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H. W. PARKER

2,732,923

VENDING MACHINE

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2 Sheets-Sheet 1

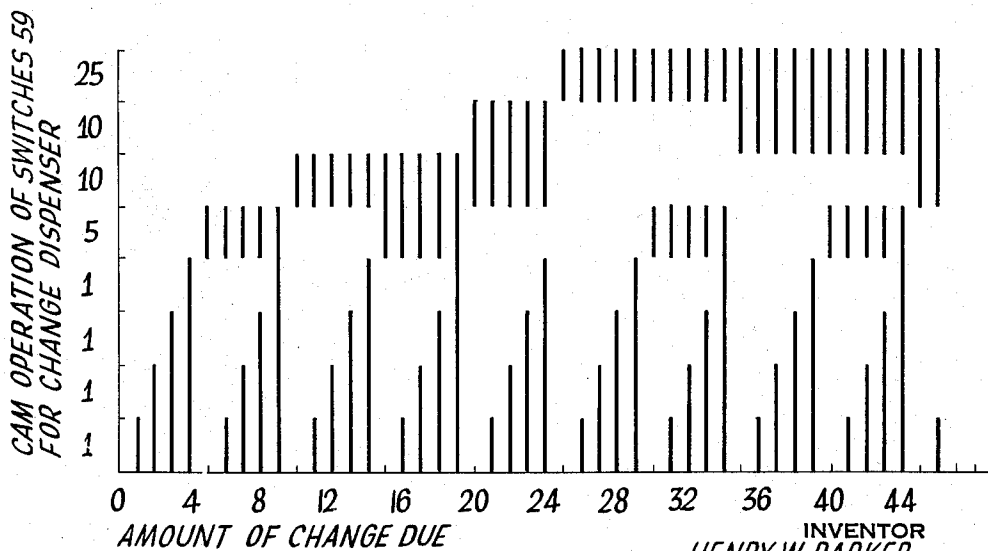
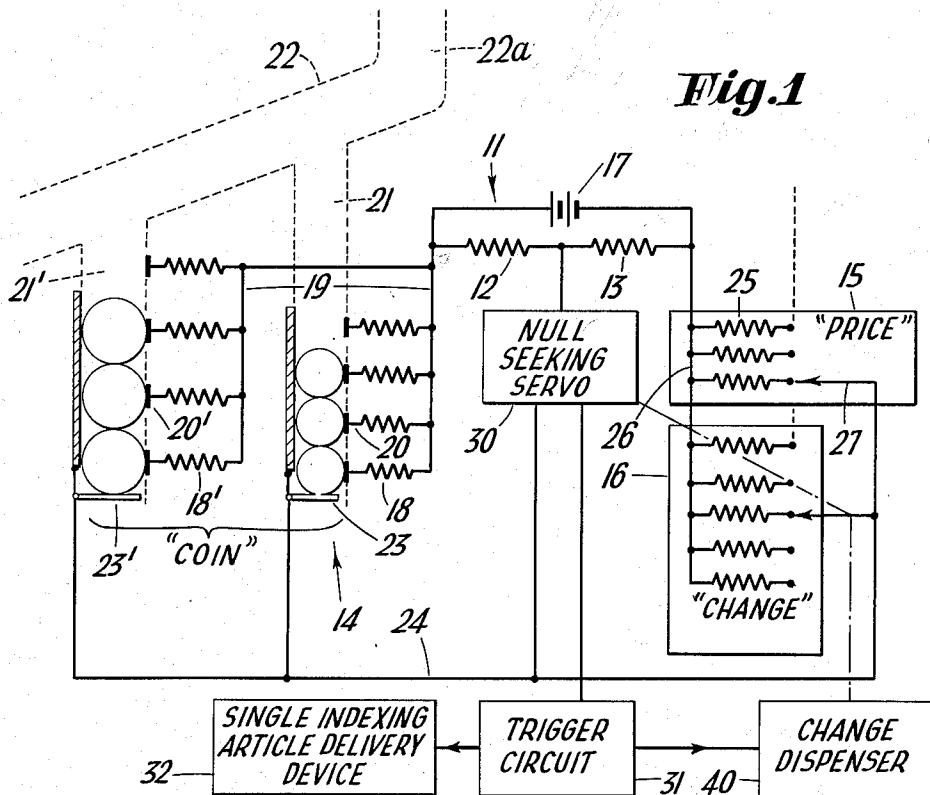


