United States Patent

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[15] **3,703,229**

[45] **Nov. 21, 1972**

[54] **COIN-OPERATED VENDING MACHINES**

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[22] Filed: **Dec. 8, 1970**

[21] Appl. No.: **96,222**

[30] **Foreign Application Priority Data**

Dec. 10, 1969 Great Britain.....60,205/69

[52] **U.S. Cl.**.....**194/10,** 194/1 N

[51] **Int. Cl.**.....**G07f 11/00**

[58] **Field of Search**.....194/10, 1 N, 4

[56] **References Cited**

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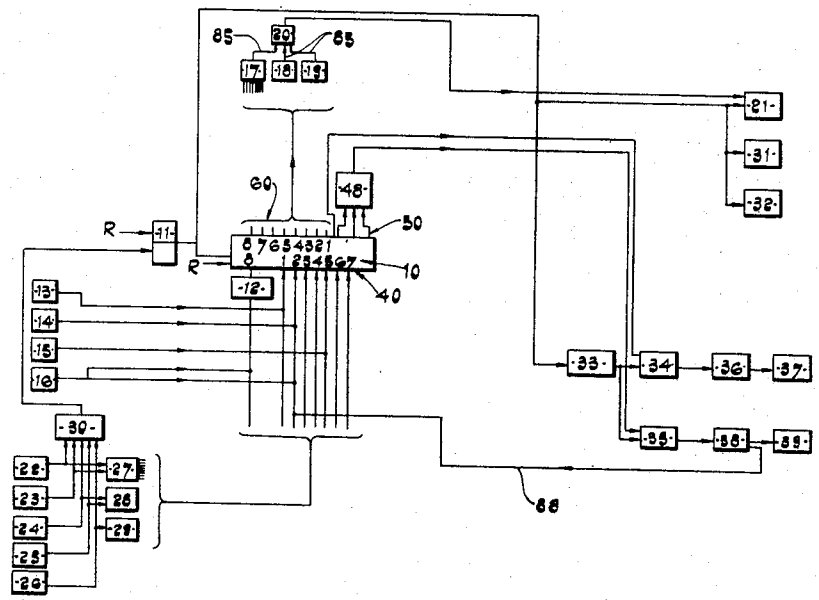
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[57] **ABSTRACT**

A coin-operated vending machine includes a multi-stage binary counter for totalizing the value of coinage inserted into the machine. Numerical outputs of the counter are connected to price setting switches for determining the prices at which commodities are to be vended and the totalized value of coinage inserted is registered by the numerical outputs. Change is given when the value of the inserted coinage exceeds that of the selected commodity.

