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(54) **Vend possible judgement device for a vending machine**

(57) A plurality of denominations are provided for coins stored for paying out of change. A shortage detection device (12, 13, 14) detects whether there is shortage or not with respect to coins of respective denominations for paying out of change. A control circuit (11) specifies one or more denominations which can be used as change corresponding to a set vend price. This specifying is made in accordance with a number of the least significant digit of digits having a number other than 0 in digits of decimal notation of the set vend price. One or more denomination of which there is no shortage in coins stored for paying out of change are represented by outputs of the shortage detection device. The control circuit (11) controls a circuit (10) for judging whether vending is possible or not so that vending requiring change should be permitted in a case where change of the specified denomination can be paid out by coins of one or more denominations which have been detected as not being short.

FIG.1

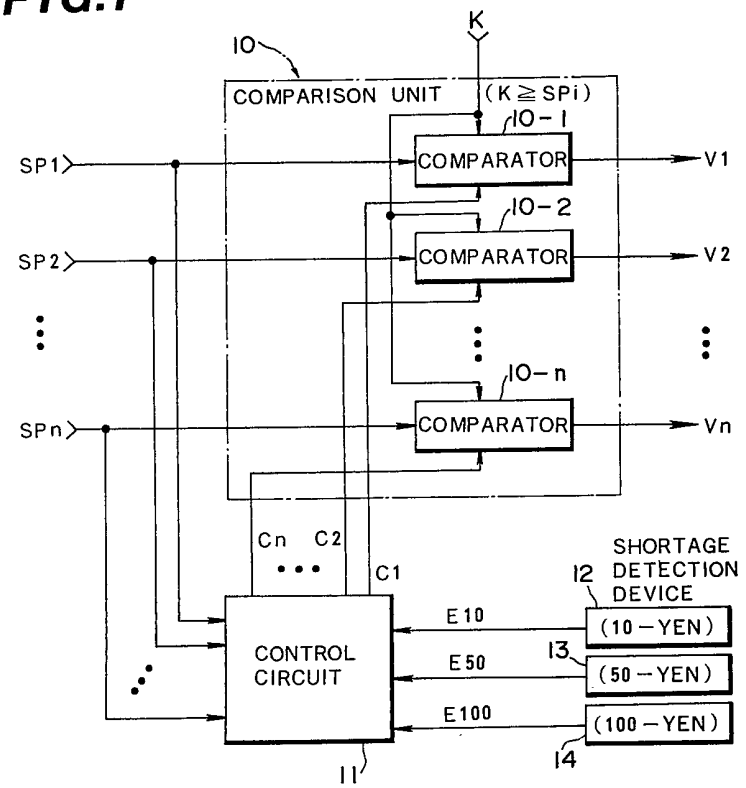

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FIG.1

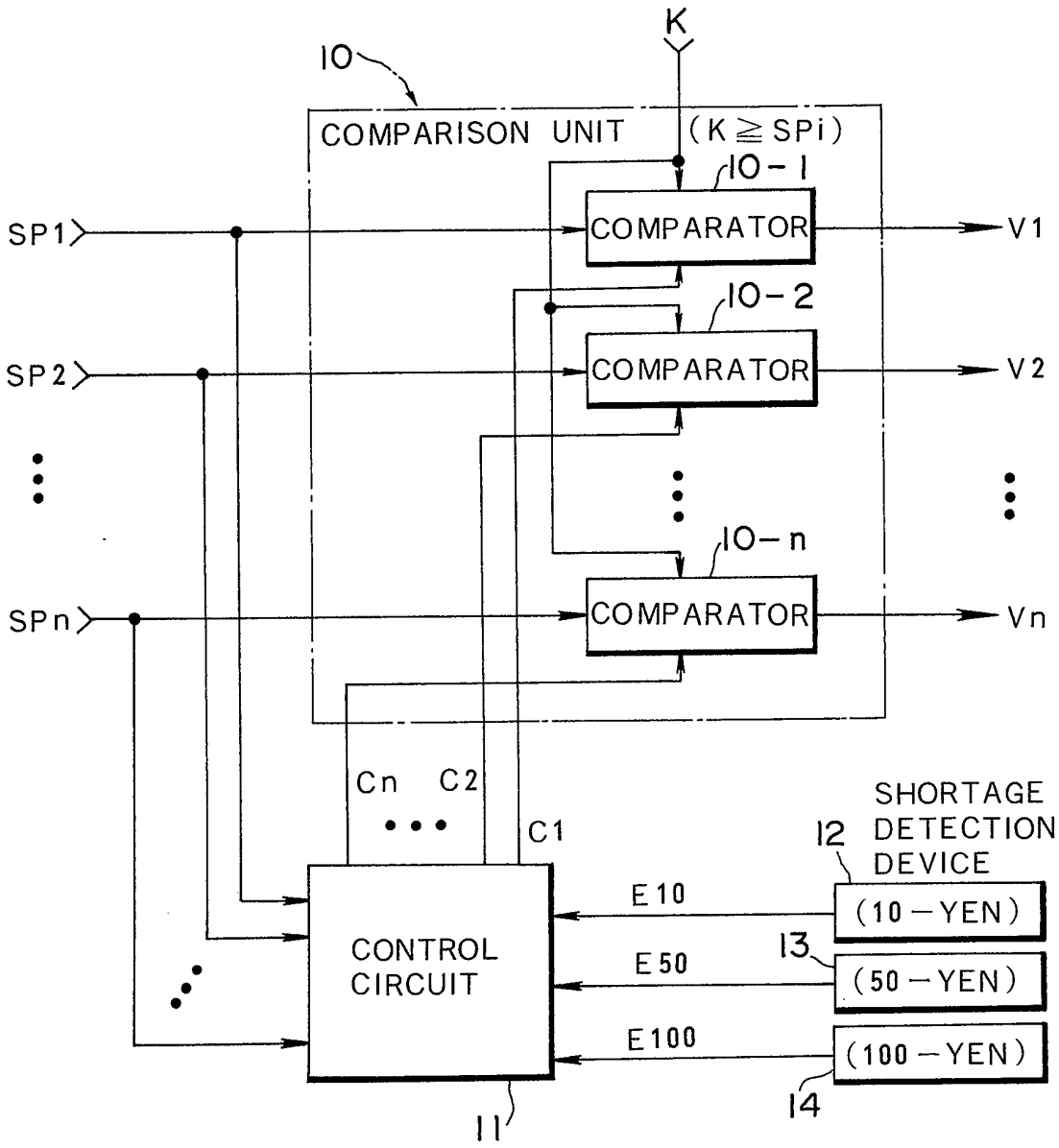

K
10
COMPARISON UNIT
(K ≧ SPi)
10-1
COMPARATOR
V1
SP1
10-2
COMPARATOR
V2
SP2
10-n
COMPARATOR
Vn
SPn
Cn
C2
C1
SHORTAGE
DETECTION
DEVICE
12
E10
(10-YEN)
13
E50
(50-YEN)
E100
(100-YEN)
14
CONTROL
CIRCUIT
11

