, vending machine motor **242***a*, and lead **238** back to the arm which comprises a component of both sets of contacts **239** and **257**. Opening of the cam switch **253** causes de-energization of the motor, by de-energizing relay **241**, the apparatus then being reset for a new cycle of operation upon insertion of additional coins.

The de-energization of operating relay **223** effects opening of the contacts **237**, which breaks the initially described vending motor circuit and causes contacts **257** to take over as indicated, until the cam switch **253** again opens. The closing of contacts **248** of the operating relay causes shorting of the resistors **105–115**, until a subsequent operation of the apparatus.

To complete the resetting of the totalizer for a subsequent cycle of operation, an arm **258** of the stopping relay closes to its contact **259**, and an arm **261** closes to its contact **262**. This effects, while the stopping relay **241** is energized prior to opening of cam switch **253** as indicated, completion of shorting circuits for the storage capacitors **206** and **207**. The first of such shorting circuits may be traced from arm **258** through contact **259**, a lead **263**, lead **118**, capacitor **206**, lead **117**, lead **251**, and back to arm **258**. The second of such shorting circuits is as follows: Arm **261**, contact **262**, a lead **264**, capacitor **207**, lead **251**, and back to arm **261**. Capacitors **206** and **207** are thus completely discharged to prepare them for subsequent cycle.

Operation—FIGURE 6

For purposes of illustration, let it be assumed that the service man has set the slider **212** at the 10¢ terminal, representing a selling price of 10¢. Let it further be assumed that the customer has inserted 25¢ into the machine, in the form of a single coin or any combination of dimes and nickels. If the inserted coin were a quarter, switch **70** would momentarily shift to a position at which arm **72** is in engagement with contact **76**, resulting in discharge of capacitor **75***a* into capacitor **206** and consequent increase in voltage on the latter. Such a voltage is insufficient, however, to initiate the vending cycle since there is no voltage across capacitor **84** due to the fact that resistors **105–115**, inclusive, are shorted through the circuit including post-select switch **247** and contacts **248** of the operating relay. Such shorting of resistors **105–115** has the beneficial effect of greatly increasing the charging voltage across resistor **104**, close to the full value across circuit points *a* and *b*, which makes the operation of the apparatus less non-linear.

After the voltage corresponding to insertion of 25¢ is impressed across capacitor **206**, it leaks (after a short period of time) through the high resistor **208** until it is also impressed across capacitor **207**.

Having inserted the coin or coins into the machine, the customer next opens the post-select switch **247** and thereby breaks the shorting circuit across resistors **105–115**. The voltage drop across resistors **105–113** (slider **212** being set at the 10¢ terminal) is thus impressed across capacitor **84**, which is in series with capacitor **207**. Since the circuit is calibrated so that a voltage across capacitor **207** corresponding to the insertion of 10¢, when combined with the voltage across capacitor **84**, will effect firing of diode **31** and thus commencement of the vending cycle, the combined voltage across capacitors **207** and **84** is more than sufficient to effect firing of diode **31** (25¢ having actually been inserted in the present illustration). Firing of diode **31** causes flow of current through pulsing transformer **34** and consequent firing of thyratron **32**.

When the thyratron fires, a circuit is completed through coil **213** of pulsing relay **214**, thereby effecting shifting of such relay—but only momentarily since the movement of arm **217** away from contact **216** breaks the circuit to relay coil **213**. Capacitor **222** is, however, operative to maintain relay **214** energized until arm **217** engages contact **221**, which completes a circuit to the coil **227** of operating relay **223**. By the time the operating relay contacts actually shift, however, and because of the time delay introduced by resistor **226** and capacitor **229**, pulsing relay **214** has returned to its initial position illustrated in the drawing. Furthermore, the thyratron **32** is extinguished upon disengagement of arm **217** from contact **216**, and diode **31** extinguishes due to dropping of the combined voltage across capacitors **207** and **84** to a value less than the sustaining voltage required to maintain the diode in firing condition. Such drop in voltage is only momentary, and builds up again to the firing voltage of diode **31** as soon as sufficient time has elapsed for the requisite voltage to leak through high resistor **208** from capacitor **206** to capacitor **207**. Subsequent pulses or firings of diode **31** then occur in accordance with the amount of excess charge on the capacitor **206**, as determined by the amount of coins inserted into the apparatus.