10 Claims, 2 Drawing Figures



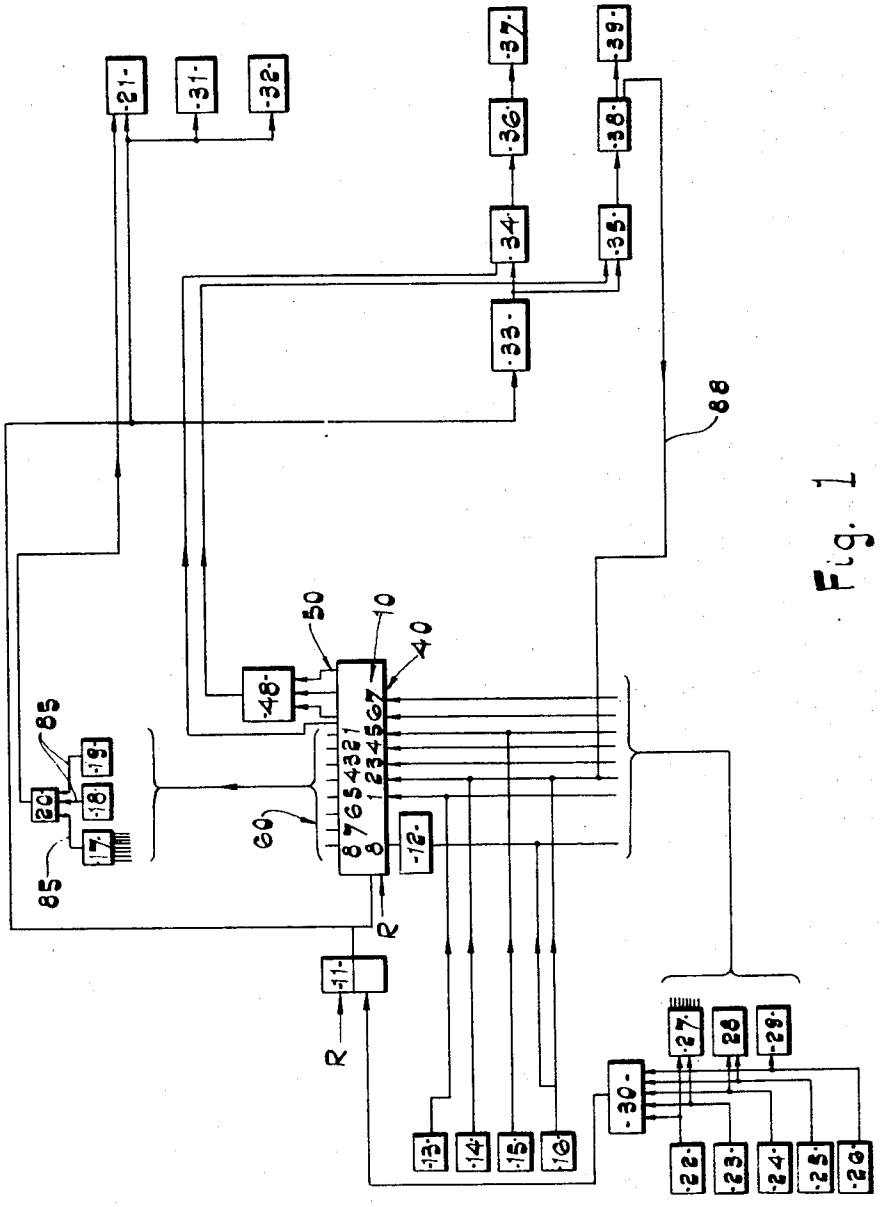


Fig. 1

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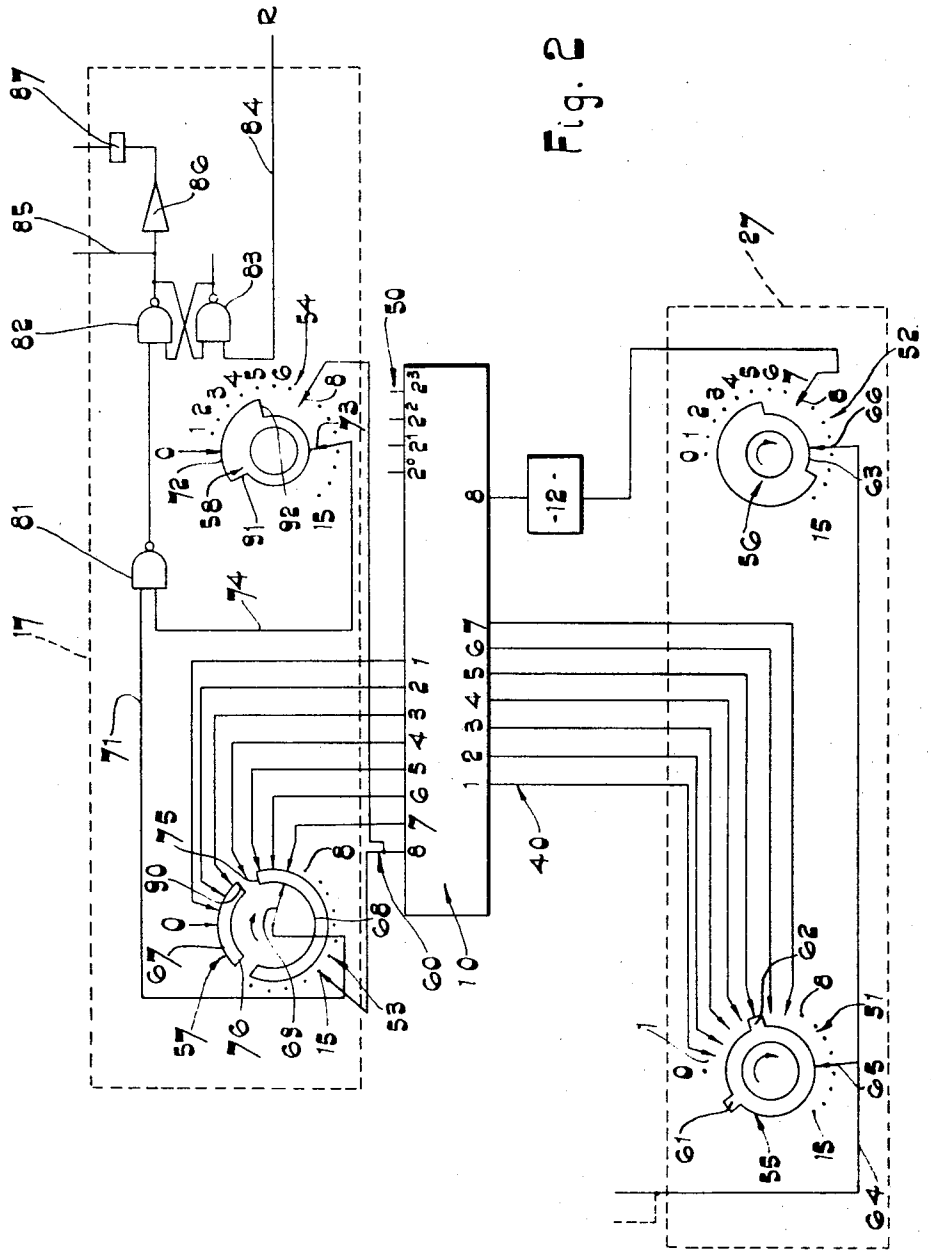


Fig. 2

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COIN-OPERATED VENDING MACHINES

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a coin-operated vending machine of the kind which includes coin responsive, pulse-generating means associated with, and operable upon, insertion of each denomination of coinage the machine accepts, a plurality of commodity selection elements, counting means for totalizing the value of coinage inserted and recording the totalized value, and for subtracting from the totalized value the value of commodity selected and recording the residual value, dispensing means operable for dispensing selected commodities in response to actuation of the commodity selection elements, and coin payout means operable to dispense change corresponding in value to said residual value.

