(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 566 154 A1**

(12) **EUROPEAN PATENT APPLICATION**

(21) Application number: **93106298.8**

(22) Date of filing: **19.04.93**

(51) Int. Cl.[5]: **G07F 3/02**, G07D 5/08, G07D 5/02

(30) Priority: **17.04.92 JP 98129/92**
17.08.92 JP 217973/92

(43) Date of publication of application:
20.10.93 Bulletin 93/42

(84) Designated Contracting States:
DE ES FR GB IT

(71) Applicant: **KABUSHIKI KAISHA NIPPON CONLUX**
2-2, Uchisaiwai-cho 2-chome,
Chiyoda-ku Tokyo(JP)

(72) Inventor: **Furuya, Yonezo**
3-8-18, Matsugaoka,
Hatoyama-machi,
Hiki-gun, Saitama(JP)
Inventor: **Osawa, Toshio**
984, Katsuse,
Fujimi-shi, Saitama(JP)

(74) Representative: **Selting, Günther, Dipl.-Ing. et al**
Patentanwälte
von Kreisler, Selting, Werner,
Postfach 10 22 41,
Bahnhofsvorplatz 1
D-50462 Köln (DE)

(54) **Coin processor.**

(57) A coin processor in which part of a magnetic field generated by a first oscillation coil (10a-1) permeates through a coin passing along a coin passage (3) and then received by a second reception coil (10b-2), while other part of the magnetic field acts on the surface of the coin and then received by a first reception coil (10b-1) and, part of a magnetic field generated by a second oscillation coil (10a-2) permeates through the coin and then received by the first reception coil (10b-1), while other part of the magnetic field acts on the surface of the coin and then received by the second reception coil (10b-2). On the basis of an addition of outputs of the first and second reception coils, the coin passing along the coin passage (3) is discriminated. The coin processor comprises a coin discriminator/sorter section (100) for discriminating whether inserted coins are true or false and sorting the true coins in accordance with their coin types, a coin accumulator/dispenser section (200 integrally formed with the coin discriminator/sorter section (100) for accumulating the sorted coins and dispensing some of the accumulated coins for change, and a single controller (500) for controlling both of the sections (100) and (200).

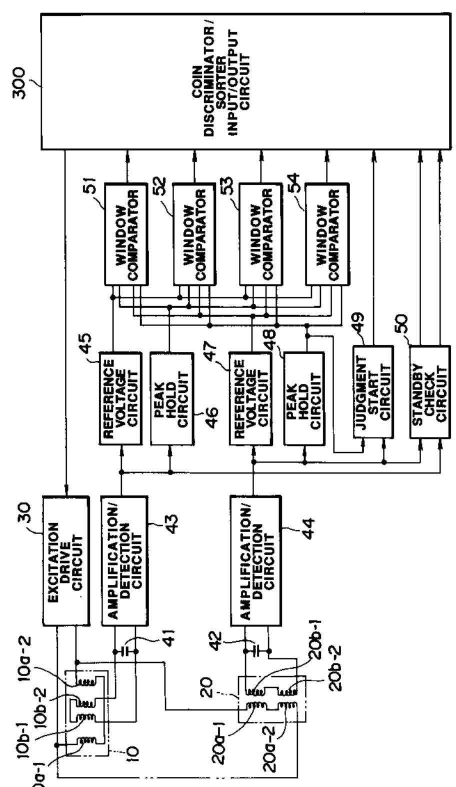

FIG.14

EP 0 566 154 A1

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to coin processors which are used for various sorts of service machines such as automatic vending machines and money exchanging machines and more particularly, to a coin processor having an improved coin selecting function in which a coin discriminator/sorter for discriminating and selecting true and false coins deposited into the machine and their denomimations and a coin accumulator/dispenser for accumulating some of the coins selected by the coin sorter for change and for dispensing some of the accumulated coins as the change are integrally formed to thereby realize a small-sized machine.

2. Description of the Related Art

One of coin processors which electronically sort coins is as disclosed in, for example, U.S. Patent No. 3870137. In the coin processor of this U.S. Patent, a coin passage is provided on its one side with a coil which in turn forms part of an oscillation circuit, so that, when a coin to be checked is moved along the coin passage, this causes a shift of oscillation frequency of the oscillation circuit. Coin discrimination is carried out on the basis of this shift.

More in detail, this coin processor utilizes a change in the inductance of the coil caused by a coin passing by a coil, generates a shift in a oscillation frequency of an oscillation circuit and judges whether the coin is true or false on the basis of a difference in the degree of frequency shift.

With such an arrangement, however, the oscillation frequency shift is differently influenced by the magnitude of the set frequency of the oscillator. For example, when the frequency of the oscillator is set to below, the oscillation frequency shift is influenced largely by the inside material of the coin; whereas, when the oscillation frequency is set to be high, the oscillation frequency shift is influenced largely by the surface material of the coin.

Assume now that the coin is made of identical homogeneous material in its inside and surface. Then, when the frequency of the oscillator is suitably set, coin sorting can be realized with use of the single coil. However, when clad coins each made of a plurality of thin layers of different materials (which coins will be referred to as the composite material coins, hereinafter) such as U.S. 10 cent, 25 cent and one dollar coins are checked, it becomes very difficult to discriminate such coins with use of the single coil.

To eliminate the above defect, in the coin processor disclosed in the aforementioned U.S. Patent No. 3870137, a plurality of coils are provided along the coin passage and a plurality of oscillation circuits are provided which include the respective coils, the oscillation frequencies of the oscillation circuits are set to be different from each other to thereby realize the discrimination between the composite material coins.

With such an arrangement, however, it is necessary to dispose the plurality of coils along the coin passage and also to space apart the coils by predetermined distances therebetween in order to eliminate the mutual influences therebetween. Thus, this requires the coin passage to be made considerably long for the purpose of detecting coins, which results in that the physical dimensions of the entire coin processor becomes large, thus hindering the realization of a small-sized coin processor.

The coin processor disclosed in the above U.S. Patent No. 3870137 is also arranged so that the coin passage is inclined toward its coil mounting wall by a predetermined angle with respect to a vertical direction. This is for the purpose of keeping constant a relationship between the coils and coins moving along the coin passage during the coin detection, whereby the coins can be moved along the coin passage as slidably contacted with one side wall of the passage. As a result, the relationship between the coils and the coins moving along the coin passage can be maintained always constant. Such an arrangement that the coin passage is inclined toward the coil mounting wall is one of essential requirements of the coin processor disclosed in the above-mentioned US patent. With the arrangement of this coin processor, when the coin passage is provided vertically for example, the distance between the passing coin and the coils varies depending on the position of the coin passing along the coin passage, whereby the oscillation frequency shift of the oscillation circuit is also changed and thus it becomes impossible to realize accurate coin discrimination.

Meanwhile, when the coin passage is arranged as inclined, there is a problem that, since the coin is moved along the coin passage as slidably contacted with one side wall of the passage, this tends to cause coin clogging when the deposited coin is wet. Further, such foreign matter as dust tends to deposit on the side wall. Such foreign matter deposition involves another problem that the deposition causes a change between the magnetic coupling relationship between the coils and inserted coins, which results in that, even when the coins are made of the same material, the coin processor generates different outputs for the coins, whereby the coin processor is deteriorated in its selection accuracy and erroneously operated.

There is another problem that the arrangement of the inclined coin passage requires the physical dimensions of the entire coin processor to be large.

Also well known is another coin processor in which an oscillation coil to be excited by a predetermined frequency signal is disposed at one side wall of a coin passage while a reception coil is disposed at the other side wall of the passage so that discrimination of coins moving along the coin passage is carried out on the basis of the level of an output voltage of the reception coil.

Even with such an arrangement, however, the coin processor provides different outputs depending on the different frequencies of the signal for excitation of the oscillation coil. That is, with this arrangement, coin discrimination is carried out on the basis of a change in that part of a magnetic field generated by the oscillation coil through the passage of the coin between the oscillation coil and reception coil and received by the reception coil, that is, on the basis of a change in mutual coupling coefficient between the oscillation and reception coils. In this case, the mutual coupling coefficient between the oscillation and reception coils differently varies with the different frequencies of the oscillation-coil exciting signal. This results from a phenomenon that a low-frequency magnetic field penetrates into the inside of the coin while a high-frequency magnetic field can penetrate only up to the surface of the coin. For example, when the frequency of the signal for excitation of the oscillation coil is set low, the output of the reception coil varies largely depending on the inside material of the coin; whereas, when the excitation signal is set high, the output of the reception coil varies largely depending on the surface material of the coin.

For this reason, even with the above arrangement, when it is desired to discriminate, for example, between composite material coins made of a plurality of thin layers of different materials such as U.S. 10 cent, 25 cent and one dollar coins, it becomes highly difficult to carry out coin discrimination with use of the single oscillation coil. In order to avoid this problem, a plurality of oscillation coils are provided along the coin passage which are to be excited by signals having respectively different frequencies and a plurality of reception coils are disposed as opposed to the respective oscillation coils with the coin passage disposed between the oscillation and reception coils, so that coin discrimination is carried out on the basis of outputs of the plurality of reception coils.