From the above it will be understood that the first firing of diode **31**, that is to say the first pulse, causes rapid shifting of pulsing relay **214** and consequent shifting of operating relay **223**, but the latter does not occur until after the pulsing relay has resumed its initial condition. The second and subsequent pulses or firings of diode **31** effect operation of pulsing relay **214** in the same manner as the first pulse, but have no effect on the operating relay **223** since such relay is maintained shifted by a holding circuit which may be traced through contacts **236** and contacts **239** of the stopping relay **241**. The pay-out solenoid **231** is not energized during the first pulse since contacts **232** close and then open before contacts **237** (which are in series therewith) close. Upon subsequent pulses, each closing of contacts **232** effects momentary energization of the pay-out solenoid **231**, since contacts **237** of the operating relay continue in closed condition. It follows that a coin, normally a nickel, is discharged upon the second pulse and upon each subsequent pulse, but not upon the first pulse.

The contacts **248** of the operating relay cause the shorting circuit for resistors **105–115** to remain in open position after the customer has released the post-select switch **247**, so that pulsing will continue. Contacts **237** of the

operating relay effect completion of a circuit to the motor 242*a* of the vending machine, thus causing the vending cycle to commence.

The vending cycle, as previously indicated, is so regulated that it will continue at least as long as is required to discharge the change from the coin apparatus associated with pay-out solenoid **231**. In the illustration, in which 25¢ was inserted for a 10¢ article, the cycle must continue at least long enough to permit four pulses of the diode **31** and associated apparatus. The first pulse causes the vending to commence, but does not effect energization of the pay-out solenoid, whereas the three subsequent pulses cause sequential discharges of three nickels to the customer for his 15¢ change. After the four pulses, there is no longer voltage on capacitor **206** sufficient to cause further pulsing.

After the customer has been given his change and the vending cycle has been completed, the vending motor 242*a* effects closing of cam switch **253** to energize stopping relay **241** and effect shifting of the contacts thereof. Contacts **239** thus open and break the holding circuit to the operating relay **223**, so that such relay assumes its initial condition and breaks the energizing circuit to the vending machine motor. The shorting circuit for resistors **105–115** is completed upon closing of contacts **248**.

When the stopping relay **241** shifts, it completes a new energizing circuit for motor 242*a*, through contacts **257**, so that the motor 242*a* continues operating until cam switch **253** has again opened to reset the apparatus for a subsequent cycle of operation. The stopping relay also operates through its contacts **259** and **262** (and associated arms **253** and **261**, respectively) to effect shorting of storage capacitor **206** and **207**.

Discussion of Circuit Relationships and Calibration, Particularly in Connection with the Change-Making Circuit of FIGURE 6

The following description relative to the selection of values of capacitors 73*a*–75*a*, relative to the value of the storage capacitor or capacitors, and relative to the values of compensating resistors **105–115**, applies not only to the change-making circuit of FIGURE 6 but also, in principle, to the penny register circuit (FIGURE 4) as well as the basic circuit shown in FIGURE 2. Such description constitutes an amplification upon the basic description given in connection with FIGURE 1.

A storage capacitor is first selected, having a capacity related to the firing voltage of diode **31** and sufficiently high to store the charge impressed thereon as a result of discharge of capacitors 73*a*–75*a*. With reference to the circuit of FIGURE 6, capacitors **206** and **207** may be treated, since they are connected in parallel, as one capacitor having a value which is the sum of the two capacitances.

Again with reference to the circuit of FIGURE 6, the full voltage between points *a* and *b* is impressed across lines **102** and **117**, by closing the shorting circuit for resistors **105–115**, after which capacitor 73*a* is repeatedly discharged ten times (assuming the nickel, dime, quarter relationship in the illustration) into the storage capacitors **206** and **207**. It is then determined what voltage is present across capacitors **206** and **207**, and the values are so selected that such voltage is not quite high enough to effect firing of diode **31**. The values are selected, however, so that one additional discharge of capacitor 73*a* (totalling **11** discharges) would cause diode **31** to fire.