Fig. 3

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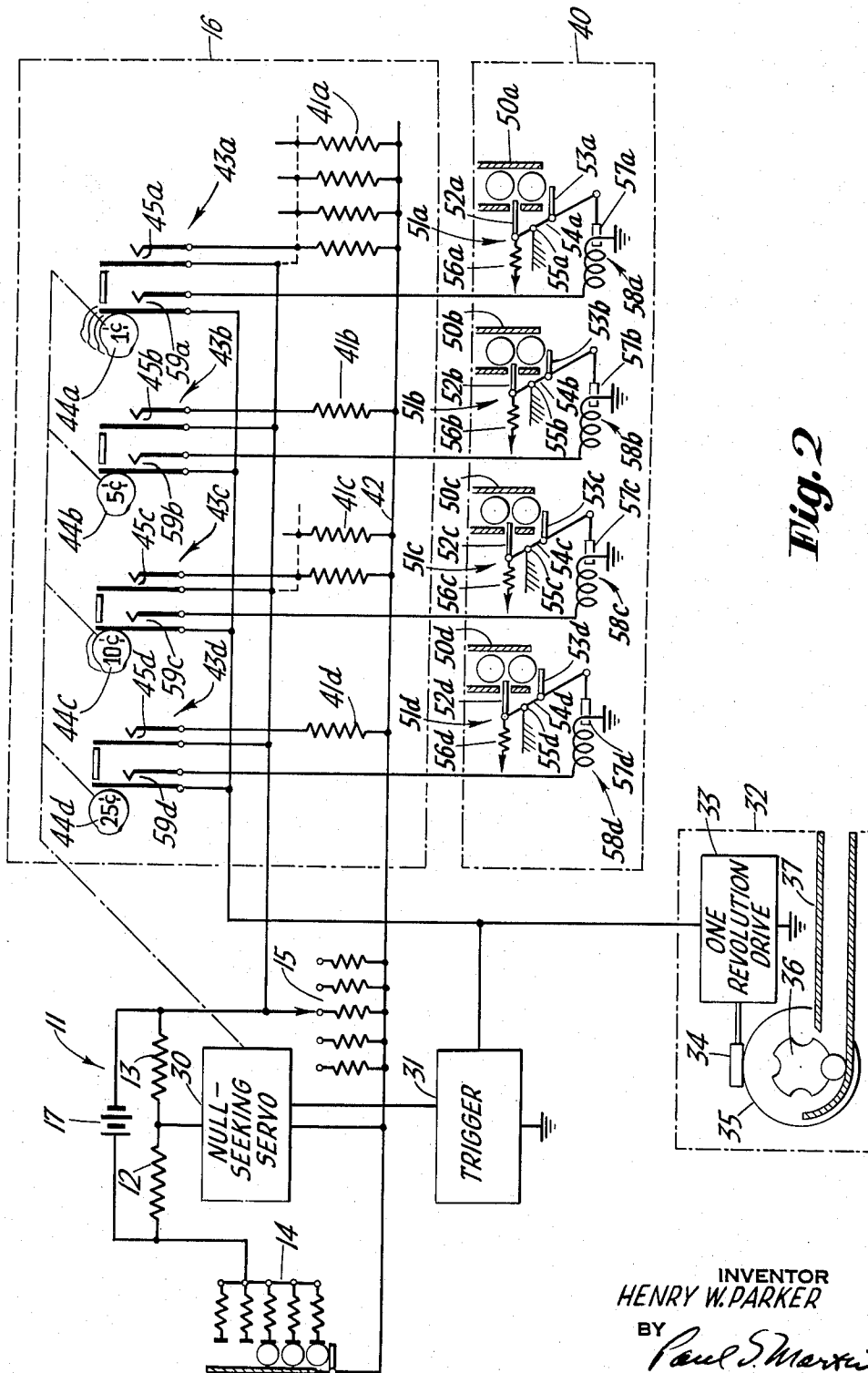
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VENDING MACHINE

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18 Claims. (Cl. 194—7)

The present invention relates to vending apparatus, and more particularly to an automatic coin controlled vending machine having an electrical control circuit.