Even with this arrangement, however, it is necessary to dispose a plurality of oscillation and reception coils along the coin passage and correspondingly it also becomes necessary to make long the coin passage for coin detection, which results in that the physical dimensions of the entire coin processor for coin detection becomes inevitably large.

In addition, the above coin processor also has a problem that, when the coin passage is arranged vertically, the detection output varies with the position of the coin passing along the coin passage and thus an output signal also largely varies with the result that the accuracy of its coin discrimination is deteriorated.

Further, in this sort of coin processor, a coin discriminator/sorter which is so called a discriminator for discriminating whether inserted coins are true or false and types of the coins is provided separately from a coin accumulator/dispenser usually called merely a coin changer for accumulating some of the coins selected by the coin sorter for change and for dispensing some of the accumulated coins as the change; and two controllers are provided for controlling the coin discriminator/sorter and the coin accumulator/dispenser, respectively.

In these years, how to make small the size of this sort of coin processor has been investigated and there has been suggested such a coin processor that a coin discriminator/sorter and a coin accumulator/dispenser are integrally formed. Even with this arrangement, however, as in the prior art, when two controllers are separately provided to the coin discriminator/sorter and coin accumulator/dispensor, this requires provision of signal lines for signal transfer between the two controllers. In addition, each of the controllers carries out the same arithmetic operation. As a result, the entire coin processor becomes redundant, thus hindering the realization of a small-size coin processor.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a coin processor which can accurately detect composite material coins each made of a plurality of thin layers of different materials, can dispose a coin passage vertically, can make small its physical dimensions, and can exhibit its excellent coin sorting ability.

Another object of the present invention is to provide a coin processor which can be made small in size and in which a controller can be simplified.

In accordance with an aspect of the present invention, the above objects can be attained by providing a coin processor which comprises a first reception coil provided to a coin passage, a second reception coil provided as opposed to the first reception coil with the coin passage disposed between the first and second reception coils, a first oscillation coil provided as mounted on the first reception coil coaxially with the first reception coil to be excited and driven by an excitation signal having a predetermined frequency, a second oscillation coil provided as mounted on the second reception coil coaxially with the second reception coil to be excited and driven by an excitation signal having a predetermined frequency, and discrimination means for discriminating a coin passed along the coin passage on the basis of an addition of outputs of the first and second reception coils.

In accordance with an aspect of the present invention, a coin processor comprises a coin discriminator/sorter section for discriminating between true and false coins inserted into the coin processor and for discriminating and sorting the coins by the coin types, a coin accumulator/dispenser section integrally formed with the coin discriminator/sorter section for accumulating some of the coins sorted by the coin discriminator/sorter section to be used as change and for dispensing some of the accumulated coins for change, and a controller of an integral structure for controlling the coin discriminator/sorter section and the coin accumulator/dispenser section.

In the present invention, part of a magnetic field generated by a first oscillation coil passes through a coin passed along a coin passage and then is received by a second reception coil, while other part of the magnetic field acts on the surface of the coin passed along the coin passage and then received by a first reception coil. Similarly, part of a magnetic field generated by a second oscillation coil passes through the coin passed along the coin passage and then is received by the first reception coil, while other part of the magnetic field acts on the surface of the coin passed along the coin passage and then is received by the second reception coil. And on the basis of an addition of outputs of the first and second reception coils, the discrimination means discriminates the coin passed along the coin passage. Since the first and second reception coils receive both of the magnetic fields passed through the coin and acted on the surface of the coin, the outputs of the first and second reception coils include information that depends on the inside material of the coin and also on the surface material of the coin, whereby the coin processor can accurately detect a composite material coin made of a plurality of thin layers of different materials. Further, since the respective coils are disposed as opposed to each other with the coin passage positioned therebetween, when the outputs of the first and second reception coils are added together, an error caused by the different positional passage of the coin along the coin passage can be canceled by the added output, whereby the coin passage can be vertically arranged without degrading the discrimination accuracy of the coin.

In accordance with another aspect of the present invention, the coin processor comprises a coin discriminator/sorter section for discriminating between true and false coins inserted into the coin processor and for discriminating and sorting the coins by the coin types, a coin accumulator/dispenser section integrally formed with the coin discriminator/sorter section for accumulating some of the coins sorted by the coin discriminator/sorter section to be used as change and for dispensing some of the accumulated coins for change, and a single controller provided for the coin discriminator/sorter section and the coin accumulator/dispenser section. According to this embodiment, the controller can be simplified and thus the coin processor can be made small in size with a low cost.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing an entire arrangement of a coin processor in accordance with an embodiment of the present invention;

Fig. 2 is a block diagram showing a schematic arrangement of a coin discriminator/sorter in Fig. 1;

Fig. 3 is a block diagram showing a schematic arrangement of a coin accumulator/dispenser in Fig. 1;

Fig. 4 is a front view of the general arrangement of the coin processor of the present embodiment;

Fig. 5 is a cross-sectional view taken along line A-A in the coin processor of Fig. 4;

Fig. 6 is a cross-sectional view taken along line B-B in the coin processor of Fig. 4;

Fig. 7 is a cross-sectional view showing a detailed structure of a material detection sensor in Fig. 4;

Figs. 8(a) and 8(b) show a front view of a reception coil forming a part of the material detection sensor in Fig. 7 and a cross-sectional view taken along line C-C in Fig. 8(a) respectively;

Figs. 9(a) and 9(b) show a front view of an oscillation coil forming a part of the material detection sensor in Fig. 7 and a cross-sectional view taken along line D-Din Fig. 9(a) respectively;

Fig. 10 is a cross-sectional view of a major part of the material detection sensor in Fig. 7;

Fig. 11 is a cross-sectional view showing a detailed structure of a diameter detection sensor in Fig. 4;

Figs. 12(a) and 12(b) show a front view of each of coils forming part of the diameter detection sensor in Fig. 11 and a cross-sectional view taken along line E-E in Fig. 12(a), respectively;

Fig. 13 is a schematic diagram for explaining a positional relationship between the coils of the diameter detection sensor in Fig. 11;

Fig. 14 is a circuit diagram of a specific arrangement of a coin discrimination circuit in Fig. 2;

Fig. 15 is a waveform of an exemplary output signal of the material detection sensor in Fig. 14;

Fig. 16 is a waveform of an exemplary output signal of an amplification/detection circuit in Fig. 14;

Fig. 17 is a circuit diagram of a specific arrangement of a window comparator in Fig. 14;

Figs. 18 and 19 collectively show a flowchart for explaining the operation of a controller in Fig. 1;

Fig. 20 is a diagram for explaining the coin discriminating principle of the material detection sensor in Fig. 4;

Fig. 21 is a diagram for explaining the coin discriminating principle of the material detection sensor in Fig. 4 when a coin to be checked is passed along a coin passage as biased against a first side wall thereof;

Fig. 22 is a diagram for explaining the coin discriminating principle of the material detection sensor in Fig. 4 when a coin to be checked is passed along the coin passage as biased against a second side wall thereof;

Fig. 23 is a diagram for explaining the coin discriminating principle of the material detection sensor in Fig. 4, showing an output when the coin to be checked is passed along the coin passage as biased against the first side wall thereof;

Fig. 24 is a diagram for explaining the coin discriminating principle of the material detection sensor in Fig. 4, showing an output when the coin to be checked is passed along the coin passage as biased against the second side wall thereof;

Fig. 25 is a graph for explaining the coin discriminating principle of the material detection sensor in Fig. 4, showing resonance characteristics of the material detection sensor; and

Figs. 26(a) and 26(b) show graphs for explaining the coin discriminating principle of the material detection sensor in Fig. 4, showing resonance characteristics of the material detection sensor and diameter detection sensors respectively.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to Fig. 1, there is shown a block diagram of a control system of a coin processor in accordance with an embodiment of the present invention.

The coin processor of the embodiment of Fig. 1 comprises a coin discriminator/sorter 100 for discriminating between true and false coins deposited in the processor and for sorting the discriminated coins by the coin types, a coin accumulator/dispenser 200 for accumulating some of the coins sorted by the coin discriminator/sorter 100 for change and for dispensing some of the accumulated coins as the change, a coin discriminator/sorter input/output circuit 300 connected to the coin discriminator/sorter 100, a coin accumulator/dispenser input/output circuit 400 connected to the coin accumulator/dispenser 200, and a controller 500 connected to the coin discriminator/sorter 100 and coin accumulator/dispenser 200 through the coin discriminator/sorter input/output circuit 300 and coin accumulator/dispenser input/output circuit 400.