The value of capacitor 74*a* is then selected so that five discharges thereof will produce the same voltage, in parallel capacitors **206** and **207** of FIGURE 6, as the ten discharges of capacitor 73*a*. Correspondingly, the value of capacitor 75*a* is selected so that two discharges thereof will produce the same voltage in the storage capacitors as five discharges of capacitor 74*a*, or the ten discharges of capacitor 73*a*.

The above arrangement is, as previously stated, non-linear. The non-linearity is such that each successive discharge of capacitor 73*a* adds a smaller increment of voltage, to the parallel capacitors **206** and **207**, than did the previous discharge. This non-linearity is important in the calibration of the resistors **105–115**, which may be termed compensating resistors since they compensate for an inadequate number of discharges of the charging capacitors to effect vending at values less than 50¢. To calibrate the first compensating resistor **105**, slider **212** is moved to the 50¢ terminal, and the shorting circuit for the resistors **105–115** is placed across resistors **106–115**. The value of resistor **105** is then adjusted until the voltage thereacross, and thus across capacitor **84**, is sufficient to cause firing of diode **31** after ten discharges of capacitor 73*a* into capacitors **206** and **207**.

Slider **212** is then moved to the 45¢ terminal and the said shorting circuit is placed across resistors **107–115**, and the value of resistor **106** is adjusted until firing of the diode **31** will occur after nine discharges of capacitor 73*a*. This process is repeated, for each of the resistors, until only one discharge of capacitor 73*a* will effect firing when the slider **212** is at the 5¢ terminal.

It is pointed out that the values of the resistors at the bottom portion of the voltage divider are generally higher than the values at the top portion thereof. This is because, as above stated, more voltage is added to the storage capacitor **206** and **207** upon the initial discharges of capacitor 73*a* (corresponding to resistors **113** and **115**) than upon the final discharges thereof (corresponding to resistors **106** and **107**, etc.).

The reason for selecting the circuit values so that ten discharges of capacitor 73*a* are insufficient to cause firing of the diode **31** is that it is not desired to cause the diode to fire until post-select switch **247** is opened to break the shorting circuit for resistors **105–115**.

Although the above calibration procedure was also applicable to the circuit of FIGURE 4 and the circuit of FIGURE 2, except for differences in the voltage supply during charging of the capacitors 73*a*–75*a* prior to discharge thereof into the storage capacitor means, the following description has reference only to FIGURE 6 (and also FIGURE 7).

During the above-described calibration procedure, the values of capacitors **206** and **207**, relative to each other, do not matter. These relative capacitance values are determined (as will next be stated) with relation to the pulsing characteristics of the change-making circuit, but are always such that the total value of capacitors **206** and **207** is approximately equal to the value of the storage capacitors present during calibration of charging capacitors 73*a*–75*a*.

Stated generally, the relationship between capacitor **206**, capacitor **207** and high resistance **208** is so adjusted that the number of pulses will be one greater than the number of increments of excess charge on capacitors **206** and **207**. Each increment of excess charge may be defined as the charge added by each discharge of capacitor 73*a* after a vending-initiating voltage has been stored in capacitors **206** and **207**. Thus, there should only be one pulse if the coins inserted into the apparatus total the price of the article being vended, there then being no increments of excess charge, and there should be one additional pulse for each nickel inserted above the price of the article being vended. The number of pulses is increased by lowering the value of capacitor **207** relative to the value of capacitor **206**, but always in such manner that these capacitances total approximately the same value as was present during calibration of capacitors 73*a*–75*a*.

The relationship between the pulsing components is non-linear, and in a different manner than the manner in which the relationship between the compensating resistors **105–115** is non-linear. However, it has been discovered that it is possible to select values of capacitors **206** and **207**

which will provide a limited number of pulses, over the range required.

To calibrate the capacitors **206** and **207** relative to each other, the slider **212** is set at a certain point, for example at the 10¢ terminal as illustrated, and capacitor **73***a* is discharged a predetermined number of times, for example five. This corresponds to an insertion of 25¢ for a 10¢ purchase price. The relative values of capacitors **206** and **207** are then adjusted until four pulses result, the first pulse starting the vending cycle and the remaining three pulses effecting discharge of three nickels to the customer. This empirical process is then repeated for different numbers of discharges of capacitor **73***a* (or capacitors **74***a* and **75***a*), and the capacitors **206** and **207** are adjusted until the proper number of pulses are obtained for various numbers of discharges of capacitors **73***a*–**75***a*.