FIG.2

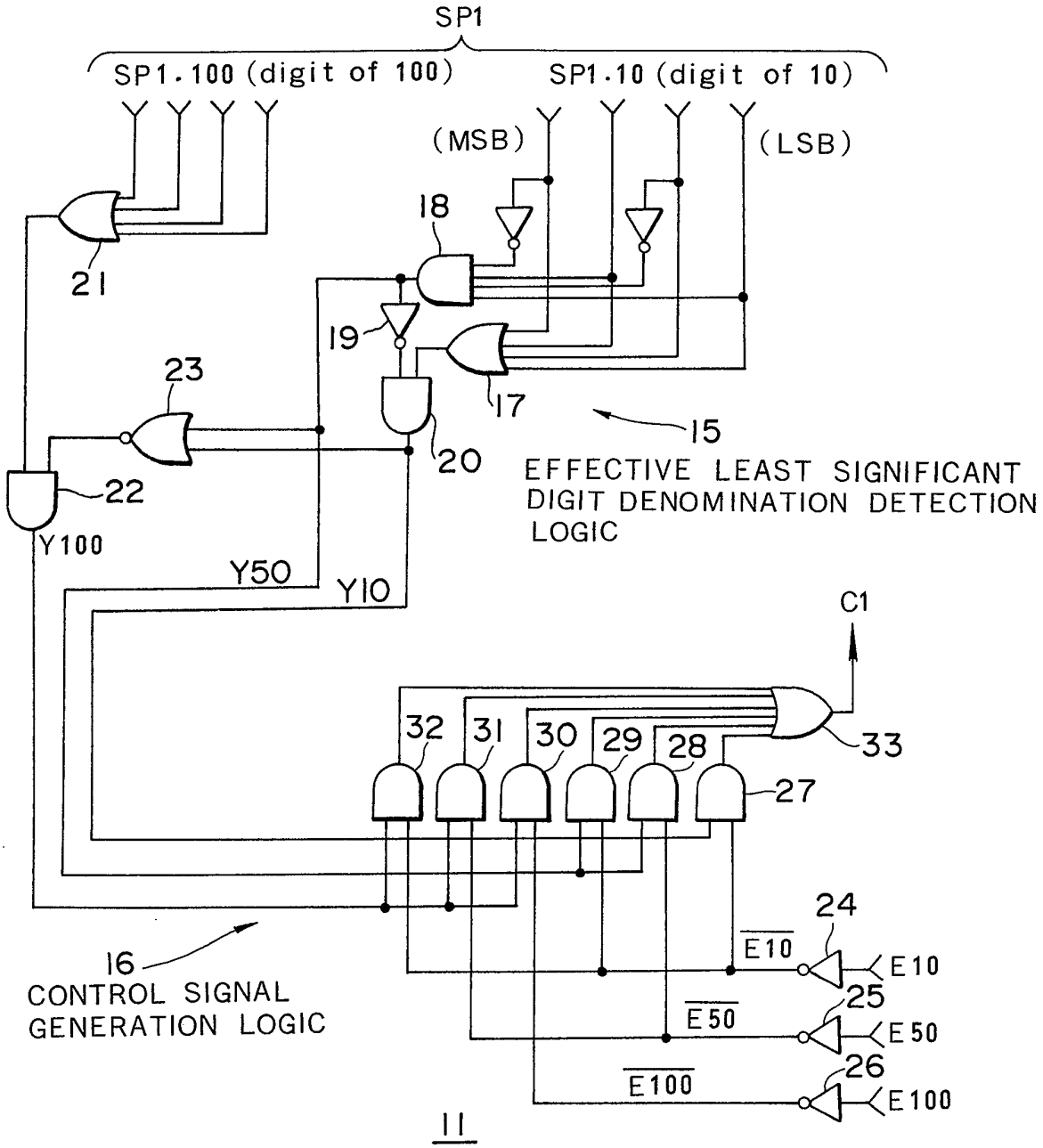

SP1
SP1.100 (digit of 100)
SP1.10 (digit of 10)
(MSB)
(LSB)
18
21
19
23
17
15
20
22
EFFECTIVE LEAST SIGNIFICANT DIGIT DENOMINATION DETECTION LOGIC
Y100
Y50
Y10
C1
32
31
30
29
28
33
27
24
E10
E10
25
E50
E50
26
E100
E100
16
CONTROL SIGNAL GENERATION LOGIC
11