The controller 500 outputs a vending start signal SE through a terminal T1 to an external device when the vending conditions of a predetermined article are satisfied, and also receives a coin acceptance inhibiting signal IH from the external device through a terminal T2. Further connected to the controller 500 are a price setting switch SPS for setting the selling price of an article, an inventory switch IVS for forcibly paying out coins within coin tubes 8-1 to 8-3 (which will be explained later), and an accepted-coin detection sensor DES for determining acceptance of inserted coins.

Fig. 2 schematically shows an arrangement of the coin discriminator/sorter 100. The coin discriminator/sorter 100 includes a coin discrimination circuit DS for discriminating between true and false coins inserted into coin the processor and also sorting the discriminated coins by the coin types, a true/false coin sorting solenoid SOL1 for operating a gate G1 (which will be explained later) for the sorting of the inserted coins into true and false coins, a true/false coin sorting solenoid driver DRV1 for driving the true/false coin sorting solenoid SOL1, a coin type sorting solenoid SOL2 for operating a gate G2 (which will be detailed later) for sorting the true coins selected by the gate G1 into a coin group for change and another coin group, and a coin type sorting solenoid driver DRV2 for driving the coin type sorting solenoid SOL2. In the illustrated embodiment, it is assumed that 4 types of coins, i.e., CA, CB, CC and CD can be accepted as true coins, the coins CA, CB and CC are guided into the coin tubes 8-1, 8-2 and 8-3 respectively to be used as change, and the coins CD are guided directly into a safe (not shown) not to be used as change. That is, the gate G2 functions to sort inserted coins into a group of the coins CA, CB and CC and a group of the coins CD.

Schematically shown in Fig. 3 is the coin accumulator/dispenser 200 which includes a coin

CA empty sensor EPS-A, a coin CB empty sensor EPS-B and a coin CC empty sensor EPS-C for detecting when the amounts of coins within the coin tubes 8-1 to 8-3 become less than their predetermined values respectively; a coin CA overflow sensor CFS-A, a coin CB overflow sensor CFS-B and a coin CC overflow sensor CFS-C for detecting when the amounts of coins within the coin tubes 8-1 to 8-3 exceed their predetermined amounts respectively; a coin CA pay-out solenoid SOL-A for controlling the pay out of the coins CA of the coin tube 8-1; a coin CA pay-out solenoid driver DRV-A for driving the coin CA pay-out solenoid SOL-A; a coin CB pay-out solenoid SOL-B for controlling the pay out of the coins CB of the coin tube 8-2; a coin CC pay-out solenoid SOL-C for controlling the pay out of the coins CC of the coin tube 8-3; and a coin CC pay-out solenoid driver DRV-C for driving the coin CC pay-out solenoid SOL-C.

Fig. 4 shows a general arrangement of the coin processor of the present invention, Fig. 5 shows a cross-sectional view taken along line A-A in Fig. 4, and Fig. 6 shows a cross-sectional view taken along line B-B in Fig. 4.

Explanation will first be made as to the schematic arrangement of the coin processor of the embodiment by referring to Figs. 4 to 6.

In Fig. 4, a coin slot 1 is provided in an upper part of a body 600 of the coin processor so that, a coin 2 inserted into the coin processor through the coin slot 1 falls on a first rail 3 which is inclined in a direction away from the coin slot 1. The coin 2 fell on the first rail 3 rollingly drops downstream along the first rail 3. Disposed in the middle of the first rail 3 are a material detection sensor 10 and a diameter detection sensor 20, so that discriminating of the coin 2 is carried out on the basis of outputs of the material detection sensor 10 and diameter detection sensor 20. The detailed structures and coin discriminating operations of the material detection sensor 10 and diameter detection sensor 20 will be detailed later.

In Fig. 5, the true/false coin sorting solenoid SOL1 is operated according to the decision of the aforementioned coin discriminating operation whether the inserted coin 2 is true or false. A plunger 872 of the true/false coin sorting solenoid SOL1 is connected through an arm 873 to the true/false coin sorting gate G1, so that, when the true/false coin sorting solenoid SOL1 is not driven, the restoring force of a spring 871 causes the arm 873 to be rotated clockwise around a pivot point 874, whereby the true/false coin sorting gate G1 is located in a position as shown by a solid line in Fig. 5, under which condition the inserted coin is guided into a return passage 6. When the true/false coin sorting solenoid SOL1 is driven, on the other hand, the plunger 872 is pulled into the true/false coin sorting solenoid SOL1, so that the arm 873 rotates counterclockwise around the pivot point 874, which results in that the true/false coin sorting gate G1 is located at a position as shown by a broken line in Fig. 5, under which condition the inserted coin is guided into a true coin passage, that is, into a true coin passage 4 or 5. In other words, when the inserted coin is false, the true/false coin sorting solenoid SOL1 is not operated so that the true/false coin sorting gate G1 is shifted or advanced toward the side of the true coin passage 4 to guide the false coin into the return passage 6 and then discharge it from a coin outlet L1 (not shown). Meanwhile, when the inserted coin is true, this causes the true/false coin sorting solenoid SOL1 to be driven, so that the true/false coin sorting gate G1 already advanced to the side of the true coin passage 4 in the wait mode is retreated to guide the true coin into the true coin passage 4 or 5. In the illustrated embodiment, the true coin passage is provided thereon with the accepted-coin detection sensor DES shown in Fig. 1 which functions to detect the true coin guided into the true coin passage by the true/false coin sorting gate G1.

As already explained in the foregoing, in the present embodiment, the 4 sorts of coins CA, CB, CC and CD are used and the coins CA, CB and CC are used for change. To this end, the present embodiment is arranged to guide the coins CA, CB and CC respectively into the coin tubes 8-1, 8-2 and 8-3 while the coins CD are guided directly to the not-shown safe to avoid its use as change.

The coins guided in the true coin passage are divided into two groups, i.e., one the coins CA, CB and CC to be used as change and the other the coins CD not used as change. A plunger 876 of the coin type sorting solenoid SOL2 is connected through an arm 877 to the coin type sorting gate G2, so that, when the coin type sorting solenoid SOL2 is not driven, the restoring force of a spring 875 causes the arm 877 to be rotated counterclockwise around a pivot point 879, which results in that the coin type sorting gate G2 is located at such a position as shown by a solid line in Fig. 5, under which condition the coin guided into the true coin passage by the true/false coin sorting solenoid G1 is guided into the true coin passage 5. On the other hand, when the coin type sorting solenoid SOL2 is driven, this causes the plunger 876 to be pulled into the coin type sorting solenoid SOL2, so that the arm 877 is rotated clockwise around the pivot point 879 and the coin type sorting gate G2 is located at such a position as shown by a broken line in Fig. 5, under which condition the coin guided in the true coin passage by the true/false coin sorting solenoid G1 is guided into the true coin passage 4.

That is, when any one of the coins CA, CB and CC is deposited into the coin processor, this causes the coin type sorting solenoid SOL2 to be driven so that the coin type sorting gate G2 closes the true coin passage 5, with the result that the coin CA, CB or CC is guided through the true coin passage 4 onto a second rail 7 shown in Fig. 4. When the inserted coin is of the type CD, on the other hand, the coin type sorting solenoid SOL2 is not operated so that the coin type sorting gate G2 closes the true coin passage 4 and thus the coin CD is guided downward into the true coin passage 5 to be held in the not shown safe. Even with respect to the coins CA, CB and CC, when an overflow state of the coin tubes 8-1, 8-2 and 8-3 is detected by any of overflow sensors OFS-A, OFS-B and OFS-C, the coin type sorting solenoid SOL2 is not operated so that the inserted coin is similarly guided to the safe.

The coin of the type CA, CB or CC guided onto the second rail 7 is selectively sorted into one of the coin tubes 8-1, 8-2 and 8-3 according to the diameter of the coin to be held or accumulated therein. Although the selective sorting arrangement of the coin based on the coin diameter is not illustrated in detail, the sorting arrangement may be realized by means of a known suitable mechanical sorting mechanism.

Turning to Fig. 6, the coin CC pay-out solenoid SOL-C is provided to the coin tube 8-3, a plunger 882 of the coin CC pay-out solenoid SOL-C is provided at its tip end with a pin 882a. The pin 882a is engaged in an opening 884a which is formed in one end of an arm 884 and one side of which opening is open. The arm 884 is connected at the other end 884b with a pay-out slide 885. The pay-out slide 885 is formed therein with an opening 885a through which the coin within the coin tube 8-3 falls. When the pay-out slide 885 is in its standby state, a tip end 885b thereof acts to block the lower end of the coin tube 8-3. When the coin CC pay-out solenoid SOL-C is driven, this causes the plunger 882 to be pulled into the coin CC pay-out solenoid SOL-C, so that the arm 884 rotates clockwise around a pivot point 883. As a result, the pay-out slid 885 is moved leftwardly in Fig. 6 so that one of the coins within the coin tube 8-3 drops into the opening 885a of the pay-out slide 885. Thereafter, the restoring force of a spring 881 wound around the plunger 882 causes the arm 884 to be rotated counterclockwise around the pivot point 883 so that, when the pay-out slide 885 is returned to its standby position, the coin within the opening 885a of the pay-out slide 885 downwardly falls through an opening 9a of a bottom plate 9. The downwardly fell coin is guided into the coin return outlet (not shown). That is, in the present embodiment, through each one-stroke operation of the coin CC pay-out solenoid SOL-C, one of the coins within the coin tube 8-3 is paid out one by one to the coin return outlet. By repeating the above operation, a desired number of coins can be paid out.