Most present day coin controlled vending machines are usually mechanically operated under control of a single coin. The more advanced mechanical types are capable of making only certain limited combinations of change from any one coin by some relatively inflexible mechanism. Further development of mechanical vending machines to accept plural coins of various denominations and thereafter to make correct change would necessitate the construction of intricate and exceptionally expensive machines. In the event that it became necessary or expedient to vary the price of the article to be delivered by a particular vending machine, the resultant structure would become still more complex. It becomes apparent that a mechanical vending machine constructed to incorporate the foregoing desirable features would have to be designed to operate under a vast number of conceivable combinations of received coins, price, and change to be delivered and hence would be expensive, bulky, complicated, and exceptionally difficult to service and maintain.

Accordingly, it is an object of the present invention to provide an electrical coin controlled vending machine which will avoid or minimize the above mentioned disadvantages and is relatively simple in construction and efficient in use as compared to a conceivable mechanical counterpart.

It is another object of the present invention to provide an essentially electrical control for a coin operated vending machine.

It is a further object of the present invention to provide an electrically controlled coin operated mechanism which dispenses any item such as standard package goods in response to the insertion therein of coins of various denominations and in an amount equal to or greater than the price of the goods, the mechanism returning the proper amount of change when necessary.

It is a further object of the present invention to provide an automatic article vending machine of the aforesaid character, which can be left unattended and may be operated at any hour of the day or night to dispense the articles and make correct change.

A still further object of the present invention is the provision of a control circuit for a coin operated vending machine which electrically evaluates the coin or coins deposited therein in comparison to the price of the article to be delivered, and causes the machine to operate when the money deposited is equal to the price or when the money deposited is equal to the price plus the change to be returned to the customer with the article.

A still further object of the present invention is the provision of a coin operated electrically controlled vending machine which instantaneously sums the monetary value of coins inserted therein regardless of their denomination and balances the sum against the price of the article to be delivered, whereupon the machine dispenses

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the article and further returns the proper amount of change.

The foregoing objects, and others will be apparent from the following detailed description of an illustrative embodiment. Certain of the objects are attained by this embodiment of the present invention by applying the concept that the combined admittance of a large number of impedance elements, when connected in parallel, is equal to the sum of the admittances of the individual elements. In this embodiment of the invention, there is provided a Wheatstone bridge network which includes an "inserted coin" arm having an impedance variable as a function of the number and denomination of the coins inserted into the machine. This "inserted coin" arm impedance embodies a plurality of impedance elements each of which has an admittance corresponding to a coin of predetermined denomination. Certain of these elements are connected in parallel as an arm of the bridge in dependence on the number and value of the respective coins inserted into the machine and represent an instantaneous sum of the monetary value of the inserted coins.

The bridge network further includes a "price" component having an impedance value selected to correspond to the price of the article being dispensed. This "price" impedance is preferably selectively settable to facilitate the coverage of a relatively wide price range by a single vending machine. A calibrated manual control may be provided for the "price" component to permit flexible, arbitrary price adjustment by the storekeeper or serviceman as predetermined by the values of the particular articles being dispensed by the machine from time to time.

Shunted across the "price" component, is a "change" component having an impedance which is variable and balances the bridge network when the combined admittance of the "price" and "change" components have a predetermined value as compared to the admittance of the "inserted coin" arm impedance. Any suitable null-seeking servo-mechanism is controlled by the bridge network and controls the "change" impedance by adjusting its admittance to balance the bridge network.

Accordingly, a broad feature of the invention is the provision of an electrical bridge adapted to take price, tendered coin, and change into account in controlling a vending machine. A more specific aspect of this is the provision of "price" and "change" impedances combined as one arm of a bridge circuit and adjusted, by a self-balancing bridge servo-drive, into balance with the impedance of the "inserted-coin" arm of the bridge circuit.

The illustrative bridge network provides an essentially electrical control for the dispensing machine which evaluates the coins inserted in comparison to the price of the article to be dispensed. If the value of the coins inserted is exactly equal to the price of the article, the bridge circuit will be balanced. However, if the value of the coins inserted is greater than the price, the bridge circuit will momentarily be unbalanced, whereupon the null-seeking servo-mechanism operates to rebalance the network by adjusting the "change" impedance. The adjusted value of the "change" impedance is a measure of the proper amount of change to be delivered along with the article dispensed. The present invention may be more fully understood by referring to the following detailed description of the illustrative embodiment of the invention, in which reference is made to the accompanying drawing, wherein:

Fig. 1 schematically illustrates a preferred embodiment of the coin controlled vending machine of the present invention;

Fig. 2 schematically shows the embodiment of Fig. 1 in greater detail; and

Fig. 3 is a graphic illustration of the development for an actuating cam which forms a part of the mechanism in Fig. 2.