FIG.3

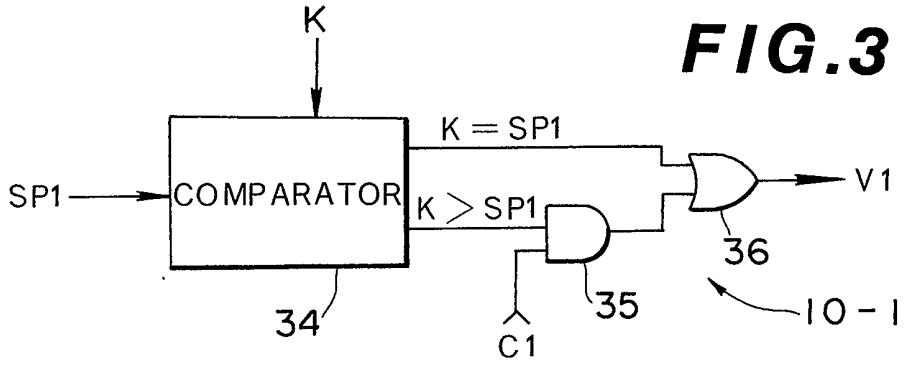


FIG.4

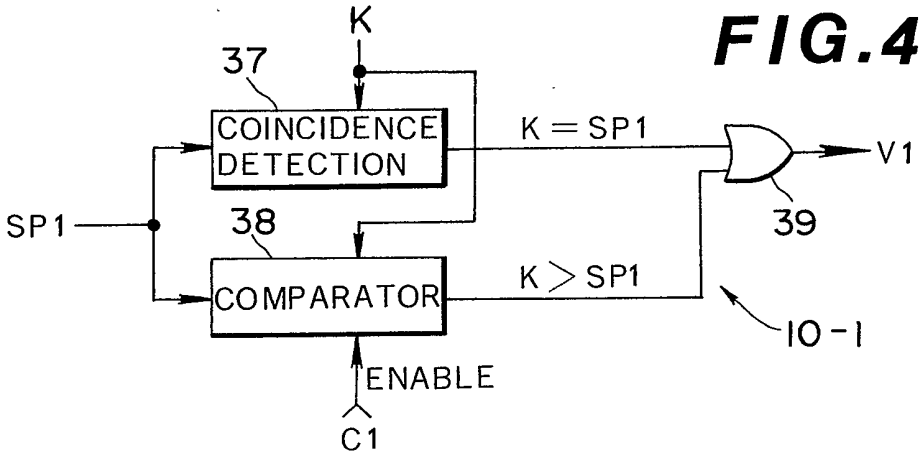


FIG.5

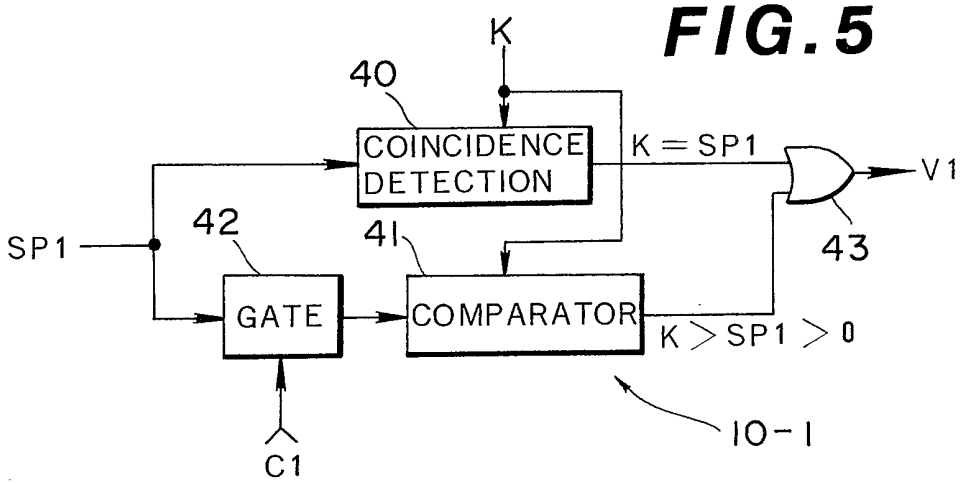


FIG.6

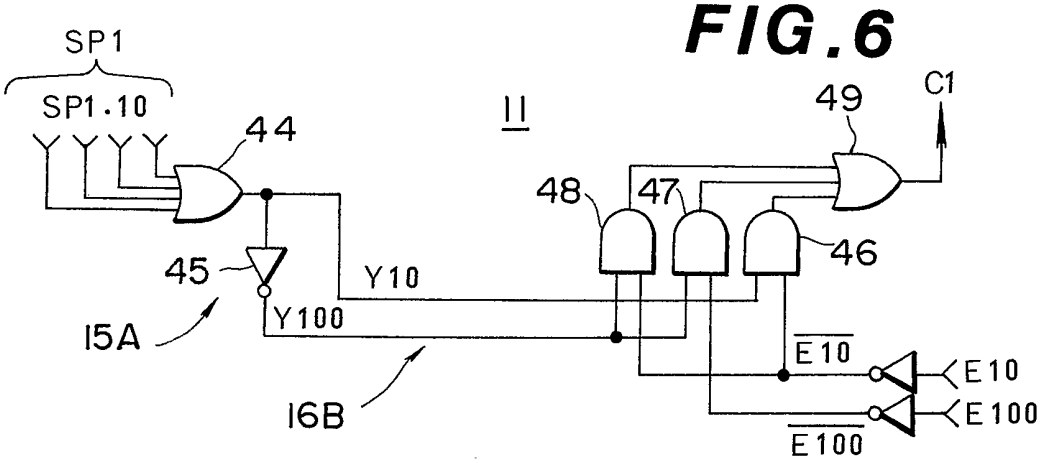
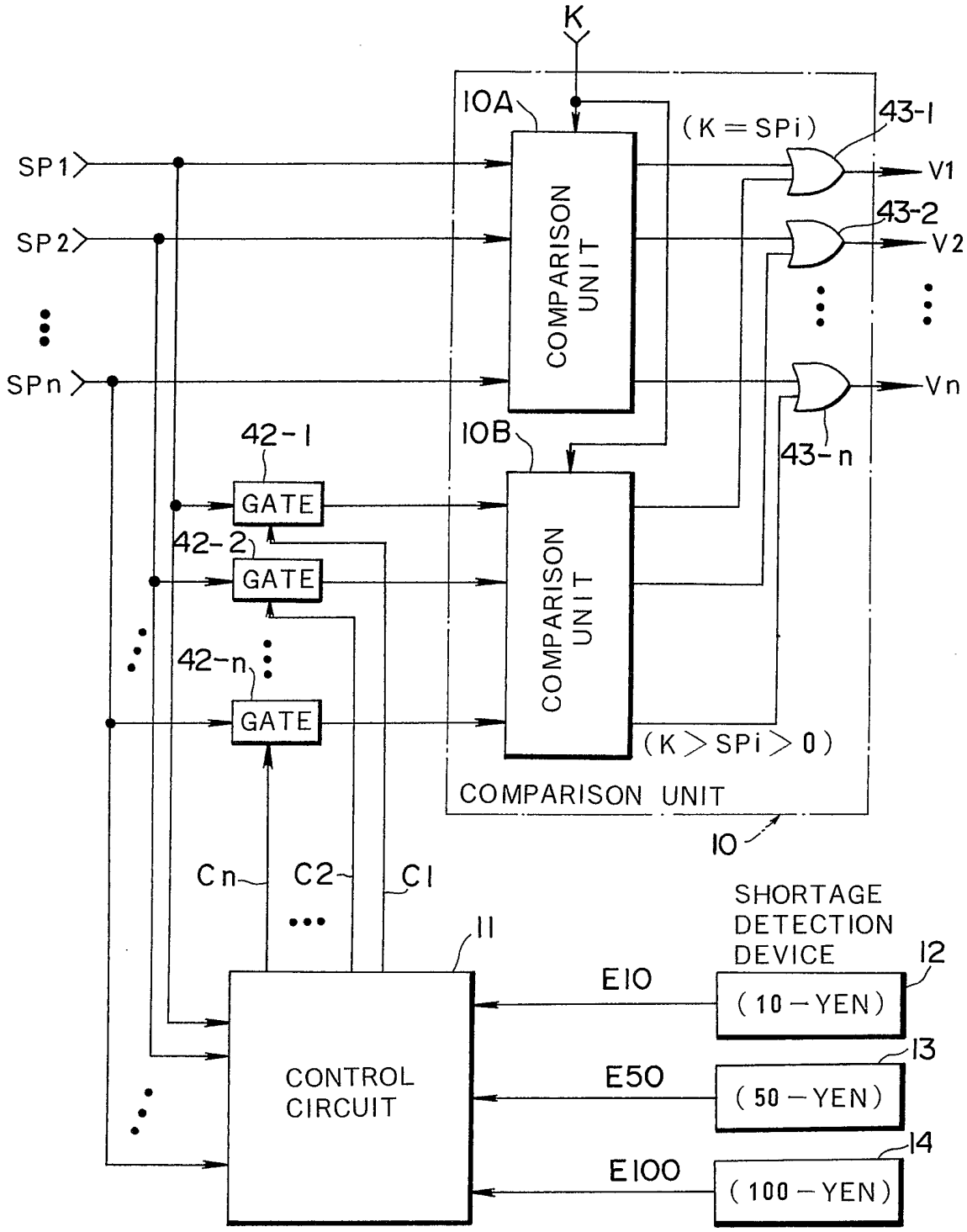