2. Description of the Prior Art

French Pat. No. 1,568,430 discloses a coin-operated vending machine of the kind referred to in which the value of commodities selected is subtracted from the totalized value in order to ensure that sufficient credit exists to pay for the selected commodities. Once the counting means has established that there is sufficient credit, the dispensing means can be operated to dispense the selected commodities.

If the value of the selected commodities exceeds the totalized value then subtraction results in over-subtraction and in order to restore the counting means to a condition wherein it registers the totalized value so that the customer is once again credited with the amount of coinage inserted into the machine, the value of the selected commodities must be added to the over-subtracted value. Consequently a machine according to this French Patent must include means for restoring the counting means to a condition in which it registers said totalized value thus increasing the complexity and hence the cost of the counting system of the machine.

The instant invention dispenses with the need for restoring means by providing an improved coin-operated vending machine of the kind referred to.

SUMMARY OF THE INVENTION

The counting means includes a multi-stage counter having outputs thereof connected to each of a plurality of settable elements of price setting means whereby the machine can establish whether sufficient coinage has been inserted thereinto to pay for a selected commodity.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. **1** is a schematic representation of a vending machine control circuit for establishing the existence of sufficient credit and for permitting subsequent dispensing of selected commodities and change, and

FIG. **2** is a detailed schematic representation of a part of the control circuit shown in FIG. **1** and illustrates the connections between numerical inputs and outputs of a counter and a price setting switch.

DESCRIPTION OF A PREFERRED EMBODIMENT

The machine comprises a coin testing and evaluation mechanism, a set of commodity selection elements, a commodity dispensing mechanism for dispensing selected commodities: a change dispensing mechanism and a control circuit. The constructional features of the coin testing and evaluation mechanism and the commodity and change dispensing mechanisms are well known to those skilled in the art.

The control circuit includes a multi-stage reversible binary counter which, in the embodiment of FIG. **1** of the drawings, is designated by reference numeral 10 and comprises a multi-input circuit driving four binary stages, these being 2^0, 2^1, 2^2, 2^3 stages. The binary counter **10** is, therefore, capable of counting from zero, when the four binary stages are in their "0" stages, up to 15 when the binary stages are all in their "1" states. The binary counter has a plurality of inputs **40** to the binary stages, thereof, there being eight such inputs **40** in the embodiment of the drawings. The eight inputs **40** correspond one to each of the values in the numerical range "1" through "8" and each input **40** is connected to the multi-input circuit so that when a particular input is energized, a count corresponding to the value of the input is caused to be added to the binary counter stages.

The binary counter **10** has two sets of outputs, one set **50** comprising four outputs connected one to each of the binary stages and registering the state of the respective binary stages, and a set **60** of eight numerical outputs corresponding one to each of the numerical values "1" through "8." The numerical outputs **60** are connected to the binary stages in such a way as to decode the states of the binary stages and express the values registered by the binary stages in the decimal system. Thus, for example, when the 2^0, 2^1 and 2^2 binary stages are in their "1" stages and the 2^3 binary stage is in its "0" state, an output signal will appear at the "7" numerical output **60**. Similarly output signals will appear at the 2^0, 2^1, and 2^2 binary stage outputs **50**.

The binary counter **10** is convertible between two conditions, in one of which it effects totalization of signals impressed upon the inputs **40** thereof and in a second condition of which the counter **10** can perform subtraction operations. The counter is convertible between these two conditions by a MEMORY circuit **11** which, in the machine stand-by condition, is set to the "totalization" condition and which, when a valid selection is made as a result of actuation of a commodity selection element, is set to the "subtract" condition.

A plurality of coin-operated, pulse-generating switches, one for each denomination of coinage that the machine will accept, are associated with the coin testing and evaluation mechanism. In the embodiment of the drawings, four coin switches **13**, **14**, **15** and **16** are provided and these correspond to coins of values 1, 2, 5 and 10. Pulses generated upon operation of the coin switches **13**, **14** and **15** are directed to the "1," "2" and "5" inputs **40** whilst pulses generated by the coin switch **16** are fed directly to the "2" input and through a time delay mechanism **12** to the "8" input, which time delay mechanism affords a time delay to allow a count of seven to be registered by the binary stages of the counter **10** before the pulse corresponding to the value of eight is impressed upon the "8" input **40**. Thus, for example, if an intending customer inserts coinage comprising coins of value 10, 2 and 1 into the machine pulses will be transmitted to the "1," "2," "2"

AND "8" inputs **40** from the coin switches **13**, **14** and **16**.