Figs. 1 and 2 represent a preferred embodiment of the coin operated vending machine of the present invention. The machine includes a control circuit network 11 constituting a specialized form of Wheatstone bridge. This bridge utilizes the concept that the conductance of a number of resistors in parallel is equal to the sum of the conductances. The application of this concept permits the instantaneous addition of a number of conductances corresponding to the monetary value of the inserted coins; and the concept also facilitates adding the conductance representing price to the conductances representing coins to be dispensed as change. Specifically, the control or bridge circuit 11 includes a pair of ratio arms 12, 13 which are preferably of equal conductance. Further the circuit 11 embodies a resistive "inserted-coin" arm 14, the conductance of which varies as a function of the monetary value of the money presented. Connected in series with the "inserted-coin" arm 14 is the fourth arm of the bridge circuit, including a resistive "price" component 15 whose conductance is variable in accordance with the price of the article to be dispensed, and a resistive "change" component 16, whose conductance is to be varied in balancing bridge circuit 11. A suitable source of potential 17 energizes the bridge circuit.

It is apparent, that the bridge circuit 11 is balanced when the instantaneous sum of the conductances of the shunted "price" and "change" components 15, 16 is equal to the conductance of the "inserted-coin" arm 14. Accordingly, there is provided a control means which instantaneously compares the value of the money presented with the price of the article or goods being dispensed.

Connected to the bridge network 11 is a suitable null-seeking servo-mechanism 30 whose mechanical output is coupled to the "change" component 16 for adjusting the conductance of the latter to balance the bridge network 11. The adjusted "change" component 16 will give an accurate measure of the proper amount and the denominations of the change to be returned, as will be seen.

Specific reference will now be made to the details of the "inserted-coin" and "price" components 14, 15. The "inserted-coin" arm 14 preferably includes a plurality of banks of resistors 18, 18', the resistors of each bank having conductances corresponding respectively to coins of several denominations. Each of the resistors 18, 18' has one lead connected to a common conductor 19, and has the other lead connected to a suitable contact 20, 20'. The contacts 20, 20' are arranged along the individual coin chutes 21, 21' which communicate with the main coin chute 22. The lower end of the individual coin chutes 21, 21' are provided with conductive base plates 23, 23'. These chutes and base plates are connected via lead 24 to the common terminals of the "price" and "change" components 15, 16. The widths of the respective coin chutes 21, 21' are selected and arranged to sort and receive only coins of the respective denominations. The individual chutes 21, 21' are arranged at spaced intervals along the main chute 22 and progressively increase in width at locations spaced further from the intake end 22a of the main chute 22. For example, the chute 21 may receive dimes as coins of the smallest diameter, and the chute 21' may receive pennies, coins of the next larger diameter. This arrangement assures the automatic selection of the resistors of the proper banks 18, 18' for connection into the bridge circuit 11. The respective resistors of each bank, which correspond to the same monetary value, are connected into the circuit 11 over a conductive path which in the illustrative apparatus includes the coins of the same

denomination. Preferably the value of each of the resistors of the banks 18, 18' is high as compared to the resistance of the respective coin to thereby minimize errors due to variations in the resistance of the coins and contacts 20, 20'. In lieu of the arrangement where the circuit is completed through the metallic coin itself, the circuit can be completed through contacts mechanically closed by the inserted various coins.

A practical embodiment for example includes fifty resistors representing pennies and each having an impedance of 100 ohms, ten resistors representing dimes and each having an impedance of 10 ohms, two resistances representing quarters and each having an impedance of 4 ohms, and one resistor representing a half dollar and having an impedance of two ohms. In this example, the respective conductance values are numerically equal to the dollar value of the represented coins.

In the "price" component 15, a single calibrated variable resistance may be employed, or as illustrated, a plurality of separate resistors 25 may be connected to a common lead 26 and selected by a movable contact 27. The conductance values of the resistances can be selected to correspond to the various prices. For example, a two ohm resistor having a conductance of .5 ohm could represent a price of fifty cents. By this simple arrangement, the storekeeper can select a desired price and thereafter lock the contact 27 in place.