FIG.7


K
10A
(K = SPi)
43-1
SP1
V1
SP2
43-2
V2
COMPARISON UNIT
SPn
Vn
42-1
10B
43-n
GATE
42-2
GATE
COMPARISON UNIT
42-n
GATE
(K > SPi > 0)
COMPARISON UNIT
10
Cn
C2
C1
11
SHORTAGE DETECTION DEVICE
12
E10
(10-YEN)
CONTROL CIRCUIT
E50
13
(50-YEN)
E100
14
(100-YEN)

SPECIFICATION

Vend possible judgement device for a vending machine

This invention relates to a vend possible judgement device for a vending machine and, more particularly, to a device capable of advantageously performing a vend possible judgement control in case of shortage in coins stored for paying out of change.

A basic condition on which the vend possible judgement (i.e., judgement that an article is vendible) is made is that an amount of money (K) which is equal or exceeding a set vend price (SPi) has been deposited, i.e., the condition $K \geqslant SPi$ has been satisfied. Since, however, it is necessary to prohibit vending if paying out of change is not possible, it has been customary with prior art vending machines to restrict the condition on which the vend possible judgement is made if there is shortage in coins stored for paying out of change. In a case where coins of a large denomination stored for paying out of change are short but those of a small denomination are sufficient, change corresponding to the coin of the large denomination can be paid out in the coins of the small denomination and, accordingly, vending may be permitted in accordance with the above described basic vend possible condition. In a case, however, where coins of the small denomination stored for paying out of change are short there is likelihood that paying out of change is not possible. For this reason, in such a case vending is generally permitted only if change is not required (i.e., the deposited amount K coincides with the set vend price SPi) and otherwise is prohibited even if the deposited amount K exceeds the set vend price SPi. If, accordingly, there is shortage in coins stored for paying out of change, particularly in coins of a small denomination, chances of vending will be missed with the result that the operation efficiency of the vending machine will be reduced.

For overcomining such problem, it has been conceived that vending may be permitted even in a case where paying out of change is required if storage of coins of a large denomination stored for paying out of change is sufficient and the change can be paid out in the large denomination coins even if coins of a small denomination are short. For this purpose, an arrangement has been made in the prior art vending machine such that in comparing the deposited amount K with the set vend price SPi, an amount of a predetermined large denomination coin (e.g. 50 yen) is previously added to the set vend price SPi, the result of addition is compared with the deposited amount and the vend possible judgement is made when they coincide with each other ($K = SPi + 50$). The coincidence of the sum of the set vend price and the amount of the large denomination coin with the deposited amount means that difference between the deposited amount and the set vend price, i.e., change, can be paid out in the large denomination coin.

The prior art arrangement for the vend possible judgement, however, has the disadvantage that it requires an addition circuit accompanying a comparison circuit for detecting coincidence resulting in a complicated construction and an increased cost. If only one kind of large denomination coin is used for paying out of change, the prior art arrangement will not pose a serious problem. If several kinds of large denomination coins are used, however, the addition circuit and the comparison circuit must be provided for each of the large denominations and this will become a problem. In the vending machines, there is an increasing tendency to employ not only coins but a large denomination bill and denominations of coins used for paying out of change are increasing from one or two kinds as was customary with an old type vending machine to three or four kinds or more. There has arisen necessity, therefore, to properly cope with such recent tendency in the vending machines

It is, therefore, an object of the present invention to provide a vend possible judgement device for a vending machine capable of performing a vend possible judgement according to which missing of chances of vending in case of shortage of coins stored for paying out of change can be prevented to the maximum possible extent. More specifically, it is an object of the invention to perform the vend possible judgement in a novel manner which is entiely different from that in the prior art vending machine in a case where coins of a large denomination are sufficient though coins of a small denomination are short as coins stored for paying out of change. According to the invention, a shortage detection device for detecting whether there is shortage in coins stored for paying out of change is provided not only for the small denomination to be used for change but also for the large denomination so that shortage of coins stored for paying out of chanage is detected with respect to a plurality of denominations. In association with a comparision device for comparing the set vend price with the amount of a deposited coin of bill to make judgement as to whether vending is possible or not, a contol circuit is provided for controlling whether vending requiring change should be permitted or not. This control circuit receives a signal representing the set vend price and shortage detection signals for respective denominations outputted by the shortage detection device, specify, in response to the signal representing the set vend price, one or more denominations which can be used as change corresponding to the set vend price, judge whether or not change in the specified denomination or denominations can be paid out by coins of one or more denominations which have been represented by the shortage detection signals as not being short as coins stored for paying out of change, and, in accordance with a result of this judgement, controls whether the vending requiring change should be permitted or not in association with the comparison device.

For example, in the control circuit, one or more denominations which can be used as change corresponding to the set vend price are specified on the basis of a denomination of an effective least significant digit of the set vend price. In the present invention, the "effective least significant digit"

means the least significant digit in digits of decimal notation having a number other than 0. The "denomination of the effective least significant digit" means a denomination corresponding to the effective least significant digit. If, for example, the set vend price is 110 yen in the Japanese currency, a 10-yen coin is the denomination of the effective least significant digit. Similarly, if the set vend price is 120 yen or 170 yen, the 10-yen coin is also the denomination of the effective least significant digit. If the set vend price is 100 yen or 200 yen, a digit having a number other than 0 is only the hundreds digit and, accordingly, the denomination of the effective least significant digit is a 100-yen coin.