Prior to the insertion of the coinage by the intending customer, the machine is in a stand-by condition wherein the MEMORY circuit **11** is set to the "-totalizing" condition and the subsequent insertion of the coinage will result in the counter totalizing the value of coinage inserted. In the example cited above, in which coins of value 10, 2 and 1 were inserted into the machine, the totalized value will be 13 and the 2^0, 2^2 and 2^3 binary stages will be in their "1" stages whilst the 2^1 binary stage will be in its "0" state. With the binary stages in these states, output signals will appear at the 2^0, 2^2 and 2^3 binary stage outputs **50** and at the "8" and "5" numerical outputs **60**. The totalized value as registered by the numerical output **60** is used in determining whether or not sufficient coinage has been inserted into the machine to pay for a subsequently selected commodity.

The numerical inputs **40** and numerical outputs **60** of the counter **10** are connected to each of a plurality of price setting switches provided one for each price of commodity that can be vended by the machine. The embodiment of the drawings includes three price setting switches, each comprising as shown in FIG. **1**, two units **17** and **27**, **18** and **28**, and **19** and **29**. Units **17**, **18**, **19** are associated with the numerical outputs **60** and the other units **27**, **28**, **29** are associated with the numerical inputs **40**.

The price setting switch comprising the units **17** and **27** is shown in greater detail in FIG. **2**. The unit **27** includes two banks **51**, **52** of 16 electrical contacts which correspond to values ranging from "0" to "15" and are arranged in circumferentially spaced relation with equal angular spacing between adjacent contacts. The unit **17** also includes two banks **53**, **54** of 16 electrical contact which likewise correspond to values ranging from "0" through "15" and are arranged in circumferentially spaced relationship. The banks **51**, **52**, **53** and **54** are shown, in FIG. **2**, separately from one another but, in practice, they are arranged in tiers.

Each bank **51**, **52**, **53** and **54** of electrical contacts has an electrical contactor **55**, **56**, **57** and **58** associated therewith and the electrical contactors are mounted for rotation about a common axis and are rotatably fast with one another.

The four banks **51**, **52**, **53** and **54** of electrical contacts of each price setting switch and their associated electrical contactors **55**, **56**, **57** and **58** are mutually insulated and are arranged in tiers with the contactors set in pre-determined angular relationship with one another.

The contactor **55** is in the form of an annulus having a pair of circumferentially spaced projections **61**, **62** extending radially outwardly therefrom, the spacing between the projections **61** and **62** being equal to the spacing between the "0" contact and the "8" contact of the bank **51** of contacts so that, when the projection **61** registers with the "0" contact, the projection **62** registers with the "8" contact. The "1" through "7" contacts are numerical inputs **40** respectively of the counter **10**.

The electrical contactor **56** associated with the bank **52** of contacts is generally annular with a part **63** of the circumference thereof relieved, the angular extent of the part **63** being greater than the angular spacing between the "0" and the "8" contact of the bank **52** of contacts. The "8" contact of the bank **52** is connected through the time delay mechanism **12** to the "8" input of the counter **10**. The contactors **55** and **56** of the unit **27** are both connected to a line **64** by fixed wipers **65** and **66** respectively.

The contactor **57** comprises a pair of circumferential portions **67** and **68** which are mutually insulated and are spaced from one another by an angular distance less than the angular spacing between an adjacent pair of contacts of the bank **53** of contacts. The contactor **68** is of sufficient circumferential extent to bridge the "0" to "15" contacts when the trailing edge **75** thereof is in register with the "0" contact whilst the circumferential extent of contactor **67** is just sufficient to bridge contacts "0" through "7" when the trailing edge **76** thereof is in register with the "0" contact.

The "1" through "7" and "15" contacts of the bank **53** are respectively connected to the "1" through "7" and "8" numerical outputs **60** of the counter **10**. A fixed angularly spaced wiper **69** is associated with the contactor **57** and is arranged in radial alignment with the "7" contact of the bank **53**. The wiper **69** is connected to a line **71** and serves to connect the "7" contact of the bank **53** to the line **71** when one of the arcuate portions **67**, **68** of the contactor **57** bridges the radial gap between the "7" and "8" contacts and the wiper **69**.

The circumferential portion **68** is operative when the contactor **57** is set to a price within the range of one to seven to transmit signals from the numerical outputs **60** via the wiper **69**. The circumferential portion **68** is no longer operative when the trailing edge **75** thereof is moved beyond the "7" contact, instead signals from the numerical output **60** are transmitted to the line **71** by the circumferential portion **67**.