The null-seeking servo-mechanism 30 of the control circuit 11 has input connections respectively to the potential reference point at the junction of resistors 12 and 13, and to the junction of "inserted-coin" arm 14 with the arm consisting of the "price" and "change" components 15 and 16. This servo-mechanism conventionally includes a high gain electrical amplifier and a motor having mechanical output in response to the electrical input produced by the bridge circuit. This servo-mechanism is mechanically coupled to adjust the "change" component of the bridge circuit until balance of the bridge is effected. Advantageously, also, the servo-mechanism can be arranged to initiate an article dispensing cycle. For example, a trigger circuit 31 may be operated in response to balancing of the circuit 11 and connected to an article delivery device 32 of proper design for delivering a single article as soon as the servo-mechanism 30 balances the circuit 11. Trigger 31 conveniently may take the form of a slow-acting relay connected to a source of potential and having open-circuit contacts so long as it is energized by the electrical output of the servo amplifier. When the bridge is balanced, the amplifier output decays and the relay contacts close to connect the source of potential to the device 32. As shown in Fig. 2, the delivery device 32 may include a one revolution drive 33 coupled through a suitable reduction gear 34 and drive gear 35 to an actuator 36 arranged within the delivery chute 37. In response to the closing of the open-circuit contacts of the trigger circuit 31, the one revolution drive 33 operates to index the actuator 37 and releases an article to enter the delivery chute 37.

Further, circuit 11 is connected to control a change dispensing mechanism 40 which returns the proper amount of change to the customer along with the goods. Referring now to Figs. 2 and 3, there is illustrated in greater detail, one embodiment of the "change" component 16 of the bridge circuit and the change dispenser 40, both of which are regulated by the servo-mechanism 30.

For the sake of clarity and simplicity, the "change" component 16 has been shown to include several "penny" resistors 41a, a single "nickel" resistor 41b, two dime resistors 41c, and a single "quarter" resistor 41d. These "change" resistors represent the banks of resistors appropriate to control delivery of an appropriate combination of coins.

It can be demonstrated that all the requisite amounts of change up to one dollar can be made by a "change" bridge component 16 including nine resistors, namely,

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four "penny" resistors, one "nickel" resistor, two "dime" resistors, one "quarter" resistor, and one fifty cent resistor. In the simplified showing of Fig. 2, the "50 cent" control is omitted. Resistors 41a, 41b, 41c and 41d have one side connected to a common lead 42 which is connected to the proper terminal of the "price" resistor 15. The other side of the respective "change" resistors are connected to associated leaf-spring switches 43a, 43b, 43c and 43d. These switches are of the single-pole single-throw type and are actuated by the control cams 44a, 44b, 44c and 44d, which are adjusted by the servo-mechanism 30. In response to the closing of contacts 45a, 45b, 45c and 45d of the switches 43a, 43b, 43c and 43d, the change resistors 41a, 41b, 41c and 41d are connected in parallel with each other and with the "price" resistor 15. The additional cams and switches associated with additional resistors 41a and 41c have been omitted for clarity.

Referring now to Fig. 3, there is shown a graphic illustration of a cam development suitable for a "change" bridge component 16. The various change amounts are plotted on the abscissa and the switch positions plotted on the ordinates. If, for example, the amount of change to be returned is thirty-two cents, then the change will be made up of two pennies, one nickel, and one quarter, and the various cam portions will operate switches for connecting two "penny" resistors, one "nickel" resistor and one "quarter" resistor into the circuit as parallel resistors, this combination being apparent at "32" of Fig. 3. In lieu of cams 44 for the switches 43, a perforated drum and associated pins or contacts may be employed for closing the appropriate switch contacts 45, and other alternatives will occur to those skilled in the art.