Also provided to the lower part of the coin tube 8-3 is the coin empty sensor EPS-C which detects when the amount of coins within the coin tube 8-3 becomes less than a predetermined value, and also provided to the upper part of the coin tube 8-3 is the overflow sensor OFS-C which detects when the amount of coins within the coin tube 8-3 exceeds a predetermined value. The empty sensor EPS-C and overflow sensor OFS-C may comprise respectively a known optical sensor.

In Fig. 6, the coin pay-out mechanism only for the coin tube 8-3 has been explained. However, the similar coin pay-out mechanisms, together with the coin empty sensors EPS-A and EPS-B and the overflow sensors OFS-A and OFS-B, are similarly provided even for the coin tubes 8-1 and 8-2, as shown in Fig. 4,

The price setting switch SPS shown in Fig. 4, which corresponds to the price setting switch SPS shown in Fig. 1, functions, for example, to set the selling price SP of each of articles handled by a vending machine employing the present coin processor. The selling price SP set by the price setting switch SPS is utilized by sales processing to be detailed later. In this connection, the price setting switch SPS may comprise a plurality of known dip switches.

The inventory switches IVS-A, IVS-B and IVS-C shown in Fig. 4, which correspond to the inventory switch IVS shown in Fig. 1, are operated when the coins held in the coin tubes 8-1, 8-2 or 8-3 are forcibly discharged. For example, when the inventory switch IVS-A is operated, the coin CA payback solenoid SOL-A provided associated with the coin tube 8-1 is driven so that the coins within the coin tube 8-1 are all forcibly paid out one by one to the coin return outlet. Similarly, the operation of the inventory switch IVS-B causes all the coins within the coin tube 8-2 to be forcibly paid out to the coin outlet, and the operation of the inventory switch IVS-C causes all the coins within the coin tube 8-3 to be forcibly paid out to the coin outlet.

Shown in Fig. 7 is a specific structure of the material detection sensor 10 in Fig. 4. In Fig. 7, the material detection sensor 10 is disposed along a coin passage formed on the first rail 3 of Fig. 4. On the first rail 3, first and second side walls 3a and 3b are provided as substantially vertically extended. That is, the coin passage is defined by the first rail 3 and the first and second side walls 3a and 3b. And, a first reception coil 10b-1 is mounted to the first side wall 3a, while a second reception coil 10b-2 is mounted to the second side wall 3b. A first oscillation coil 10a-1 is provided on the side of the first side wall 3a as mounted on the first reception coil 10b-1 coaxially therewith and similarly, a second oscillation coil 10a-2 is provided on the side of the second side wall 3b as mounted on the first reception coil 10b-2 coaxially therewith.

Fig. 8(a) shows a front view of the first reception coil 10b-1 and Fig. 8(b)is a cross-sectional view taken along line C-C in Fig. 8(a). More specifically, the first reception coil comprise a pot-type coil which is made up of a core 11 having a cylindrical opening 11a formed at its center portion and a bobbin 12 with a coil 13 wound around the bobbin 12.

Figs. 9(a) and 9(b) show a front view of the first oscillation coil 10a-1 and a cross-sectional view taken along D-D in 9(a). More specifically, the first oscillation coil 10a-1 comprises a drum-type coil which is made up of a core 14 provided with a projection 14a which fits into the cylindrical opening 11a of the pot-type coil shown in Fig. 8 and a coil 15 wound around the core 14.

The projection 14a of the first oscillation coil 10a-1 of the drum-type coil structure of Fig. 9 is fitted into the cylindrical opening 11a of the first reception coil 10b-1 of the pot-type coil structure of Fig. 8 and then mounted on the first side wall 3a in Fig. 7 in such a manner that the first oscillation coil 10a-1 is stacked on the first reception coil 10b-1, as shown in Fig. 10.

Although the detailed structures of the second reception coil 10b-2 and second oscillation boil 10a-2 are not illustrated, these second coils have the same structures as those of the above first reception and oscillation coils 10b-1 and 10a-1 and are similarly mounted on the second side wall 3b in Fig. 7.

Fig. 11 shows a specific structure of the diameter detection sensor 20 in Fig. 4. The diameter detection sensor 20 is disposed downstream of the material detection sensor 10 on the coin passage formed on the first rail 3. The sensor 20 comprises first and second oscillation coils 20a-1 and 20a-2 provided on the side of the first side wall 3a of the coin passage and also comprises first and second reception coils 20b-1 and 20b-2 provided on the side of the second side wall 3b as opposed to the first and second oscillation coils 20a-1 and 20a-2 respectively. In this case, for easy discrimination in diameter between coins to be checked, the first oscillation coil 20a-1 is disposed as shifted by a predetermined distance from the second oscillation coil 20a-2.

The first oscillation coil, as shown in Fig. 12(a) which is a front view thereof and in Fig. 9(b) which is a cross-sectional view taken along line E-E in (a), comprises a drum-type coil which has a core 21 and a coil 22 wound around the core 21. Although the structures of the second oscillation coil 20a-2 and first and second reception coils 20b-1 and 20b-2 are not illustrated in detail, the structures of these coils are the same as that of the first oscillation coil 20a-1 of Fig. 12.

Fig. 13 shows a positional relationship between the first oscillation and reception coils 20a-1, 20b-1 and the second oscillation and reception coils 20a-2, 20b-2 in the diameter detection sensor 20, with respect to a relationship between coins 2a and 2b to be checked. It is assumed in this case that the coin 2a is the largest in diameter of coins usable for this coin processor and the coin 2b is the smallest. That is, the first oscillation and reception coils 20a-1 and 20b-1 of the diameter detection sensor 20 are disposed at such a first position that is most suitable for the detection of the largest-diameter coin 2a; while the second oscillation and reception coils 20a-2 and 20b-2 of the diameter detection sensor 20 are disposed at such a second position that is most suitable for the detection of the smallest-diameter coin 2b, the first and second positions being shifted by predetermined distances from the first rail 3 respectively. The reception coils 20b-1 and 20b-2 are connected in series as will be explained later, so that an output voltage obtained from the series circuit becomes smaller (attenuation factor becomes larger) in proportion to the increased outer diameter of the coil 2. That is, the output voltage corresponds to the outer diameter of the coin 2.

Shown in Fig. 14 is a specific configuration of the coin discrimination circuit DS shown in Fig. 2. In Fig. 14, the first and second oscillation coils 10a-1 and 10a-2 of the material detection sensor 10 of Fig. 7 are connected in series and further connected to an excitation driver 30 while the first and second oscillation coils 20a-1 and 20a-2 of the diameter detection sensor 20 of Fig. 11 are connected in series and further connected also to the excitation driver 30.

The excitation driver 30 receives a reference pulse signal from the controller 500 through the coin discriminator/sorter input/output circuit 300 in Fig. 1, and generates and outputs A.C. excitation signals having an identical frequency of about between 20 and 60KHz on the basis of the received reference pulse signal. Accordingly, the first and second oscillation coils 10a-1 and 10a-2 of the material detection sensor 10 as well as the first and second oscillation coils 20a-1 and 20a-2 of the diameter detection sensor 20 are excited and driven by the A.C. excitation signals having the same frequency of about between 20 and 60KHz as the outputs of the excitation driver 30 respectively. In this connection, the output excitation signal of the excitation driver 30 is not limited to a sine wave but may be a square or triangular wave.

The first and second reception coils 10b-1 and 10b-2 of the material detection sensor 10 are connected in series and also connected to an amplification/detection circuit 43 through a parallel resonance capacitor 41.

The first and second reception coils 20b-1 and 20b-2 of the diameter detection sensor 20 are connected in series and also connected to an amplification/detection circuit 44 through a parallel resonance capacitor 42.

The amplification/detection circuit 43 amplifies and detects a signal generated by the series circuit of the first and second reception coils 10b-1 and 10b-2 of the material detection sensor 10 and extracts an envelope from the amplified and detected signal.

The amplification/detection circuit 44 amplifies and detects a signal generated by the series circuit of the first and second reception coils 20b-1 and 20b-2 of the diameter detection sensor 20 and extracts an envelope from the amplified and detected signal.

An example of the signal generated by the series circuit of the first and second reception coils 10b-1 and 10b-2 of the material detection sensor 10 when a coin is passed along the coin passage is shown in Fig. 15. In this case, the output signal amplified and detected by the amplification/detection circuit 43 has such a waveform as shown in Fig. 16. In the drawing, a voltage V represents a standby voltage when the coin 2 is not present within the material detection sensor 10, and a voltage ΔV represents a voltage attenuation caused by the passage of the coin 2. The voltage attenuation ΔV varies depending on the coin type (coin material and thickness).