The electrical contactor **58** associated with the bank **54** of contacts is generally annular and is provided with a radially projecting portion **72** whose circumferential extent is equal to the angular spacing between the "0" and the "7" contacts of the bank **54**. A wiper **73** connects the "0" contact to a line **74** when the contactor **58** is set to a price within the range of zero to seven and the "8" contact to a line **74** when the contactor **58** is rotated to a price position exceeding value 7 wherein the circumferential portion **72** thereof registers with the "8" contact of bank **54**.

When the circumferential portion **67** is operative and serves to transmit signals from the numerical outputs **60** to the line **71** the circumferential portion **72** will register with the "8" contact of the bank **54**. The trailing edge **76**, of the circumferential portion **67** and the circumferential portion **72** then together determine the price at which commodition associated with that price setting switch can be vended. For example when the price setting switch is to be set to correspond to a value of 12, the trailing edge **76** of the contactor **67** will register with the "4" contact of the bank **53** and the portion **72** will register with the **8**" contact of the bank **54**, the "4" or "8" numerical outputs being coupled by the contactors **57** and **58** to correspond to a value of 12.

The "0" contacts of both banks **53** and **54** are connected to an unshown source which, operates to impress a "1" signal upon these contacts.

The settings of the contactors **55** through **58** of each price setting switch determine the price at which the commodities associated with that price setting switch are to be vended. For example, if the commodities associated with the price setting switch comprising the units **17** and **27** are of value 5 then the contactors **55** through **58** are set in the positions shown in FIG. **2**. If the commodities associated with the price setting switch comprising the units **18** and **28** thereof are of value 7, then the contactors **55** through **58** of the units **18** and **28** thereof will be in positions displaced through an angular spacing corresponding to the angular spacing between alternate contacts of the banks of contacts thereof relative to the position shown in FIG. **2**.

It will be seen that, when the price setting switches are set for commodities of value less than 8, the contactors **56** and **58** thereof will not be in positions wherein the "8" contacts of the banks **52** and **54** are connected to the lines **64** and **74** respectively. Thus, the line **74** will not be connected to the "8" numerical output of the counter **10** nor will the "8" input of the counter **10** be connected to the line **64**. A signal derived from the source connected to the "0" contact of the bank **54** will however, appear on the line **74** but there will only be a signal on the line **71** if the trailing edge **75** of the circumferential portion **68** registers with the zero contact or if the circumferential portion **68** registers with a contact which is connected to a numerical output **60** having a signal thereon.

If the price setting switch comprising the units **19** and **29** corresponds to commodities of value **10**, then the contactors **55** through **58** thereof will be in positions displaced through angular distances equal to the angular spacing between contacts whose values differ by six relative to the positions shown in FIG. **2**. Thus, when a price setting switch is set to a value of 10, the projection **61** of the contactor **55** will register with the "2" contact of bank **51** whilst the unrelieved portion of the contact on **56** will register with the "8" contact of the bank **52**. The trailing edge **75** of the circumferential portion **68** of contactor **57** will be clear of the "7" contact of bank **53** and the circumferential portion **68** will be inoperative. The trailing edge **76** of the circumferential portion **67** will register with the "2" contact of bank **53** so that all of the numerical outputs of value greater than 2 are connected through the circumferential portion **67** to the line **71**, and the circumferential portion **72** of the contactor **58** will register with the " 8" contact of the bank **54** to connect the "8" numerical output **60** with the line **74**.

A plurality of switches **22** through **26** are associated one with each commodity selection element and are connected to the line **64** of the unit **27, 28, 29** of the price setting switch corresponding to the price of commodity the machine will vend upon actuation of that commodity selection element. In the embodiment of the drawings, switches **22** and **23** correspond to different commodities of the same price and are both connected to line **64** of the unit **27**, likewise switches **24** and **25** correspond to different commodities whose prices differ from those associated with switches **22** and **23** and switch **26** is connected to line **64** of unit **29**. Thus, in the example given above, the commodity selection switches **22** and **23** correspond to commodities of price 5, switches **24** and **25** correspond to commodities of price 7 and switch **26** corresponds to a commodity of price **10**. The switches **22** through **26** are also connected to the input of an OR element **30** the output of which is applied to the MEMORY circuit **11** to set the same in the "subtraction" connection in response to receipt of a signal from one of the switches **22** through **26**. A mechanical, electrical or electronic interlock system is provided to prevent the actuation of more than one of the commodity selection switches **22** through **26** at any one time.

The lines **71** and **74** of the unit **17, 18, 19** of each price setting switch are connected to inputs of a NAND element **81** whose output is connected to a further NAND element **82** which is cross-coupled with another NAND element **83** to one of the inputs of which a RESET signal can be applied by a line **84**. The output of each NAND element **82** of the unit **17, 18, 19** of each price setting switch is connected by a line **85** to the input of an AND element **20**, see FIG. **1**, and is also connected to the input of an amplifier **86** whose output is connected to a command relay **87** which when energized, permits operation of the machine commodity selection switches **22** through **26** and the corresponding dispensing mechanism. Thus, in the example given above, the command relay **87** of units **17, 18, 19** permit operation of switches **22** and **23, 24** and **25, 26** respectively.