As for the United States currency or the British currency, if the set vend price is 70 cents (or 70 pence), for example, a ten-cent (or a tenpence) coin is the denomination of the effective least significant digit. If the set vend price is 50 cent (or 50 pence), a fifty-cent (or a fifty pence) coin is the denomination of the effective least siginficant digit. In this case, the denomination of the effective least significant digit and smaller denominations are fifty-cent, twenty-five-cent, ten-cent and five-cent coins (or fifty pence, tenpence and fivepence coins). Similarly, if the set vend price is $1.10 (or £1.10), the effective least significnat digit denomination is a ten-cent coin (or a tenpence coin).

Alternatively stated, "the denomination of the effective least significant digit" means the denomination of the least significant digit in a case where the set vend price is composed of one or more denominations with priority being given to as large a denomination as possible. For example, the set vend price of 120 yen (or 70 cents or 70 pence) is composed of a 100-yen coin and 10-yen coins (or a fifty-cent coin and ten-cent coins or a fifty pence coin and tenpence coins) and the denomination of the least significant digit is the 10-yen coin (or ten-cent coin or tenpence coin).

The denomination of the effective least significant digit and smaller denomination or denominations in the set vend price means a denomination which has possibility of being used as a coin of the minimum unit among coins paid out as change when vending requiring change is made with respect to an article corresponding to the set vend price. If, for example, the set vent price is 120 yen (or 70 cents or 70 pence), the unit of the change coin is a 10-yen coin (or a ten-cent coin or a tenpence coin) regardless of the deposited amount and the 10-yen coin (or ten-cent coin or tenpence coin) is the denomination of the least significant digit of this set vend price (120 yen, 70 cents or 70 pence). If the denomination of the effective least signficiant digit of the set vend price is 100 yen (or 50 cents or 50 pence) such as in a case where the set vend price is 100 yen or 200 yen (or 50 cents or 50 pence), change must be paid in the unit of 100 yen (or 50 cents or 50 pence) and the denominations which have possibility of becoming the minimum unit among coins being actually paid out as change are a 100-yen coin and a 10-yen coin (or a fifty cent coin and a ten-cent coin or a fifty pence coin and a tenpence coin). If the change is paid out in 100-yen coins (or fifty cent coins or fifty pence coins), the 100-yen coin (or fifty cent coin or fifty pence coin) is the change coin of the minimum unit, whereas if the change is paid out in 10-yen coins (or ten-cent coins or tenpence coins) only or in combination of 100-yen coins and 10-yen coins (or in combination of fifty cent coins and ten-cent coins or in combination of fifty pence coins and tenpence coins), the 10-yen coin (or ten-cent coin or tenpence coin) is tye coin of the minimum unit among the change coins. Accordingly, paying out of an amount corresponding to the denomination of the effective least significant digit as change can be made not only by a single coin corresponding to the denomination but also by several coins of a smaller denomination than it. By permitting, as proposed by the present invention, vending requiring change concerning the set vend price on condition that there is no shortage in coins stored for paying out of change in any of the denomination of the effective least significant digit and smaller denominations of the set vend price, change can be paid out without fail when the vending is made. As a result, if coins of a large denomination stored for paying out of change are not short even though coins of a small denomination are short, judgement that vending is possible can be made even in vending requiring change if the change can be paid out in the coins of the large denomination. According to the invention, the above described special vend possible judgement is made possible with a simple construction without requiring the addition operation as in the prior art device. Accordingly, a vend possible judgement device of a simple construction capable of effectively operating the vending machine without missing chances of vending can be provided.

In the accompanying drawings,

Figure 1 is a block diagram showing an embodiment of the vend possible judgement device for a vending machine according to the invention;

Figure 2 is a logical circuit diagram showing an example of the control circuit in Figure 1;

Figures 3, 4 and *5* are block diagrams showing examples of construction of the comparators shown in Figure 1;

Figure 6 is a logical circuit diagram showing another example of the control circuit shown in Figure 2; and

Figure 7 is a block diagram showing another embodiment of the invention.

Referring first to Figure 1, data K representing an amount of a deposited coin or bill (or balance thereof) is supplied from an up-down counter (not shown) of the vending machine. As is well-known, this up-down counter cumulatively adds amounts of deposited coins and subtracts amounts of paid-out coins and a price of a vended article. SPl through SPn are data respectively representing set vend prices of respective articles to be vended by the vending machine (i.e. set vend prices for respective article dispensing columns). Data SPl - SPn is supplied from a proper vend price setting device (not shown). The deposited amount data K and set vend price data SPl - SPn are supplied to a comparison unit 10 for examining vend possible conditions. In this comparison unit 10, the amount of deposited

coins is compared with the respective set vent prices for making a basic judgement as to whether the amount of deposited coins is equal to or exceeding the set vend prices or not (i.e. K ≥ SPi where i = 1, 2, ... n). In the illustrated embodiment, the comparison unit 10 includes comparators 10-l through 10-n corrresponding respectively to the set vend prices SPI - SPn each of which comparators compares whether the basic vend possible condition K ≥ SPi is satisfied of not. One or more of the comparators 10-l through 10-n in which the condition K ≥ Spi has been satisfied output a vend possible signal (one of Vl-Vn). The vend possible signals Vl-Vn are supplied to a vend control circuit (not shown) of the vending machine to bring one or more of the article dispensing columns for which the vend possible signals Vl-Vn have been generated into a vend possible state. As is known, a desired article can be dispensed from one of the article dispensing columns which have been brought into a vend possible state by operating an article selection switch.