With respect to the waveform of a signal generated by the series circuit of the first and second reception coils 20b-1 and 20b-2 of the diameter detection sensor 20 as well as the waveform of an output of the amplification/detection circuit 44, a standby voltage V and its voltage attenuation ΔV when the coin 2 is not present within the diameter detection sensor 20 have substantially the same waveforms as shown in Figs. 15 and 16 though their values are different from those output from the sensor 10 and the circuit 43. In this case, the voltage attenuation ΔV corresponds to the diameter of the coin.

An output of the amplification/detection circuit 43 is applied to a reference voltage circuit 45, a peak hold circuit 46 and a standby check circuit 50; while an output of the amplification/detection circuit 44 is applied to a reference voltage circuit 47, a peak hold circuit 48, a judgment start circuit 49 and the standby check circuit 50.

Outputs of the reference voltage circuit 45 and peak hold circuit 46 are applied to window comparators 51, 52, 53 and 54 respectively; while outputs of the reference voltage circuit 47 and peak hold circuit 48 are also applied to the window comparators 51, 52, 53 and 54 respectively.

The reference voltage circuit 45 acts to hold the output of the amplification/detection circuit 43, ie., the standby voltage V shown in Fig. 16, when a coin is not present in the material detection sensor 10.

The peak hold circuit 46 acts to hold an attenuation peak value of the output of the amplification/detection circuit 43 caused by the passage of the coin, i.e., a peak voltage Vp corresponding to the voltage attenuation ΔV shown in Fig. 16.

The reference voltage circuit 47 acts to hold the output of the amplification/detection circuit 44, i.e., the standby voltage V shown in Fig. 16, when a coin is not present in the diameter detection sensor 20.

The peak hold circuit 48 acts to hold an attenuation peak value of the output of the amplification/detection circuit 44 caused by the passage of the coin, i.e., the peak voltage Vp corresponding to the voltage attenuation ΔV shown in Fig. 16.

The judgment start circuit 49, to which outputs of the amplification/detection circuit 44 and peak hold circuit 48 are applied, generates a judgment start signal when the output of the amplification/detection circuit 44 drops and the output of the peak hold circuit 48 corresponds to the peak value.

The standby check circuit 50 detects that the output of the amplification/detection circuit 43 and the output of the amplification/detection circuit 44 are both at their predetermined standby voltages. On the basis of outputs of the standby check circuit 50, the outputs of the amplification/detection circuits 43 and 44 in the standby mode are held in the reference voltage circuits 45 and 47.

The window comparators 51, 52, 53 and 54, in which window threshold values corresponding to the materials and diameters of the coins CA, CB, CC and CD are set respectively, generate judgment signals corresponding to the respective coins CA, CB, CC and CD when the peak value of the inserted coin lies within a window threshold range corresponding to the coin material, i.e., lies in a range of between voltages VH and VL in Fig. 16, and also when it lies within a window threshold range corresponding to the coin diameter. In this case, the coins CA, CB, CC and CD correspond, for example, to U.S. 5 cent, 10 cent, 25 cent and 1 dollar coins respectively. The threshold values of the window comparators 51, 52, 53 and 54, which correspond to the material and diameter of the coins, vary depending on the outputs of the reference voltage circuits 45 and 47.

As the window comparators 51, 52, 53 and 54, a circuit 64 as shown in Fig. 17 may be used. More specifically, this circuit of Fig. 17 corresponds to one of the window comparator circuits 51, 52, 53 and 54 and has 4 comparators CO1, CO2, CO3 and CO4. The comparators CO1 and CO2 generate first window threshold values corresponding to the material of coins, while the comparators CO3 and CO4 generate second window threshold values corresponding to the diameter of the coins.

The first window threshold values are set by resistors R11, R12 and a variable resistor R13, the first window threshold values can be adjusted by the variable resistor R13, and its relative value varies along with the output of the reference voltage circuit 45, i.e., a voltage Vref1.

The second window threshold values are set by resistors R21, R22 and a variable resistor R23, the second window threshold values can be adjusted by the variable resistor R23, and its relative value varies along with the output of the reference voltage circuit 47, i.e., a voltage Vref2.

A voltage divided by the resistor R11 and the resistors R12, R13, i.e., a voltage corresponding to a voltage VH in Fig. 16 is applied to a plus input of the comparator CO1; a voltage divided by the resistors R11, R12 and the resistor R13, i.e., a voltage corresponding to a voltage VL in Fig. 16 is applied to a minus input of the Comparator CO2; the output of the peak hold circuit 46, i.e., a voltage VM, is applied to a minus input of the comparator CO1 and to a plus input of the comparator CO2. Further, a voltage divided by the resistor R21 and the resistors R22, R23 is applied to a plus input of the comparator CO3; a voltage divided by the resistors R21, R22 and the resistor R23 is applied to a minus input of the comparator CO4; the output of the peak hold circuit 48, i.e., a voltage VD is applied to a minus input of the comparator CO3 and to a plus input of the comparator CO4. Outputs of the comparators CO1, CO2, CO3 and CO4 are AND connected and pulled up by a resistor R0.

Accordingly, only when the above voltage VM lies within a range of between the first window threshold values and when the above voltage VD lies within a range of between the second window threshold values; an output VOUT has a high level. Otherwise, the output signal VOUT has a low level. In the illustrated embodiment, the first and second window threshold values are set in the window comparators 51, 52, 53 and 54 to provide discrimination between the materials of the coins CA, CB, CC and CD and discrimination between the diameters thereof. Thus, when the output VM of the peak hold circuit 46 lies within the material discrimination window threshold range and at the same time when the output VD of the peak hold circuit 48 lies within the diameter discrimination window threshold range; corresponding one of the window comparators 51, 52, 53 and 54 generates corresponding one of discrimination signals corresponding to the coin CA, CB, CC and CD. The discrimination outputs of the window comparators 51, 52, 53 and 54 are applied through the coin discriminator/sorter input/output circuit 300 to the controller 500.

The controller 500 in Fig. 1, when receiving a judgment start signal from the decision start circuit 49 of Fig. 14 through the coin discriminator/sorter input/output circuit 300, inputs the discrimination outputs of the window comparators 51, 52, 53 and 54 through the coin discriminator/sorter input/output circuit 300 to judge the type of the inserted coin. The judgment start circuit 49 is arranged to receive the output of the amplification/detection circuit 44 and the output of the peak hold circuit 48 and to generate a judgment start signal when the output of the peak hold circuit 48 corresponds to the peak value, as mentioned above.

Meanwhile, though the judgment start circuit 49 is not monitoring the output of the peak hold circuit 46, because the diameter detection sensor 20 is disposed downstream of the material detection sensor 10 as mentioned above, it is sufficient to monitor only the output of the peak hold circuit 48 which became to the peak value. In this connection, there may be employed such an arrangement that the judgment start signal is generated on the basis of both of the outputs of the peak hold circuits 46 and 48.

The controller 500 performs its predetermined operation in accordance with a procedure previously stored in a read only memory (ROM) (not shown) within the controller 500 based on the respective input signals. That is, the controller 500 sees the discrimination outputs of the window comparators 51, 52, 53 and 54 on the basis of the judgment start signal output from the judgment start circuit 49, and judges that the inserted coin is true when any one of the discrimination outputs is issued from the window comparators. In this case, the true/false coin sorting solenoid SOL1 is driven through the true/false coin sorting solenoid driver DRV1 in Fig. 2 to shift the true/false coin sorting gate G1 to the position as shown by the broken line in Fig. 5, whereby the inserted coin is guided into the true coin passage, that is, into the true coin passage 4 or 5.

When the type of the inserted coin is any one of the coin types CA, CB and CC, the coin type sorting solenoid SOL2 is driven through the coin type sorting solenoid driver DRV2 to shift the coin type sorting gate G2 to the position as shown by the broken line in Fig. 5, whereby the inserted coin CA, CB or CC is guided through the true coin passage 4 onto the second rail 7 in Fig. 4.

Further, the controller 500 in Fig. 1 is monitoring the output signal of the accepted-coin detection sensor DES shown in Figs. 1 and 5. When the coin judged as a true coin within a predetermined time after the detection of the accepted coin by the coin discrimination circuit DS of Fig. 2 is detected by the accepted-coin detection sensor DES, the money value of the corresponding coin type is temporarily stored in the random access memory (RAM) (not shown).

When the temporarily stored money value SK is equal to or higher than the selling price SP set by the price setting switch SPS (SK ≧ SP), the controller 500 issues the vending start signal SE from the terminal T1 for a predetermined time.

The controller 500, when judging the necessity of the change after the issuance of the vending start signal SE from the terminal T1 for the predetermined time, on the basis of an operating result of the controller 500 and the outputs of the empty sensors EPS-A to EPS-C, causes the solenoids SOL-A to SOL-C to be driven through the driver circuits DRV-A to DRV-C of Fig. 3, whereby the necessary change is paid out.