The output of the AND element **20** is connected to a coin block mechanism **21** which, when a signal appears at each of the inputs of the AND element **20** as will occur when an intending customer has inserted coinage of value exceeding the highest price at which commodities are to be vended, operates to project an armature into the coin insertion path to prevent the insertion of further coinage. The MEMORY circuit **11** is also connected to the coin block mechanism **21** and is additionally connected to a reject block **31** and an escrow operating mechanism **32** so as to energize the same when one of the commodity selection switches **22** through **26** is actuated if the associated command relay **87** is energized.

The operation of the control circuit thus far described is as follows:

assuming that the machine is in the stand-by condition with the MEMORY circuit **11** in the "totalizing" condition and with the binary stages of the counter **10** in their "0" states, the insertion of, for example, coinage of value 8 in the form of coins of denominations 1, 2 and 5, results in the application of pulses to the "1", "2" and "5" inputs **40** of the counter **10** causing conversion of the 2^3 binary stage to its "1" state. With the 2^3 binary stage in its "1" state, a signal appears at the "8" numerical output **60** which signal is transmitted to the "8" contacts of the banks **53** and **54** of electrical contacts of the unit **17, 18, 19** of each price setting switch.

The contactor **57** of the unit **17** is connected to the "8" numerical output by the circumferential portion **68** and the contactor **58** of the unit **17** is connected to the "0" output by the circumferential portion **72** and consequently a signal will be applied to each of the inputs of the NAND element **81**. With signals applied at both inputs of the NAND element **81**, no signal will be generated at the output of the NAND element **81**. The absence of a signal at the output of the NAND element

81 is registered and memorized by the cross-coupled NAND elements 82 and 83 and a signal is applied from the output of the NAND element 82 to the amplifier 86 to energize the command relay 87 and to the line 85 and hence one of the inputs of the AND elements 20. Energization of the command relay 87 permits the operation of switches 22, 23 and the commodity dispensing mechanism of the machine to dispense commodities of value 5.

In a similar manner, the command relay 87 of the unit 18 whose contactors 57 and 58 are set to a value of seven, will be energized. The trailing edge 76 of the circumferential portion 67 of the unit 19 will be clear of the "2" contact of the bank 53 whilst the leading edge 90 thereof will be in register with the "9" contact of that bank and since the trailing edge 75 of the circumferential portion 68 will be clear of the "7" contact and hence the wiper 69 of the "8" numerical output 60 of the counter will not be connected to the line 71 by the circumferential portion 68. The contactor 58 will be in a position wherein the trailing edge 91 thereof is clear of the "0" contact of bank 54 and the leading edge 92 is in register with the "8" contact. A signal will appear on line 74 because there will be a signal on the "8" numerical output of the counter 10. Consequently only one signal, i.e., that on line 74 will be applied the inputs of the NAND element 81 and a signal will be transmitted from the output thereof to one of the inputs of the NAND element 82 so that no signal will be generated at the output of the NAND element 82. The command relay 87 of unit 19 will not therefore, be energized and a signal will not be transmitted to the AND element 20 from the unit 19 via the line 85.

Thus, with the machine in this condition, the command relays 87 of the units 17 and 18 are energized and vending of commodities of values 5 and 7 will be permitted. The command relay 87 of the unit 19 will not be energized and the machine will not therefore, be able to dispense a commodity of value 10. There will be no signal at the output of the AND element 20 and the coin block mechanism 21 will not be operated so that the intending customer can if he wishes insert further coinage. Should the customer now insert further coinage of denomination greater than 1 then the command relay 87 of the unit 19 will be energized to permit dispensing of a commodity of value 10.

Assuming that the intending customer does not insert further coinage but, instead, actuates a commodity selection element corresponding to commodities of price 5, then one of the commodity selection switches 22, 23, depending upon which type of commodity of price 5 is selected will be operated and a signal will be applied to the OR element 30 to convert the counter to its "subtraction" condition and to the line 64 of the unit 27. The signal applied by the MEMORY circuit 11 to the counter is also applied to the coin block mechanism 21, the reject block 31 and the escrow operating mechanism 32. The signal applied to line 64 will be directed by wiper 65 and contactor 55 to the "5" input of the counter and because the counter 10 is converted to its "subtraction" condition upon actuation of one of the switches 22 through 26, the value of the commodity selected will be subtracted from the totalized value registered by the binary stages prior to the actuation of the corresponding commodity selection element.

Prior to the actuation of the commodity selection element, the binary stages of the counter 10 were all in their "0" states except for the 2^3 binary stages which was in its "1" state. The application of a subtraction pulse corresponding to a value of five to the "5" input 40 of the counter converts the binary stages into a condition wherein the 2^0 and 2^1 binary stages are in their "1" states and the 2^2 and 2^3 binary stages are in their "0" states. Thus, the subtraction process having been completed, the counter 10 registers a residual value corresponding to the difference between the value of coinage inserted into the machine and the value of the commodity selected.