Slider **212** is then moved to various other terminals, and the process is repeated until the capacitors **206** and **207** are proper in value (over the entire range) to provide the required number of pulses. It is pointed out that more than five pulses are not normally required, since the customer would not insert more than 25¢ for a 5¢ purchase, or more than 50¢ for a 30¢ purchase.

The value of the high impedance resistor **208** is adjusted to control the speed of pulsing, and is generally related to the speed of operation of the pulsing relay **214**, pay-out solenoid **231**, etc. Thus, the resistor **208** is preferably of such value that the remaining components in the circuit will operate as fast as they are capable of operating, to increase the pay-out speed to the maximum.

To continue the illustration in which 25¢ has been inserted into the apparatus for a 10¢ purchase, the voltage across capacitor **84** is high since slider **212** is at the lower end of the voltage divider. The combined voltage across capacitor **207** and capacitor **84** is thus high (because of the excess coins inserted) in relation to the value required to fire diode **31**. Let it be assumed that diode **31** fires at 63 volts and extinguishes at a predetermined lower voltage, for example 50 volts. Since the voltage across capacitors **207** and **84** is substantially higher than 63 volts, diode **31** will fire and result in the initial pulse required to start the vending cycle. Such pulse causes a rapid drop in the voltage across capacitors **207** and **84**, and may (as a transient condition) cause the voltage across capacitor **207** to become negative relative to that across capacitor **84**. Regardless of whether or not such a negative condition may exist as a transient state, it has been determined that the diode **31** extinguishes after the first pulse, which means that the combined voltage must be depressed lower than 50 volts. Thus, it has been experimentally determined that in certain instances the diode **31** will extinguish even when the voltage across capacitor **84**, by itself, is higher than the 50 volt extinguishment voltage of the diode **31**.

The momentary reduction in the voltage across capacitors **207** and **84** is made up or replaced by the remaining voltage across capacitor **206**, and at a rate determined by the magnitude of resistor **208**. As soon as the voltage across the combined capacitors **207** and **84** again reaches the 63 volt firing voltage of diode **31**, the diode fires to cause a second pulse which continues until the voltage across capacitors **207** and **84** momentarily drops below the 50 volt extinguishment voltage. This process is repeated, with some of the voltage across capacitor **206** feeding into capacitor **207** after each pulse, until there is no longer sufficient voltage to raise the combined voltage value across capacitors **207** and **84** to the 63-volt firing voltage. In the present illustration, this occurs after four pulses.

In the preferred embodiments of FIGURES 2, 4, 6 and 7, capacitor **73***a* has approximately 0.016 mfd. capacitance, capacitor **74***a* has approximately 0.033 mfd. capacitance and capacitor **75***a* has approximately 0.09 mfd. capacitance. In the preferred embodiment of FIGURE 4, capacitor **79***a* has approximately 0.25 mfd. capacitance; and in the preferred embodiments of FIGURES 6 and 7, capacitor **206** has approximately 0.15 mfd. capacitance and in FIGURE 6 capacitor **207** has approximately 0.1 mfd. capacitance. In the preferred embodiments of FIGURES 4 and 6, resistor **104** is approximately 330,000 ohms, **105** is approximately 9,700 ohms, **106** is approximately 10,300 ohms, **107** is approximately 10,960 ohms, **108** is approximately 11,640 ohms, **109** is approximately 12,400 ohms, **110** is approximately 13,200 ohms, **111** is approximately 14,040 ohms, **112** is approximately 14,940 ohms, **113** is approximately 15,900 ohms, **114** is approximately 16,920 ohms and **115** is approximately 18,000 ohms. In the embodiment of FIGURE 4, capacitor **159** has a capacitance of 0.033 mfd., capacitor **162** has a capacitance of 0.250 mfd., and capacitor **164** has a capacitance of 1.250 mfd.