The controller 500 is also monitoring the outputs of the inventory switches IVS (inventory switches IVS-A to IVS-C in Fig. 4). When at least one of the inventory switches IVS generates an output, the controller 500 causes corresponding one of the solenoids SOL-A to SOL-C to be driven through corresponding one of the driver circuits DRV-A to DRV- C, so that the coin processor performs its inventory operation, i.e., the coin held in associated one of the coin tubes 8-1, 8-2 and 8-3 is forcibly discharged.

The controller 500, when receiving the coin acceptance inhibiting signal IH from the terminal T2, also performs its coin acceptance disabling operation to inhibit acceptance of all the inserted coins.

Figs. 18 and 19 collectively show a flowchart for explaining the operation of the controller 500.

Explanation will then be made as to the operation of the controller 500 by referring to the flowchart.

First, the coin processor is turned ON, the controller 500 initializes the RAM and input/output circuits in the controller 500 (step 101). Thereafter, the controller 500 performs its error checking operation (step 102) and then loads the selling price SP set by the price setting switch SPS into a register R0 (not shown) within the controller 500 (step 103).

The controller 500, after loading the selling price SP set by the price setting switch SPS into the register R0, checks the outputs of the overflow sensors OFS-A, OFS-B and OFS-C provided to the coin tubes 8-1, 8-2 and 8-3 to perform overflow check to determine the presence or absence of overflowed one of the coin tubes 8-1, 8-2 and 8-3 (step 104), and then checks the outputs of the empty sensors ESP-A, ESP-B and ESP-C provided to the coin tubes 8-1, 8-2 and 8-3 to determine the presence or absence of the change within the coin tubes 8-1, 8-2 and 8-3 (step 105).

The controller 500 next decides whether or not any one of the inventory switches IVS is turned ON (step 106). When determining that any one of the inventory switches IVS is turned ON, the controller 500 causes associated one of the pay-out solenoids SOL-A, SOL-B and SOL-C to be driven through associated one of the pay-out solenoid drivers DRV-A, DRV-B and DRV-C whereby coin pay-out operation is carried out, that is, the coin held in associated one of the coin tubes 8-1, 8-2 and 8-3 is forcibly discharged (step 111), after which the controller 500 returns to the step 102. When determining in the step 106 that the inventory switch IVS is not turned ON, the controller 500 judges the arrival or non-arrival, i.e., insertion or non-insertion of a coin on the basis of the outputs of the material detection sensor 10 and diameter detection sensor 20 (step 107). In the absence of insertion of a coin, the controller 500 returns to the step 102. When determining the insertion of a coin, the controller 500 checks whether the coin acceptance inhibiting signal IH is input from the terminal T2 (step 108). In the illustrated example, when it is desired to inhibit acceptance of any coins due to the run-out of articles in the vending machine for example, the coin acceptance disable signal IH is applied to the terminal T2.

The controller 500, when judging in the step 108 that the coin acceptance inhibiting signal IH is input, returns to the step 102. In this case, the true/false coin sorting solenoid SOL1 is not driven so that the true/false coin sorting solenoid G1 remains at the position as shown by the solid line in Fig. 5, whereby the inserted coin is discharged from the not shown coin outlet through the return passage 6. In other words, the inserted coin will not be accepted.

When determining in the step 108 that the coin acceptance inhibiting signal IH is not input, the controller 500 executes its starting operation of the T1 timer (step 109) and then examines the reception or non-reception of the judgment start signal from the judgment start circuit 49, i.e., the judgment start or not (step 110). When determining the non-judgment start, the controller 500 examines whether or not the T1 timer times out, that is, a time T1 (step 112). When determining the non-expiration of the time T1, the controller 500 returns to the step 108. When determining the judgment start in the step 110, the controller 500 starts performing its true/false coin judgment operation (step 113).

That is, when the judgment start signal is input from the judgment start circuit 49 within the time T1 after the start of the T1 timer, the controller starts its true coin judgment operation (step 113); whereas, when the judgment start signal is not input from the judgment start circuit 49 within the time T1, the controller judges in the step 112 the expiration of the time T1 and thus the generation of an abnormality and returns to the step 102.

The true coin judgment operation (step 113) is carried out on the basis of the outputs of the window comparator circuits 51, 52, 53 and 54. That is, when the coin discrimination signal is issued from any one of the window comparator circuits 51, 52, 53 and 54, the controller judges that the type of the inserted coin corresponds to the one of the window comparator circuits which issued the signal. When no coin discrimination signal is issued from any of the window comparator circuits 51, 52, 53 and 54, the controller judges that the inserted coin is false. For example, when only the window comparator 51 generates an output signal, the inserted coin is decided to be a true U.S. 5 cent coin; when only the window comparator 52 generates an output signal, the inserted coin is judged to be a true U.S. 10 cent coin; when only the window comparator 53 generates an output signal, the inserted coin is judged to be a true U.S. 25 cent coin; when only the window comparator 54 generates an output signal, the inserted coin is judged to be a true U.S. 1 dollar coin; and otherwise, the inserted coin is judged to be a false coin.

When the inserted coin is decided to be a false coin, the controller returns to the step 102 through a procedure (not shown). In this case, the true/false coin sorting solenoid SOL1 is not driven so that the true/false coin sorting gate G1 remains at the position as shown by the solid line in Fig. 5, which results in that the inserted coin is discharged to the coin outlet (not shown) through the return passage 6.

After completing the true coin judgment operation of the step 113, the controller judges whether or not the change can be paid out with the coins held in the coin tubes 8-1, 8-2 and 8-3 (step 114). This change judgment is carried out on the basis of the total amount of money values of coins accepted as true coins, the selling price SP set in the step 103 and also the change present/absence check result carried out in the step 105.

When determining in the step 114 that the change cannot be paid out, the controller returns to the step 102.

When determining in the step 114 that the change can be handled, the controller, on the basis of the true coin judgment result of the step 113 and the overflow check result of the step 104, next judges whether the inserted coin is of the coin type D corresponding to the coin D or of the type corresponding to the overflowed coin tube (step 115). When the inserted coin is of the type D or of the overflowed coin type, the driver DRV1 drives only the true/false coin sorting solenoid SOL1 (step 116), so that the inserted coin is guided into the true coin passage 5. When the inserted coin is not of the type D nor of the overflowed coin type, the drivers DRV1 and DRV2 respectively drive the true/false coin sorting solenoid SOL1 and coin type sorting solenoid SOL2 (step 117), so that the inserted coin is guided into the true coin passage 4. The coin guided into the true coin passage 5 is held in the not shown safe; the coin guided into the true coin passage 4 is guided onto the second rail 7 shown in Fig. 4 to be selectively sent to associated one of the coin tubes 8-1, 8-2 and 8-3 and held therein according to the diameter of the coin.

The controller 500, after executing the operation of the step 116 or 117, judges whether or not the accepted-coin detection sensor DES is turned ON (step 118). The determination of the turned-ON accepted-coin detection sensor DES causes the money value of the inserted coin to be loaded into a register R1 (not shown) of the controller 500 (step 119). However, the determination of the turned-OFF accepted-coin detection sensor DES causes the controller to execute its starting operation of the timer T2 (step 124). The controller next examines whether or not the T2 timer expires or the expiration or non-expiration of the time T2 (step 125). The determination of the non-expiration of the time T2 causes the controller to return to the step 118.

More specifically, when the accepted-coin detection sensor DES is turned ON within the time T2 after the start of the timer T2, the controller goes to the step 119 to load the money value of the inserted coin into the register R1. When the accepted-coin detection sensor DES is not turned ON within the time T2, the controller judges in the step 125 the expiration of the time T2, in which case the controller judges the inserted coin to be a false coin and performs its predetermined false coin operation (step 126), after which the controller returns to the step 102.

After performing the loading operation of the inserted coin value into the register R1 in the step 119, the controller next judges whether the inserted coin value SK loaded in the register R1 is larger than or equal to the selling price SP loaded in the register R0, that is, whether or not a relationship $SP \leqq SK$ is satisfied (step 120). When the relationship $SP \leqq SK$ is satisfied, the controller performs its sale signal outputting operation to output the vending start signal SE from the terminal T1 (step

121). When the relationship SP ≦ SK is not satisfied, however, the controller returns to the step 102.

The controller 500, after the completion of the sale signal outputting operation in the step 121, judges whether or not the change is needed (step 122). This decision is carried out on the basis of whether or not the inserted coin value SK is larger than the selling price SP, that is, a relationship SP < SK is satisfied. When the relationship SP < SK is satisfied, the controller performs its change pay-out operation (step 123): whereas, when the relationship SP < SK is not satisfied, the controller does not perform the change pay-out operation (step 123) and terminates this operation.