During the subtraction process, a signal is transmitted to the machine dispensing mechanism in response to actuation of one of the commodity selection elements and because the command relay 87 of the price setting switch which is set to a value of five, the selected commodity is dispensed. At a suitable stage during the dispensing cycle, a RESET signal R is applied to the counter 10, to the NAND element 83 via the line 84 and to the MEMORY circuit 11 to reset the counter 10 to zero, to remove the signal generated at the output of the NAND element 82 and hence deenergize the associated command relay 87 and to convert the counter from its "subtraction" condition to its "totalizing" condition.

In the embodiment of the drawings, means are provided for paying out of coins corresponding to the residual value registered by the binary stages of the counter 10 after the subtraction process has been completed and before the application of the RESET signal R to the MEMORY circuit 11. The coin payout system includes a payout delay mechanism 33 the output of which is connected to one input of each of a pair of AND elements 34 and 35. The other input of the AND element 34 is connected to the 2^0 binary stage output of the counter 10 and the output thereof is connected to the input of a mono-stable circuit 36 the output of which is connected to a mechanism 37 for paying out coinage of value 1.

The 2^1, 2^2 and 2^3 binary stage outputs of the counter 10 are connected to the inputs of an OR element 48 the output of which is connected to the other input of the AND element 35. The output of the AND element 35 is connected to a gated oscillator 38 one output of which is connected to a mechanism 39 for paying out coinage of value 2 and the other output of which is connected by a line 88 to the "2" numerical input of the counter 10.

The time delay afforded by the delay mechanism 33 is such as to allow the subtraction of the price of the selected commodity from the totalized value recorded by the counter. The presence of a signal on any one of the 2^1, 2^2 or 2^3 binary stage outputs 50 results in the transmission of a signal from the output of the OR element 48 to the AND element 35. Similarly the presence of a signal at the 2^0 binary stage output results in the transmission of a signal to one input of the AND element 34.

Once the time delay afforded by the delay mechanism 33 has expired, a signal from the output of the delay mechanism 33 is applied simultaneously to the other inputs of the AND elements 34 and 35 so that, if there is a signal at the 2^0 binary stage output, a signal will be generated at the output of the AND ele-

ment to switch the mono-stable circuit **36** on for a sufficient length of time to energize the mechanism **37** to dispense a coin of denomination 1. Likewise, if there is a signal at one or more of the 2^1, 2^2, and 2^3 binary stage outputs, a signal will be generated at the output of the AND element **35** to operate the oscillator **38**.

Operation of the oscillator **38** results in the application of a pulse to the coin dispensing mechanism **39** to energize the same for a sufficient length of time to energize the mechanism **39** to dispense a coin of denomination 2 and a pulse is applied to the "2" numerical input **40** of the counter **10** via the line **88**. Because the coin dispensing system is operated before the MEMORY circuit **11** is reset by the RESET signal R, the application of a pulse to the "2" input **40** of the counter **10** results in the subtraction of 2 from the residual value as registered by the binary stages. The oscillator **38** will continue to be operated until all signals at the 2^1, 2^2 and 2^3 outputs disappear, i.e., coins of value 2 are dispensed by the mechanism **39** until the residual value registered by the binary stages is either 1 or 0.

No provision is made to convert the 2^0 binary stage to its "0" state during dispensing of change because the application of the RESET pulse to the counter **10** serves to restore all of the binary states of the counter **10** to their "0" stages.

Returning now to the example cited above in the description relating to the totalization of coinage inserted into the machine and subtraction therefrom of the value of a selected commodity. After the subtraction has been completed, the 2^0 and 2^1 binary stages of the counter were in their "1" states and the 2^2 and 2^3 binary stages were in their "0" states, i.e., the residual value recorded by the counter **10** was 3. With the binary stages of the counter in this condition, there will be signals at the 2^0 and 2^1 binary stage outputs **50** and these signals will be applied to the AND elements **34** and **35** respectively. After the time delay afforded by the delay mechanism **33** has expired, a signal will be generated at the output of the AND element **34** to energize the coin dispensing mechanism **37** and dispense a coin of denomination 1 and a signal will also be generated at the output of the AND element **35**. The signal generated at the output of the AND element **35** will operate the oscillator **38** to energize the dispensing mechanism **39** to dispense a coin of denomination 2 and to apply a signal to the "2" input of the counter **10**. The receipt of a signal at the "2" input will cause the conversion of the 2^1 binary stage to its "0" state and consequently the signal at the 2^1 binary stage output will disappear. At this time, only the 2^0 binary stage will be in a "1" state but further dispensing of coins of denomination 1 by the mechanism **37** is prevented by the mono-stable circuit **36**. Thus, when the RESET signal R is applied to the counter **10**, to the MEMORY circuit **11** and to the lines **84** of the price setting switches, the control circuit of the vending machine is returned to the stand-by condition in readiness for a further transaction.