Description of the Circuit of FIGURE 7, Which Is Particularly Adapted for Use in Connection With Coin-Operated Phonographs.

The circuit of FIGURE 7, which is particularly adapted for conventional nickel-dime-quarter coin-operated phonographs (although it may be employed for other denominations of coins), is basically the same as the change-making circuit of FIGURE 6. Corresponding components of the circuit of FIGURE 7 and that of FIGURE 6 have been correspondingly numbered in most instances. In the circuit of FIGURE 7, the resistors **266** and **268** are so related that the operation of the circuit is the same as that of FIGURE 6, when the slider **212** of the latter is set at 5¢. Accordingly, one pulse is delivered by the pulsing transformer **33** upon insertion of 5¢, two pulses for 10¢, and five pulses for 25¢.

Each pulse causes firing of thyratron **32**, and completes a circuit to a stepping relay **266** so that the wheel **267** thereof rotates one step clockwise for each pulse. This circuit may be traced from the plate of thyratron **32** through a lead **268**, normally-closed contacts **269** of the stepping relay, solenoid coil **271** of such relay, a lead **272**, a lead **273**, lead **101**, source terminals **17** and **16**, lead **18**, rectifier **22**, and lead **103** back to the cathode of thyratron **32**.

Each time the solenoid coil **271**, preferably a shaded pole type, is energized, it operates not only to open the contacts **269** but also to shift an operating arm **274** downwardly. This effects the above-indicated clockwise rotation of wheel **267** for one step, there being a detent mechanism **276** provided to determine exactly the amount of rotation effected. As soon as contacts **269** open, the circuit to coil **271** is broken and thyratron **32** extinguishes, but the capacitor **277**, preferably having approximately 4 to 8 mfd. capacitance, (across coil **271**) maintains coil **271** energized sufficiently long to effect the above-described downward shifting of arm **274**.

A roller **278** on the relay wheel **267** is in engagement with an arm **279** only when the wheel is at the illustrated neutral position. By shifting the wheel **267** (and thus roller **278**) one step clockwise, arm **279** is released to permit closing of a normally-open switch **281**. Closing of switch **281** completes a power circuit through the motor **282** of the phonograph, such circuit being traceable from power lead **18** to a lead **283**, motor **282**, lead **284**, switch **281**, and lead **273** to power lead **101**.

Motor **282** operates continuously while roller **278** is out of engagement with arm **279**. After the phonograph plays each record, motor **282** effects momentary closing of a cam switch **286** to complete a circuit to a second solenoid coil **287** of the stepping relay **266**. Such circuit is from lead **18** through a lead **288**, switch **286** therein, and then back through lead **273** to power lead **101**. Energization of solenoid coil **287** causes downward shifting of an associated arm **291** and thus causes rotation of relay wheel **267** one step counter-clockwise, or in the opposite direction from the rotation effected by shifting of arm **274**.

After a second record has been played, switch **286**

again momentarily closes to energize solenoid coil **287** and cause wheel **267** to rotate another step counter-clockwise. This continues until roller **278** again engages arm **279**, causing opening of switch **281** and consequent de-energization of motor **282**. From the above it will be understood that five pulses from the pulsing circuit will cause rotation of wheel **267** five steps clockwise, so that motor **282** will effect playing of five records before the roller **278** will re-engage arm **279** and cause de-energization of the motor. The number of records played is thus related to the number of coins (and the value of the coins) inserted in the various coin slots.

It is frequently desired, in apparatus of the type indicated, that insertion of a quarter will result in six plays instead of five. This is provided for by adding an additional capacitor **292** in parallel with the quarter capacitor **75***a*. A switch **293** is adapted to cut capacitor **292** into and out of the circuit, when desired by the serviceman. The value of capacitor **292** is so selected that, when added to the value of quarter capacitor **75***a*, and after discharge into the storage capacitors **206** and **207***a*, it will effect six pulses instead of five; and that value will preferably be approximately 0.15 mfd. The motor **282** is thus caused to play six records instead of five, upon insertion of a quarter.