According to the present invention, comparision is not unconditionally made in the comparators 10-l through 10-n but a substantial comparison is made only in those of the comparators 10-l through 10-n which have been judged capable of making comparison by a control circuit 11. To the control circuit 11 are applied the respective set vend price data SPI-SPn and shortage detection signals E10, E50, E100 for respective denominations representing shortage of coins of respective denominations stored for paying out of change. The control circuit 11 judges, for each of the set vend prices SPi, whether there is shortage of coins stored for paying out of change with respect to the denomination of the effective least significant digit and smaller denominations and thereupon outputs a control signal Ci (where i = 1, 2, ... n) in correspondence to the set vend price SPi. If no shortage of coins sotred for paying out of change has been detected in any of the denomination of the effective least significant digit and the smaller denominations, the control signal Ci for the set vend price SPi in this case is "1" and otherwise the control signal Ci is "0". Control signals Cl-Cn are respectively applied to the comparators 10-1 through 10-n for controlling comparison operations of these comparators, particularly a comparison operation relating to vend possible conditions in a case where change is required. More specifically, when any of the control signals Cl-Cn is "1", a comparison operation concerning "K > Spi" is made possible in the comparators 10-l through 10-n corresponding to the control signals which is "1". The condition "K > SPi" means that the deposited amount K is greater than the vend price SPi, i.e., a vend possible condition requiring paying out of change. The comparison operation concerning "K > SPi" is substantially prohibited in the comparators 10-l through 10-n when the control signals Cl-Cn corresponding thereto are "0". The comparison operation for judging the vend possible condition "K = Spi" requiring no paying out of change is always made possible regardless of the state of the control signals Cl-Cn.

The detection signals E10, E50 and E100 representing shortage of coins sotred for paying out of change are provided by known change coin shortage detection devices 12, 13 and 14. Assume, for example, that there are three kinds of coins of different denominations, i.e., a 10-yen coin, a 50-yen coin and a 100-yen coin, as coins stored for paying out of change. The change coin shortage detection device 12 is provided for detecting a 10-yen coin, the device 13 for detecting a 50-yen coin and the device 14 for detecting a 100-yen coin, respectively. The detection signal E10 is a signal representing shortage of a 10-yen coin, E50 shortage of a 50-yen coin and a detection signal E100 shortage of a 100-yen coin, respectively. In the present embodiment, it is assumed that the level of the signals E10, E50 and E100 is "1" when there is shortage of coins of a corresponding denomination and "0" when there is no such shortage. As the change coin shortage detection devices 12, 13 and 14 is employed, for example, a change coin shortage sensor (not shown) provided in a suitable place in a change coin storage tube (not shown) or a change coin shortage counter (not shown) which calculates the number of coins stored in the change coin storage tube by cumulatively adding the number of coins supplied to the tube (coins received in the tube among deposited coins) and subtracting the number of coins paid out of the tube.

Figure 2 shows an example of internal construction of the control circuit 11 with respect only to one set vend price SPI. Circuits for the other set vend prices SP2-SPn may be constructed in a similar manner. The control circuit 11 includes an effective least significant digit denomination detection logic 15 and a control signal generation logic 16. In this example, it is assumed that the set vend price SPI (SPi) consists of the units digit, tens digit and hundreds digit in the decimal notation and the value of the set vend price SPI is expressed substantially by the tens digit and hundreds digit, the units digit always remaining 0. The decimal number of each digit is expressed by a 4-bit binary coded decimal (BCD). In the effective least significant digit denomination detection logic 15, all bits of data SPI.10 of the tens digit in the set vend price SPI are applied to an OR gate 17. Further, the least significant bit (LSB) and third bit of the data SPI.10 are applied to an AND gate 18 and inverted signals of the most significant bit (MSB) and the second bit are applied to the remaining input terminals of the AND gate 18. When the tens digit is 5 (i.e., 50 yen), the data SPI.10 is "0101" so that the AND gate 18 produces an output signal "1". The output signal of the AND gate 18 is inverted by an inverter 19 and thereafter is applied to an AND gate 20. The AND gate 20 receives, at another input terminal thereof, an output signal of the OR gate 17. When the tens digit is any value other than 0, the output of the OR gate 17 is "1" and, if the tens digit is a value other than 5, the output of the AND gate 20 is "1".

All bits of data SPI.100 of the hundreds digit of the set vend price SPI are applied to an OR gate 21. If, accordingly, the hundreds digit is any value other than 0, the output of the OR gate 21 is "1". The output of the OR gate 21 is applied to an AND gate

22. The AND gate 22 receives, at another input terminal thereof, a signal obtained by inverting the output of the AND gate 18 or 20 by a NOR gate 23. When the tens digit is any value other than 0, the output of the NOR gate 23 is "0" so that the output of the OR gate 21 is inhibited by the AND gate 22.

According to the above described construction, if the effective least significant digit denomination is a 10-yen coin, an output signal Y10 of the AND gate 20 is turned to "1" whereas the outputs of the AND gates 18 and 22 are "0". If the effective least significant digit denomination is a 50-yen coin, the output signal Y50 of the AND gate 18 is turned to "1" and other signals Y10 and Y100 are "0". If the effective least significant digit denomination is a 100-yen coin, the output signal Y100 of the AND gate 22 is turned to "1" whereas the other signals Y10 and Y50 are "0". If, for example, the set vend price SPI is 110 yen, SPI.10 is "0001", SPI.100 is "0001", the output of the OR gate 17 is "1", the output signal Y50 of the AND gate 18 is "0", the output of the OR gate 21 is "1", the output signal Y10 of the AND gate 20 is "1", the output of the NOR gate 23 is "0" and the output signal Y100 of the AND gate 22 is "0" and, accordingly, the effective least significant digit denomination is found to be 10 yen.

In the control signal generation logic 16, the shortage detection signals E10, E50 and E100 representing shortage of coins of the respective denominations stored for paying out of change are inverted by inverters 24, 25 and 26. Output signals $\overline{E10}$, $\overline{E50}$ and $\overline{E100}$ of the inverters 24, 25 and 26 represent that the coins of the respective denominations (10-yen, 50-yen and 100-yen) stored for paying out of change are not short when these signals are "1". The signal $\overline{E10}$ is applied to AND gates 27, 29 and 32. The signal $\overline{E50}$ is applied to AND gates 28 and 31. The signal $\overline{E100}$ is applied to an AND gate 30. The signal Y10 representing that the effective least significant digit denomination is 10 yen is applied to the AND gate 27. The signal Y50 representing that the effective least significant digit denomination is 50 yen is applied to the AND gates 28 and 29. Likewise, the signal Y representing that the effective least significant digit is 100 yen is applied to AND gates 30, 31 and 32. If, accordingly, coins stored for paying out of change are not short in any of the effective least significant digit denomination and smaller denominations, at least one of the AND gates 27-32 is enabled and a signal "1" is applied to the OR gate 33. The output of the OR gate 33 is supplied to the comparator 10-I as the control signal CI.