As described, the coin dispensing system uses coins of values 1 and 2. However, it is envisaged that change can be dispensed in coins of ratios other than 1:2 for example, coins can be dispensed in denominations of 1 and 4 by connecting the 2^0 and 2^1 binary stage outputs **50** to one OR element the output of which is connected to the AND element **34** and by connecting the 2^2 and 2^3 binary stage outputs **50** to another OR element the output of which is connected to an input of the AND element **35**. In this example, it would be necessary to replace the mono-stable circuit **36** by a gated oscillator of similar form to the oscillator **38** having one of the outputs thereof connected to the "1" input of the counter **10**.

As an alternative to having a coin dispensing system which includes provision for paying out coinage of two different values, the paying out of coinage can be effected by a plurality of operations of the paying out mechanism **37** for the coin of denomination 1, in which case all of the binary stage outputs **50** would be connected to inputs of a single OR element and the mono-stable circuit **36** would be replaced by a gated oscillator of similar form to the oscillator **38** with an output thereof connected to the "1" input **40** of the counter.

Provision can also be made for a payout operation to be effected only on demand. For example, the machine can include a customer-actuated coin payout element which, when no further vends are required or are possible, renders the coin dispensing mechanism operable.

The command relays **87** of each price setting switch can, if desired, be additionally used to cause illumination of display lamps associated with each commodity that the machine can vend so that, when a customer has inserted coinage into the machine, the appropriate display lamps are illuminated to indicate those commodities for which sufficient coinage has been inserted into the machine.

Although, as described above, the machine is adapted to receive a maximum value of coinage corresponding to a value of 15, the value of coinage which the machine can accept can be increased by increasing the number of stages of the binary counter. The counter could alternatively consist of two reversible binary decimal stages giving a count range of 0 to 99 or any other appropriate range.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A coin-operated vending machine comprising:
   a. reversible electronic counting means having a normal totalizing condition in which input signals increase the output of the counting means and a subtraction condition in which input signals reduce said output;
   b. a plurality of coinage sensing means connected to the counting means to provide counter input signals which produce a counting means output corresponding to the total of the denominations of the coinage inserted into the machine at the start of a vend cycle of the machine;
   c. a plurality of selectively operable commodity selection elements each corresponding to a commodity to be vended;
   d. comparator means operative upon operation of any one of said selection elements to compare the price of the commodity selected with the output of the counting means and, if the output is at least as great as said price, permit a signal to pass from the element to
      1. operate a vend circuit to dispense the commodity,

2. set the counting means to its subtraction condition, and

3. provide a counter input signal corresponding to the price of the commodity selected which price is thus subtracted from the output;

e. a detector connected to the counting means and operable after the subtraction of said price to detect if the residual output of the counting means exceeds a predetermined value;

f. pay-out means associated with the detector to pay out change if said residual output is greater than the predetermined value; and

g. reset means operable at the end of the vend cycle to reset the counting means to its totalizing condition.

2. A machine according to claim **1** including manually operable means for initiating operation of the pay-out means whereby more than one commodity selection element can be operated during a vend cycle and provide counter input signals corresponding to the total price of the commodities selected.

3. A machine according to claim **1** including memory means associated with said comparator means for enabling the vend cycle to proceed during the subtraction once the counter output determined by the coinage inserted in the machine has equalled or exceeded the price of the commodity selected.

4. A machine according to claim **1** wherein the counting means includes a multi-stage counter which has a first, numerical, output which is associated with the comparator means and a second, stage, output which is associated with the detector and pay-out means.

5. A machine according to claim **4** including first and second detectors associated respectively with a first and a second of said pay-out means, the first detector and the first pay-out means being associated with the first stage of the stage output and the second detector and the second pay-out means being associated with the remaining stages of the stage output, the second pay-out means being arranged to provide a counter input signal corresponding to the change paid out thus to subtract the value thereof from the output until the residual output is reduced to said predetermined value.

6. A machine according to claim **1** wherein the pay-out means provides a counter input signal corresponding to the change paid out thus to subtract the value thereof from the output until the residual output is reduced to said predetermined value.

7. A machine according to claim **6** including price-setting means comprising first and second elements settable in accordance with a price of a commodity to be vended, said first element being associated with the comparator means so that the setting of the element is compared with the output of the counting means and said second element being connected to the counting means input to provide a counter input signal corresponding to the price of the commodity selected.

8. A machine according to claim **7** wherein said comparator means comprises a plurality of comparators, each with said associated price-setting means individually settable to different prices, each comparator and its associated price-setting means being associated with different commodity selection elements.

9. A machine according to claim **7** wherein said comparator means and associated price-setting means are associated with more than one commodity selection element so as to cooperate with the counting means whenever any one of said associated commodity selection elements is operated.

10. A machine according to claim **7** wherein the first and second elements of the price-setting means are settable in synchronism by a single manual control.

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