In order to adapt the apparatus for monetary inflation and deflation, a capacitor **294** is added, in series with a switch **296**, across storage capacitor **207***a*. When switch **296** is closed, capacitors **294** and **207***a* are in parallel with each other and result in a lesser number of pulses. For example, to compensate for present operation and future monetary inflation, capacitor **207***a* is selected so its capacity plus that of capacitor **294** equals the capacity of capacitor **207** in FIGURE 6; and so capacitor **207***a* will respond to opening of switch **296** to provide one pulse for 10¢, two pulses for 20¢ and three pulses for 25¢, and will respond to paralleling with capacitor **294** when switch **296** is closed to provide one pulse for 10¢, two pulses for 20¢ and three pulses for 30¢. Consequently, in such a case, opening of the switch **296** provides normal operation and closing of that switch provides operation in times of monetary inflation. To compensate for present operation and future monetary deflation, capacitor **207***a* is selected so its capacity plus that of capacitor **294** equals the capacity of capacitor **207** in FIGURE 6; and so capacitor **207***a* will respond to paralleling with capacitor **294** when switch **296** is closed to provide one pulse for 10¢, two pulses for 20¢ and three pulses for 25¢; and will respond to opening of switch **296** to provide one pulse for 10¢, two pulses for 15¢ and four pulses for 25¢. Consequently, in this latter case, closing of the switch **296** provides normal operation and opening of that switch provides operation in times of monetary deflation. In this latter case, the values of capacitors **294** and **207** will be different from those assigned to those capacitors in the former case.

Various embodiments of the present invention, in addition to what has been illustrated and described in detail, may be employed without departing from the scope of the accompanying claims.

I claim:

1. In a totalizer or accumulator for coin-operated apparatus, storage capacitor means, charging capacitor means, coin-operated switch means to effect charging of said charging capacitor means and then discharging thereof into said storage capacitor means, and pulse means connected to said storage capacitor means to generate sequentially and automatically a number of electrical pulses which is related to the charge on said storage capacitor means as determined, at least partially, by the number of coins inserted and consequent number of operations of said switch means, said pulse means also being connected to an output circuit to effect sequential operation of components thereof, said pulse means being self contained within the totalizer for operation in the absence of external stimuli.

2. In a coin totalizer or accumulator, charging capacitor means, storage capacitor and pulsing means including at least two parallel-connected capacitors separated by a high resistor, coin switch means adapted upon insertion of coins therethrough to effect charging of said charging capacitor means with voltage from a direct voltage source and thereafter to effect discharging of said charging capacitor means into one of said capacitors of said storage capacitor and pulsing means, the resulting voltage across said one capacitor then leaking into the other of said capacitors of said storage capacitor and pulsing means and at a rate determined by factors including the magnitude of said resistor, and means responsive to the voltage across said other capacitor to effect a control operation and also to effect momentary reduction of said voltage across said other capacitor to a lower value, said last-named means operating to effect another control operation after building up of said voltage across said other capacitor from said lower value to a higher value due to leakage of voltage from said one capacitor.

3. In a coin totalizer or accumulator, charging means, storage capacitor and pulsing means including at least two parallel-connected capacitor means separated by high resistor means, means including coin-responsive means to effect charging of one of said capacitor means by said charging means, the resulting voltage across said one capacitor means then leaking into the other of said capacitor means of said storage capacitor and pulsing means and at a rate determined by factors including the magnitude of said resistor means, said storage capacitor and pulsing means also including a gas-filled diode connected to said other capacitor means and adapted to fire at a predetermined voltage value and extinguish at a predetermined lower voltage value, whereby a sufficiently large charge on said one capacitor means creates a series of successive chargings of said other capacitor means and consequent successive firings of said diode, and means responsive to each firing of said diode to produce a control effect.

4. The invention as claimed in claim 3, in which said last-named means includes a stepping relay responsive to successive firings of said diode.

5. A combination change-making totalizer or accumulator and coin-operated apparatus, which comprises a coin-operated apparatus, a payout means operably associated with said apparatus and responsive to each energization thereof to discharge one coin having a predetermined relatively low denomination, storage means, coin-operated charging means to charge said storage means to a voltage related to the monetary value of various coins inserted into the apparatus, pulsing means associated with said storage means and responsive to said voltage to generate successive pulses the number of which is one greater than a predetermined number, said predetermined number being determined by subtracting the operating price of the apparatus from the total monetary value of the inserted coins and dividing the remainder by the monetary value of said low-denomination coin, means responsive to one of said pulses to initiate operation of said apparatus, and means responsive to each other pulse to energize said payout means.