Once again referring to Fig. 2, the structure of an illustrative change dispensing mechanism 40 will now be described. This mechanism includes the change dispensing chutes 50a, 50b, 50c, 50d, each of which stores a supply of coins of the same denomination. A diagrammatically illustrated escapement mechanism 51a, 51b, 51c and 51d is associated with the respective dispensing chutes 50a, 50b, 50c and 50d to permit coins to drop into a common change return, not shown. The escapement mechanisms operate after the connection of the "change" resistors of the related denominations into the bridge circuit 11 and in response to balancing of the bridge circuit. Each of the escapement mechanisms 51a, 51b, 51c, 51d includes a pair of spaced slides 52, 53 interconnected by a linkage 54, the latter having pivots 55. A suitable spring 56 is connected to one end of each of the respective linkages 54 to bias the linkages into an inoperative position shown, wherein the slides 52 are drawn back out of the adjacent one of dispensing chutes 50a, 50b, 50c, 50d and the slide 53 traverses the open mouth of the adjacent dispensing chute. Operatively connected to the other ends of the linkages 54 are the armatures 57a, 57b, 57c and 57d of solenoids 58a, 58b, 58c, and 58d. The armatures 57a, 57b, 57c and 57d are drawn back in response to the energization of the solenoids and momentarily reverse the position of the slides 52, 53 permitting the lowermost coins to drop into the coin return and thereafter allowing the next coin to fall into position to be subsequently delivered. The solenoids 58a, 58b, 58c and 58d are energized through the contacts 59a, 59b, 59c and 59d of the associated switch 43a, 43b, 43c and 43d, which in turn are connected to the trigger circuit. Instead of the solenoids 58a, 58b, 58c and 58d and the escapement mechanisms 51a, 51b, 51c and 51d connected thereto, any other suitable arrangement may be employed which may be set in accordance with the setting of the "change" bridge component 16 to deliver the proper amount of change when the bridge circuit 11 is balanced.

In operation, the storekeeper sets the "price" resistor 15 to correspond in conductance to the price of the article to be delivered. After loading the machine 32 with items to be delivered and filling the change dispensing chutes 50, the device may be left unattended. The

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bridge circuit is unbalanced since the "price" component differs from the "inserted coin" arm in a way that cannot be corrected by adjusting the "change" bridge component. The customer inserts any combination of coins into the machine. These coins fall into the appropriate chutes 21. When an insufficient number of coins are inserted, the control circuit 11 remains unbalanced. If the value of the inserted coins is equal to the price of the article, the bridge circuit 11 will be balanced, the input to the servo-mechanism 30 will be zero, and there will be no necessity for the device to make change. The trigger circuit 31 then will energize the delivery device 32 and a single article is delivered at chute 37. The inserted coins are released for delivery to an internal container by suitably releasing plates 23, 23', and the machine is ready for a new cycle.

In situations where the customer inserts change in an amount greater than the price, the bridge circuit 11 will be momentarily unbalanced and the null-seeking servo-mechanism 30 will be energized in a polarity or sense enabling this servo-mechanism to adjust cams 44 until balance of the bridge is restored by connection of appropriate resistors 41 through switches 43 in parallel with price resistor 15. Simultaneously with the selection of the change arm resistors 41, the change dispenser 40 is preset. When the balance condition is reached, the trigger circuit 31 enables the dispensing mechanism 32 to deliver the article and also operates the change dispenser 40.

There has been described a widely adaptable, effective, electrically controlled, coin operated vending machine, which automatically evaluates the coins inserted and delivers an article of a predetermined price, together with change when necessary.

While in accordance with the provisions of the statutes, I have illustrated and described the best form of embodiment of my invention now known to me, it will be apparent to those skilled in the art that changes may be made in the form of the apparatus disclosed without departing from the spirit of my invention as set forth in the appended claims and that in some cases certain features of my invention may be used to advantage without a corresponding use of other features.

What I claim is:

1. A coin controlled vending machine, comprising coin receiving means, a circuit network including a first impedance controlled by inserted coins and variable in accordance with the value of coins inserted in said coin receiving means, a second impedance having a value selected in accordance with the price of the article to be delivered, and a third impedance variable to balance said network, a null-seeking electromechanical drive connected to said network and controlled by the unbalance thereof and operatively connected to said third impedance to balance said network, means dispensing values of coin change under control by said drive and responsive to the balancing of the network after adjustment of said third impedance for returning change in an amount corresponding to the adjustment of said third impedance, and article dispensing means operable in response to balancing of said network for delivering said article

2. A coin controlled vending machine according to claim 1, wherein said impedances are resistive elements.

3. A coin controlled vending machine according to claim 2, wherein said first impedance is connected as one arm of a bridge circuit and said second and third impedances are connected as another arm of a bridge circuit.

4. A coin operated vending machine, comprising coin receiving means, a circuit network including an "inserted-coin" component controlled by inserted coins and variable in impedance in accordance with the number and denomination of the coins inserted in said coin receiving means, a "price" component variable in impedance in accordance with the price of the article to be vended, and a "change" component variable in impedance to balance said network, a null-seeking servo-mechanism having input connections to said network and operatively

connected to said "change" component, means dispensing values of coin change under control by said servo-mechanism and responsive to the balancing of said network after adjustment of the impedance of said "change" component for returning change in an amount corresponding to the adjusted impedance of said "change" component, and article dispensing means operable in response to balancing of said network for delivering the article.