The change pay-out operation (step 123) is carried out by driving the pay-out solenoids SOL-A, SOL-B and SOL-C through the pay-out solenoid drivers DRV-A, DRV-B and DRV-C.

Next, the coin discriminating principle of the material detection sensor 10 used in the present embodiment will be further detailed.

Shown in Fig. 20 is a diagram for explaining the coin discriminating principle of the material detection sensor 10, showing a state before the coin 2 to be checked is deposited into the coin passage defined by the first and second side walls 3a and 3b. In this case, exciting magnetic force lines 401 and 402 emitted from the oscillation coil 10a-1 are received by the reception coil 10b-1, while magnetic force lines 403 and 404 emitted from the oscillation coil 10a-2 are received by the reception coil 10b-2. Let consider a case where the coin 2 is deposited into the coin passage under the above condition. In this case, the magnetic force lines 401 and 402 emitted from the oscillation coil 10a-1 and arriving at the coin 2 act on the surface of the coin 2 and then reach the reception coil 10b-1. Similarly, the magnetic force lines 403 and 404 emitted from the oscillation coil 10a-2 and arriving at the coin 2 act on the surface of the coin 2 and reach the reception coil 10b-2. Part of the magnetic force lines 401 and 402 arrived at the coin 2 permeate through the coin 2 and reach the reception coil 10b-2 as magnetic force lines 405 and 406; while part of the magnetic force lines 403 and 404 arriving at the coin 2 permeate through the coin 2 and reach the reception boil 10b-1 as magnetic force lines 407 and 408.

Under such a phenomenon, the output voltages of the reception coils 10b-1 and 10b-2 vary depending on the materials of shallow and deep parts of the coin 2 respectively, that is, the output voltages include information associated with the materials of the shallow and deep parts of the coin 2.

Accordingly, with the structure of the material detection sensor 10 of the present invention, in place of such clad coins each made of a copper core stacked by cupronickel thin layers as U.S. 10 cent, 25 cent and 1 dollar coins, even when substitute copper coins having the same outer dimensions and thicknesses as the above clad coins are inserted into the coin processor, the material detection sensor 10 can easily discriminate between the true and false coin. That is, the material detection sensor 10 of the present embodiment can provide clear distinction between the clad and mere-copper substitute coins and thus can sort the clad true coins from the copper substitute coins.

The oscillation coils 10a-1, 10a-2 and reception coils 10b-1, 10b-2 of the material detection sensor 10 of the present embodiment are disposed as opposed to the first and second side walls 3a and 3b of the coin passage respectively. For this reason, even when the coin 2 is passed along the coin passage as biased toward one of the first and second side walls 3a and 3b, a sum of voltages induced in the reception coils 10b-1 and 10b-2 always lies within a constant range so long as the inserted coins are the same money type.

More specifically, even when the coin 2 is passed along the coin passage as biased toward the first side wall 3a and thus an attenuation in the inducted voltage of the reception coil 10b-1 is larger than an attenuation in the inducted voltage of the coil 10b-1 when the coin is passed as centered along the coin passage, an attenuation in the inducted voltage of the other reception coil 10b-2 becomes correspondingly small, which results in that a sum of such attenuations becomes constant. Accordingly, even when the coin 2 is passed along the coin passage as biased toward one side wall, an accurate detection voltage can be obtained according to the type of the inserted coin.

This measuring principle will be further explained by referring to Figs. 21 to 24.

The output voltages of the reception coils 10b-1 and 10b-2 of the material detection sensor 10 vary depending on the distance of the inserted coin 2 therefrom.

More in detail, when the coin 2 is passed along the coin passage defined by the first and second side walls 3a and 3b as right centered therebetween (so that the distance between the coin 2 and the reception coil 10b-1 is equal to the distance between the coin 2 and the reception coil 10b-2) as shown in Fig. 7; the output voltage of the reception coil 10b-1 becomes equal to the output voltage of the reception coil 10b-2.

In the case where the coin passage is vertically disposed, however, the coin 2 is not always passed along the coin passage as right centered therein and is sometimes as biased toward either one of the first and second side walls 3a and 3b. Fig. 21 shows a state when the coin 2 is passed as biased toward the first side wall 3a, and Fig. 22 shows a state when the coin 2 is passed as biased toward the second side wall 3b.

Now consider a case where the coin 2 is passed as biased toward the first side wall 3a as shown in Fig. 21. Also assume that, in the above case, a total attenuation factor obtained by the series circuit of the reception coils 10b-1 and 10b-2 in the absence of the coin 2 within the material detection sensor 10 is 0(%), and a total attenuation factor obtained by the above series circuit when the coin 2 is passed through the material detection sensor 10 is p(%), as shown in Fig. 23. Then, when attention factors obtained by the reception coils 10b-1 and 10b-2 when the coin 2 is passed through the material detection sensor 10 are observed, the attenuation factor by the reception coil 10b-1 is q(%) because the coin 2 is moved toward the reception coil 10b-1 while the attenuation factor by the reception coil 10b-2 is r(%) because the coin 2 is moved away from the reception coil 10b-2. In this case, a relationship of $q + r = p$ is satisfied between the total attenuation factor p obtained by the series circuit of the reception coils 10b-1 and 10b-2 and the respective attenuation factors q and r of the reception coils 10b-1 and 10b-2.

Further, consider a case where the coin 2 is passed as biased toward the second side wall 3b as shown in Fig. 22. Also assume that, in the above case, a total attenuation factor obtained by the series circuit of the reception coils 10b-1 and 10b-2 in the absence of the coin 2 within the material detection sensor 10 is 0(%), and a total attenuation factor obtained by the above series circuit when the coin 2 is passed through the material detection sensor 10 is p'(%), as shown in Fig. 24. Then, when attention factors obtained by the reception coils 10b-1 and 10b-2 when the coin 2 is passed through the material detection sensor 10 are observed, the attenuation factor by the reception coil 10b-1 is q'(%) because the coin 2 is moved away from the reception coil 10b-1 while the attenuation factor by the reception coil 10b-2 is r'(%) because the coin 2 is moved toward the reception coil 10b-2. In this case, a relationship of $q' + r' = p'$ is satisfied between the total attenuation factor p' obtained by the series circuit of the reception coils 10b-1 and 10b-2 and the respective attenuation factors q' and r' of the reception coils 10b-1 and 10b-2.

However, when the coin 2 is biased toward the reception coil 10b-1 or 10b-2 during the passage of the coin along the coin passage, since the output voltage of the reception coil 10b-1 is opposite to the output voltage of the reception coil 10b-2 with respect to their varying directions and thus their changes are equal to each other. That is, the following relationships are satisfied.

$$q + r = q' + r'$$
$$p = p'$$

That is, in the present embodiment, when the reception coils 10b-1 and 10b-2 of the material detection sensor 10 are connected in series as shown in Fig. 14, the influence of the coin 2 by the positional bias in the coin passage can be canceled by extracting an addition of the output voltages of the reception coils 10b-1 and 10b-2.

With the arrangement of the present embodiment, since the inserted coin is passed as biased toward either one of the side walls of the coin passage, it becomes unnecessary to incline the coin passage and thus it is possible on principle to vertically dispose that part of the coin passage which is used for material sorting. When the coin passage is vertically arranged, there can be eliminated a possibility that such foreign matter as dust is accumulated, which results in that, even when the inserted coin is wet, the inserted coin can be prevented from being stopped in the middle of the coin passage.

Since it is only required to mount the both sets of coils of the material detection sensor 10 and diameter detection sensor 20 on the first rail 3, the length of the first rail 3 can be made remarkably short.

Further, the excitation frequency of the material detection sensor 10 of the present embodiment is always constant even when the coin 2 affects the material detection sensor 10.

Shown in Fig. 25 is an example of resonance characteristics when the coin 2 is not present within the material detection sensor 10 of the present embodiment and when the coin 2 is present therewithin respectively. In the drawing, abscissa represents frequency, ordinate represents resonance voltage, a graph 200 denotes the resonance characteristic in the absence of the coin 2 within the material detection sensor 10, and a graph 300 denotes the resonance characteristic in the presence of the coin 2 within the material detection sensor 10. As will be clear from Fig. 25, the resonance voltage becomes maximum at a frequency f0a in the absence of the coin 2 within the material detection sensor 10 while the resonance voltage become maximum at a frequency f1a that is shifted by Δfa from the frequency f0a in the presence of the coin 2 within the material detection sensor 10.

In the present embodiment, the excitation frequency of the material detection sensor 10 is always constant regardless of the influence or non-influence of the coin 2 on the material detection sensor 10. Thus, if the excitation frequency is assumed to be F, then the material of the inserted coin can be judged on the basis of a voltage ΔVa.