6. A totalizer for coin-operated apparatus, which comprises a first storage capacitor, a first charging capacitor, a first coin switch adapted when in normal position to charge said first charging capacitor from a source of direct voltage and when in actuated position to effect discharge of said first charging capacitor into said first storage capacitor, a second charging capacitor, a second coin switch adapted when in normal position to effect charging of said second charging capacitor from a source of direct voltage and when in actuated position to effect discharge of said second charging capacitor into said first storage capacitor, a third charging capacitor, a third coin switch

adapted when in normal position to effect charging of said third charging capacitor from a source of direct voltage and when in actuated position to effect discharge of said third charging capacitor into said first storage capacitor, a second storage capacitor connected in parallel with said first storage capacitor, a high resistance connected between said first and second storage capacitors whereby the voltage impressed across said first storage capacitor must leak through said high resistance before being impressed across said second storage capacitor, a compensating capacitor connected in series with said second storage capacitor, a gas-filled diode connected across the series combination of said second storage capacitor and said compensating capacitor, means to impress a variable direct voltage across said compensating capacitor and in accordance with the price of the article or commodity being vended, said charging capacitors being so related to said first and second storage capacitors that different numbers of discharges of said charging capacitors are required before a predetermined voltage is built up across said storage capacitors, means to effect operation of a pulsing relay upon each firing of said gas-filled diode, an operating relay adapted to effect initiation of an operation of said apparatus, means to effect operation of said operating relay due to the first operation of said pulsing relay upon the first firing of said gas-filled diode, pay-out solenoid means adapted to discharge a coin to the customer upon each energization thereof, and means to effect energization of said pay-out solenoid means upon the second operation of said pulsing relay and upon each subsequent operation thereof, as determined by the number of firings of said diode.

7. The invention as claimed in claim 6, in which time-delay means are provided to prevent shifting of said operating relay until after said pulsing relay has shifted to actuating position and then returned to initial position, and in which the circuit to said pay-out solenoid includes contacts of both the pulsing relay and the operating relay whereby operation of said pay-out solenoid during the first operation of said pulsing relay is prevented.

8. A totalizer for coin-operated apparatus, which comprises a first storage capacitor, a first charging capacitor, a first coin switch adapted when in normal position to charge said first charging capacitor from a source of direct voltage and when in actuated position to effect discharge of said first charging capacitor into said first storage capacitor, a second charging capacitor, a second coin switch adapted when in normal position to effect charging of said second charging capacitor from a source of direct voltage and when in actuated position to effect discharge of said second charging capacitor into said first storage capacitor, a third charging capacitor, a third coin switch adapted when in normal position to effect charging of said third charging capacitor from a source of direct voltage and when in actuated position to effect discharge of said third charging capacitor into said first storage capacitor, a second storage capacitor connected in parallel with said first storage capacitor, a high resistor connected between said first and second storage capacitors whereby the voltage impressed across said first storage capacitor must leak through said high resistor before being impressed across said second storage capacitor, a compensating capacitor connected in series with said second storage capacitor, a gas-filled diode connected across the series combination of said second storage capacitor and said compensating capacitor, means to impress a voltage across said compensating capacitor, a stepping relay, means to effect operation of said stepping relay one step upon each successive firing of said diode, means to effect operation of the motor of said apparatus while said stepping relay is at a position away from the normal position assumed prior to the first firing of said diode, and means to return said stepping relay one step in the opposite direction upon each operation of said apparatus, whereby operation of said apparatus motor is discontinued after a number of operations of the apparatus related to the number of firings of said diode.

9. The invention as claimed in claim 8, in which means are provided to vary the capacitance of said second storage capacitor, to thus create different numbers of firings of said diode.

10. The invention as claimed in claim 8, in which means are provided to vary the capacitance of said third charging capacitor, to thus vary the voltage impressed across said first and second storage capacitors upon each discharge of said third charging capacitor.

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