5. A coin operated vending machine, comprising coin receiving means, a bridge circuit including a potential divider having a predetermined ratio, a resistive "inserted-coin" arm controlled by inserted coins and variable in accordance with the number and denomination of the coins inserted in said coin receiving means, resistive "change" and "price" components in said bridge circuit and arranged to balance said bridge circuit when said "change" and "price" components combined are related to said "inserted-coin" arm in the same ratio as that of said potential divider, a null-seeking servo drive energized under control of the unbalance of said bridge and operatively connected to said "change" component for adjusting the latter to balance said bridge circuit, means dispensing values of coin change under control of said drive and responsive to the balance of said bridge circuit after adjustment of the conductance of said "change" component for returning change in an amount corresponding to the adjustment of said "change" component, and article dispensing means operable in response to balancing of said bridge circuit for delivering the article to be vended.

6. A coin operated vending machine according to claim 5, wherein said "change" and "price" components are connected in parallel with each other as one arm of said bridge circuit and in series with said "inserted-coin" arm.

7. A coin operated vending machine according to claim 5, wherein said "inserted-coin" arm includes at least one bank of resistors each connectable into said bridge circuit over a conductive path including the respective coins inserted into said coin receiving means, the value of each of said resistors being high as compared to the resistance of the respective coins.

8. A control circuit for a coin operated vending machine, comprising coin receiving means, a circuit network including a first impedance controlled by inserted coins and variable in accordance with the monetary value of coins inserted in said coin receiving means, a second impedance adjustable to correspond to the price of the article to be vended, a third impedance variable to balance said network, and adjusting means operable in response to unbalance of said network and operatively connected to said third impedance to balance said network.

9. A control circuit according to claim 8, including change making means adjusted by said adjusting means coordinately with said third impedance.

10. A control circuit according to claim 8, wherein said first impedance includes a plurality of banks of resistors, the resistors of each bank individually having a value of conductance corresponding to a selected one of several denominations of coins.

11. A control circuit according to claim 8, wherein said third impedance includes a plurality of resistors each having a conductance corresponding to a coin of predetermined denomination.

12. A control circuit for a coin operated vending machine, comprising coins receiving means and a bridge circuit including an "inserted-coin" arm having a conductance

controlled by inserted coins and variable in accordance with the number and denomination of coins inserted in said coin receiving means, "change" and "price" components in said bridge circuit connected in parallel and arranged to balance said bridge circuit when their combined conductance has a predetermined ratio to the conductance of said coin arm, and null-seeking adjusting means energized by said bridge circuit and operatively connected to said "change" component for adjusting the latter to thereby balance said bridge circuit.

13. A control circuit according to claim 12, wherein said "inserted coin" arm includes a plurality of banks of resistors, the resistors of each bank being arranged for connection in parallel and individually having a value of conductance corresponding to a selected one of several denominations of coins.

14. A control circuit according to claim 13, including contact means operatively connected to the respective resistors of said banks and operable under control of the inserted coins to connect the respective resistors into said bridge circuit.

15. A control circuit for a coin operated vending machine, comprising a circuit network having a first impedance for unbalancing said circuit network in accordance with the value of coins inserted in said machine, said first impedance including at least one bank of resistors each having a conductance corresponding to a coin of one denomination, at least one coin chute constructed to receive coins of said one denomination, a second impedance corresponding to the price of the article being vended and connected in said circuit network, a third impedance in said circuit network for balancing said circuit network, contact means constructed and arranged to connect the respective resistors of said bank into said circuit network under control of the coins inserted into said coin chute, and adjusting means operable in response to unbalance of said circuit network and operatively connected to said third impedance for balancing said bridge network.

16. A control circuit according to claim 15, wherein said contact means includes a plurality of spaced apart contact elements arranged along said coin chute, each of said contact elements being connected to a resistor of said bank for connecting said resistor into said bridge circuit over a conductive path including one or more coins inserted in said coin chute.

17. A control circuit according to claim 16, including manually operable means for adjusting the value of said second impedance.

18. A control circuit according to claim 15, wherein said third impedance is connected in parallel with said second impedance and in series with said first impedance.

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