If, for example, the set vend price SPI is 200 yen, a coin corresponding to the effective least significant digit denomination is a 100-yen coin. In this case, the AND gates 30, 31 and 32 are enabled by the signal Y100 which is "1", whereas the AND gates 27, 28 and 29 are not enabled for the signals Y50 and Y10 are "0". If, in this case, coins stored for paying out of change are short with respect to all of the denominations (i.e., 10 yen, 50 yen and 100 yen), the signals E10, E50 and E100 are all "1" so that the AND gates 30, 31 and 32 are not enabled. The control signal C1 therefore is "0" and the comparison operation "K > SPI" in the comparator 10-I is prohibited. Hence, a vending operating requiring paying out of change is prohibited. If coins stored for paying out of change in the small and medium denominations (i.e., 10 yen and 50 yen) are short but those in the large denomination (i.e., 100 yen) are not short, the signals E10 and E50 are "1" and the signal E100 is "0". The AND gate 30 therefore is enabled and the control signal C1 is turned to "1". The comparison operation "K > SPI" in the comparator 10-I thereby is made possible and a vending operation requiring paying out of change is permitted. If in this case a 1000-yen bill or a 500-yen bill or coin is deposited in the vending machine, the condition "K > SPI" is satisfied (by reason of 1000 > 200 or 500 > 200) and the judgement that vending is possible is made. The change of 800 yen or 300 yen can be paid out by the large denomination coins (i.e. 100-yen coins) which are not short, though the small and medium denomination coins are short. If an extra coin (e.g. a 10-yen coin) is inserted in addition to the 1000-yen bill or the 500-yen bill with the result that K becomes K = 1010 or K = 510 and that the change to be paid out becomes 810 yen or 310 yen, an extra change 10 yen can be paid out by the 10-yen coin which has been inserted just now and no particular problem will arise even though the small and medium denomination coins are short.

Figures 3, 4 and 5 respectively show examples of the comparator 10-I. The other comparators 10-2 through 10-n xn can be constructed in a similar manner.

Figure 3 shows an example in which a comparator 34 performs the comparison operation K > SPI and whether or not its output should be utilized is controlled by the control signal CI. The comparator 34 performs the comparison operations concerning K = SPI and K > SPI and the output concerning K = SPI is utilized as the vend possible signal V1 through an OR gate 36. Whether the comparison output concerning K > SPI should be applied to the OR gate 36 or not is controlled at an AND gate 35 by the control signal CI.

Figure 4 shows an example in which a coincidence detection circuit 37 performs the comparison operation concerning K = SPI and a comparator 38 performs the comparison operation concerning K > SPI. The control signal CI is used as an enable signal for the comparator 38. The comparator 38 carried out the comparison operation when the control signal CI is "1" but does not when the control signal CI is "0". The outputs of the two circuits 37 and 38 are provided as the vend possible signal V1 through an OR gate 39.

The example shown in Figure 5 includes, just as the example shown in Figure 4, a coincidence detection circuit 40 for performing the comparision operation concerning K = SPI and a comparator 41 for performing the comparison operation concerning K > SPI. In this example, however, whether the set vend price data SPI should be applied to the comparator 41 or not is controlled by a gate 42 provided on the input side of the comparator 41. When the control signal CI is "0", the gate 42 is closed so that the comparison operation concerning K > SPI is substantially prohibited. When the control

signal Cl is "1", the gate 42 is open and thereby enables the vend price SPl to be supplied to the comparator 41. The comparator 41 produces an output "1" when the conditions K> SP1 > 0 are both satisfied. This arrangement is made for prohibiting satisfaction of the condition K > SPl in a case where the condition SPl = 0 is satisfied by closing of the gate 42. The outputs of these two circuits 40 and 41 are provided as the vend possible signal V1 through an OR gate 43.

In the example shown in Figure 1, the comparators 10-l through 10-n are provided for the respective set vend prices SPi. These comparators may be replaced by a comparator for a single vend price which is used on a time shared basis for the respective vend prices SPi. In this case, the effective least significant digit denomination detection logic 15 and the control signal generation logic 16 for a single vend price may be provided and used on a time shared basis for the respective set vend prices SPi.

Instead of providing the effective least significant digit denomination detection logic 15 in the control circuit 11, an arrangement may be made so that a signal representing the effective least signifiant digit denomination of the respective set vend price SPi may be previously supplied to the control circuit 11. In this case, the control circuit 11 is composed of only the control signal generation logic 16.

If the respective set vend prices SPi are set in such a manner that these set vend prices SPi have the same effective least significant digit denomination, the construction of the control circuit 11 can be simplified, i.e., the effective least significant digit demonination detection logic 15 and the control signal generation logic 16 need not be provided for each of the set vend prices SPi.

Even if the respective prices SPi have different effective least significant digit denominations, priority may be given to the smallest denomination among these different effective least significant digit denominations and the vend possible judgement may be controlled commonly with respect to all of the prices SPi on the basis of the denomination to which priority has been given. In this case also construction of the control circuit 11 may be simplified.

In the control circuit 11, the shortage detection signal need not be utilized with respect to all of the denominations of coins stored for paying out of change but may be utilized with respect to only a part thereof. For example, two kinds of denominations for change coins, i.e., the smallest denomination and the largest denomination, can achieve a sufficient effect with a simplified control circuit 11. In a case where, for example, three kinds of coins, i.e., 10-yen, 50-yen and 100-yen coins, are used for coins stored for paying out of change, it is in many cases sufficient to make the vend possible judgement taking shortage of the 10-yen and 100-yen coins only into account, for the 50-yen coin is less frequently used than the 10-yen and 100-yen coins. In this case, the control circuit 11 may be simplified as shown in Figure 6. The example shown in Figure 2 is so constructed that a 50-yen coin as well as a 10-yen coin can be detected as the denominations when the effective least significant digit is the tens digit, whereas in the example of Figure 6, detection of the 10-yen coin only is made. In an effective least significant digit denomination detection logic 15A, BCD data SPl.10 for the tens digit of the set vend price SPl only is applied to an OR gate 44. When the output of the OR gate 44 is "1", it represents that the effective least signficant digit denomination is the 10-yen coin. When the output of the OR gate 44 is "0", it is assumed that the effective least significant digit denomination is the 100-yen coin and this signal "0" is inverted by an inverter 45 and outputted as a 100-yen signal Y100. To an AND gate 46 of a control signal generation logic 16B are applied a 10-yen signal Y10 provided by the OR gate 44 and an inverted signal $\overline{E10}$ of the 10-yen shortage detection signal E10. To an AND gate 47 are applied the 100-yen signal Y100 and an inverted signal $\overline{E100}$ of the 100-yen shortage detection signal E100. To an AND gate 48 are applied the signal Y100 and the signal $\overline{E10}$. Outputs of these AND gates 46, 47 and 48 are outputted as the control signal C1 through an OR gate 49.

Assume, for example, that the set vend price SPl is 100 yen, SP2 is 120 yen and SPn is 200 yen, that the 10-yen coins, the smallest denomination, stored for paying out of change are short and that the 100-yen coins, the largest denomination, stored for paying out of change are not short. Since the effective least significant digit denomination of the vend prices SP1 and SP2 is 100 yen and the 200-yen coins stored for paying out of change are not short, the control signals Cl and Cn outputted from the control circuit 11 are respectively "1". On the other hand, the effective least significant digit denomination of the vend price SP2 is 10 yen and coins stored for paying out of change in this denomination and smaller denomination (i.e., 10 yen) are short so that the control signal C2 outputted by the control circuit 11 is "0". Accordingly, the comparison operation concerning "K > SPi" in the comparators 10-l and 10-n is made possible and the comparison operation concerning "K > SPi" in the comparator 10-2 is prohibited. If 100-yen is deposited in this state, the condition K = SPl is satisfied and the vend possible signal Vl thereupon is generated. If 120 yen is deposited, the conditions K > SP1 and K = SP2 are satisfied and the vend possible signals V1 and V2 are generated. If a 500-yen coin is deposited, the conditions K > SPl and K > SPn are satisfied and, as a result, the vend possible signals Vl and Vn are generated. Since, however, the comparison operation concerning K > SP2 is prohibited, the vend possible signal V2 is not generated.

Figure 7 shows a modification of the example shown in Figure 5 in which gates 42-l through 42-n are provided outside of the comparison unit 10. These gates 42-l through 42-n are controlled, as the gate 42 in Figure 5, by the control signal Cl-Cn provided by the control circuit 11. A comparison unit 10A is provided for judging the vend possible condition (K = SPi) not requiring paying out of change and corresponds to the coincidence detectoin circuit 40. A comparison unit 10B is provided for the condition K > SPi requiring paying out of change

and corresponds to the comparator 41 in Figure 5. OR gates 43-l through 43-n which correspond to the OR gate 43 in Figure 5 receive outputs of the comparison units 10A and 10B corresponding to the respective set vend prices SPi and outputs of these comparison units 10A and 10B are utilized as the vend possible signals Vl and Vn.

Control circuits of vending machines generally are presently made by a LSI circuitry and the comparison unit 10 is included in such LSI circuitry. The control circuit 11 can also be designed so that it is included in such LSI circuitry. If, however, the gates 42-l through 42-n are provided outside of the comparison unit 10 as shown in Figure 7, these gates 42-l through 42-n and the control circuit 11 can be composed as an outside circuit of the LSI circuitry and can be connected to an existing LSI control circuit of the vending machine.

In the above described embodiments, the present invention is realized by a discrete circuit. The invention, however, is not limited to this but may be realized by a software processing employing a microcomputer.

The above described embodiments have been described with respect to a vending machine in which Japanese coins (yen) are used. It will be understood, however, that the invention is applicable to vending machines in which coins of other currencies are used. If, for example, the United States currency is used for the vending machine, the vending machine should be so constructed that coins including five-cent, ten-cent and fiftypcent pieces and bills may be deposited, these coins of respective denominations are stored for paying out of change, shortage detection signals corresponding to E10, E50 and E100 are generated for shortage of the coins of the respective denominations and the control circuit 10 is composed after the control circuit of the above described embodiments with necessary modifications. Likewise, in a case where the British currency is used in the vending machine, the vending machine should be so constructed that coins including a penny, fivepence, tenpence and fifty pence pieces and bills may be deposited, these coins of respective denominations are stored for paying out of change, shortage signals corresponding to E10, E50 and E100 are generated and the control circuit 10 is composed after the above described embodiments with necessary modifications.

CLAIMS

1. A vend possible judgement device for vending machine comprising:

comparison means for comparing a set vend price with an amount of deposited coin or bill to make judgement as to whether vending is possible or not;

shortage detection means for detecting whether or not there is a shortage in coins of a plurality of denominations stored for paying out of change with respect to each of said denominations; and

a control device for receiving a signal representing said set vend price and shortage detection signals for the respective denominations outputted by said shortage detection means, specifying, in response to said signal representing said set vend price, one or more denominations which can be used as change corresponding to said set vend price, judging whether or not change in the specified denomination or denominations can be paid out by coins of one or more denominations which have been represented by said shortage detection signals as not being short as coins stored for paying out of change and, in accordance with a result of this judgement, controlling whether the vending requiring change should be permitted or not in association with said comparison means.

2. A vend possible judgement device as defined in Claim 1 wherein said control circuit comprises:

effective least significant digit denomination detection means detecting digits having a number other than 0 in digits of decimal notation of said set vend price for detecting a denomination corresponding to a number of the least signficant digit in said digits having a number other than 0 as the effective least significant digit denomination; and

logic means for judging, with respect to said effective least significant digit denomination and smaller denominations, whether coins of all of these denominations stored for paying out of change are short or there is any denomination of which coins stored for paying out of change are not short in response to output signals of said effective least significant digit denomination detection means and said shortage detection signals provided by said shortage detection means;

vending requiring paying out of change being prohibited in association with said comparison means when said logic means has judged that the coins of all of said effective least significant denomination and said smaller denominations are short.

3. A vend possible judgement device as defined in Claim 2 wherein said comparison means comprises first comparator comparing whether or not said set vend price coincides with the amount of the deposited coin or bill and second comparator comparing whether or not said set vend price is smaller than the amount of the deposited coin or bill;

the comparison operation of said second comparator being substantially prohibited when said logic means has judged that coins of all of said effective least significant digit denomination and said smaller denominations are short, whereas the comparison operation of said second comparator being substantially permitted when said logic means has judged that coins of any one of said effective least significant digit denomination and said smaller denominations are not short.

4. A vend possible judgement device as defined in Claim 3 which further comprises gate means for gating the output signal of said second comparator and in which the substantial prohibition of permission of the comparison operation of said second comparator is controlled by controlling said gate means by means of output signal of said logic means.

5. A vend possible judgement device as defined in Claim 3 which further comprises gate means for gating a signal representing said set vend price to be

applied to said second comparator and in which the substantial prohibition or permission of the comparison operation of said second comparator is controlled by controlling said gate means by means of output signal of said logic means.

6. A vend possible judgement device as defined in Claims 1, 2, 3, 4 and 5 wherein there are a plurality of said set vend prices and the control by said control device is carried out for each of said set vend prices.

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