In the prior art coin processor disclosed in U.S. Patent No. 3870137 for example, on the other hand, since an oscillation circuit includes coils disposed on one side of a coin passage. Thus, even when the oscillation frequency of the coils in the standby conditions, that is, the excitation frequency is F, the frequency F is varied by ΔF because the passage of the coin causes a change of inductance of the coil itself, which results in that the excitation frequency becomes F'. In this case, the material of the inserted coin is judged on the basis of ΔVa' corresponding to the changed frequency F'. As will be clear from Fig. 25, since a relationship ΔVa > ΔVa' is satisfied, the present embodiment can judge the material of the coin 2 more accurately than the coin processor disclosed in U.S. Patent No. 3870137.

Turning to Fig. 26, there are shown an example of resonance characteristics of the material detection sensor 10 and diameter detection sensor 20 of the present embodiment in the presence and absence of the coin within the sensors, respectively. More specifically, In Fig. 26(a), a graph 201 shows the resonance characteristic in the absence of the coin 2 within material detection sensor 10, a graph 301 shows the resonance characteristic in the presence of the coin 2 within the material detection sensor 10. Further, in Fig. 26(b), a graph 202 denotes the resonance characteristic in the absence of the coin 2 within the diameter detection sensor 20, and a graph 302 denotes the resonance characteristic in the presence of the coin 2 within the diameter detection sensor 20. As will be clear from Fig. 26(a), the resonance voltage becomes maximum at a frequency f0a in the absence of the coin 2 within the material detection sensor 10, and the resonance voltage becomes maximum at a frequency f1a that is shifted by Δfa from the frequency f0a in the presence of the coin 2 within the material detection sensor 10.

In the present embodiment, since the excitation frequency of the material detection sensor 10 is always as constant as F, the material of the inserted coin is discriminated on the basis of the voltage ΔVa corresponding to the frequency F. It will also be clear from Fig. 26(b) that the resonance voltage becomes maximum at a frequency f0b in the absence of the coin 2 within the diameter detection sensor 20, and the resonance voltage becomes maximum at a frequency f1b that is shifted by Δfb from the frequency f0b in the presence of the coin 2 within the diameter detection sensor 20.

In the present embodiment, since the excitation frequency of the diameter detection sensor 20 is always as constant as F, the diameter of the inserted coin is discriminated on the basis of the voltage ΔVb corresponding to the frequency F.

Claims

1. A coin processor having a coin discriminating section disposed on a coin passage (3) for discriminating a coin passing through said coin passage (3) by said coin discriminating section, characterized in that said coin discriminating section comprises:

   a first reception coil (10b-1) provided on said coin passage (3);

   a second reception coil (10b-2) provided as opposed to said first reception coil (10b-1) with said coin passage (3) being sandwiched by said first and second reception coils;

   a first oscillation coil (10a-1) provided as mounted on said first reception coil (10b-1) coaxially with said first reception coil (10b-1) to be excited and driven by an excitation signal having a predetermined frequency;

   a second oscillation coil (10a-2) provided as mounted on said second reception coil (10b-2) coaxially with said second reception coil (10b-2) to be excited and driven by an excitation signal having a predetermined frequency; and

   discrimination means for discriminating a coin passed along said coin passage (3) on the basis of an addition of outputs of said first and second reception coils.

2. A coin processor as set forth in claim 1, characterized in that said first and second oscillation coils are connected in series to be excited and driven by single excitation means (30).

3. A coin processor as set forth in claim 1, characterized in that said first and second reception coils are connected in series, and said discrimination means performs its coin discriminating operation on the basis of an output of a series circuit of said first and second reception coils.

4. A coin processor as set forth in claim 3, characterized in that said discrimination means includes:

   an amplification/detection circuit (43) for amplifying and detecting the output of said series circuit;

   a standby voltage hold circuit (45) for holding an output voltage of said amplification/detection circuit (43) in a standby mode;

   a peak voltage hold circuit (46) for holding a peak voltage of the output voltage of said amplification/detection circuit (43) in a coin passage mode; and

   a plurality of window circuits (51,52,53,54) each having a window which is set to correspond to each type of coins and which varies along with an output of said standby voltage hold circuit (45), for generating a coin discrimination output when an output of said peak voltage hold circuit (46) lies within the windows,

wherein a coin passed along said coin passage (3) is discriminated on the basis of coin discrimination outputs of said plurality of window circuits (51,52,53,54).

5. A coin processor as set forth in claim 1, characterized by further comprising:

a third oscillation coil (20a-1) provided on said coin passage to be excited and driven by an excitation signal having a predetermined frequency;

a fourth oscillation coil (20a-2) provided as shifted by a predetermined distance from said third oscillation coil (20a-1) to be excited and driven by an excitation signal having a predetermined frequency;

a third reception coil (20b-1) provided as opposed to said third oscillation coil (20a-1) with said coin passage (3) being sandwiched by said third oscillation and reception coils;

a fourth reception coil (20b-2) provided as opposed to said fourth oscillation coil (20a-2) with said coin passage (3) being sandwiched by said fourth oscillation and reception coils; and

diameter discrimination means for discriminating a diameter of the coin passed along said coin passage (3) on the basis of an addition of outputs of said third and fourth reception coils,

wherein said discrimination means performs its discriminating operation over the coin passing along said coin passage (3) on the basis of said addition of the outputs of said first and second reception coils and also of a discrimination result of said diameter discrimination means.

6. A coin processor as set forth in claim 5, characterized in that said third and fourth oscillation coils are connected in series to be excited and driven by single excitation means (30).

7. A coin processor as set forth in claim 5, characterized in that said third and fourth reception coils are connected in series, and said diameter discrimination means performs its coin diameter discriminating operation on the basis of an output of a series circuit of said third and fourth reception coils.

8. A coin processor as set forth in claim 7, characterized in that said diameter discrimination means includes:

an amplification/detection circuit (44) for amplifying and detecting the output of said series circuit;

a standby voltage hold circuit (47) for holding an output voltage of said amplification/detection circuit (44) in a standby mode;

a peak voltage hold circuit (48) for holding a peak voltage of the output voltage of said amplification/detection circuit (44) in a coin passage mode; and

a plurality of window circuits (51,52,53,54) each having a window which is set to correspond to each type of coins and which varies along with an output of said standby voltage hold circuit (47), for generating a coin diameter discrimination output when an output of said peak voltage hold circuit (48) lies within the windows,

characterized in that the diameter of the coin passed along said coin passage (3) is discriminated on the basis of coin diameter discrimination outputs of said plurality of window circuits (51,52,53,54).

9. A coin processor as set forth in claim 5, characterized in that said first and second oscillation coils are connected in series while said third and fourth oscillation coils are connected in series, a series circuit of said first and second oscillation coils is connected in parallel to a series circuit of said third and fourth oscillation coils, and said first, second, third and fourth oscillation coils are excited and driven by single excitation means (30).

10. A coin processor having a coin discriminating section disposed on a coin passage (3) for discriminating a coin passing through said coin passage (3) by said coin discriminating section, characterized in that said coin discriminating section comprises:

a first reception coil (10b-1) provided on said coin passage (3);

a second reception coil (10b-2) connected in series with said first reception coil (10b-1) as opposed to said first reception coil (10b-1) with said coin passage (3) being sandwiched by said first and second reception coils;

a first oscillation coil (10a-1) provided as mounted on said first reception coil (10b-1) coaxially with said first reception coil (10b-1);

a second oscillation coil (10a-2) connected in series with said first oscillation coil (10a-1) as mounted on said second reception coil

(10b-2) coaxially with said second reception coil (10b-2);

a third oscillation coil (20a-1) provided downstream of said first reception coil (10b-1) mounting position of said coin passage (3);

a fourth oscillation coil (20a-2) provided as shifted by a predetermined distance from said third oscillation coil (20a-1);

a third reception coil (20b-1) provided as opposed to said third oscillation coil (20a-1) with said coin passage (3) being sandwiched by said third oscillation and reception coils;

a fourth reception coil (20b-2) provided as opposed to said fourth oscillation coil (20a-2) with said coin passage (3) being sandwiched by said fourth oscillation and reception coils;

excitation means (3) for exciting and driving said first, second, third and fourth oscillation coils with use of an excitation signal having a predetermined frequency;

a first amplification/detection circuit (43) for amplifying and detecting an output of a series circuit of said first and second reception coils;

a second amplification/detection circuit (44) for amplifying and detecting an output of a series circuit of said third and fourth reception coils;

a first standby voltage hold circuit (45) for holding an output voltage of said first amplification/detection circuit (43) in a standby mode;

a second standby voltage hold circuit (47) for holding an output voltage of said second amplification/detection circuit (44) in a standby mode;

a first peak voltage hold circuit (46) for holding a peak voltage of an output voltage of said first amplification/detection circuit (43) in a coin passage mode;

a second peak voltage hold circuit (48) for holding a peak voltage of an output voltage of said second amplification/detection circuit (44) in a coin passage mode;

a plurality of window circuits (51,52,53,54) corresponding in number to types of coins and having first and second windows which are set for material and diameter of each coin respectively, said first window varying with an output of said first standby voltage hold circuit (45) , said second window varying with an output of said second standby voltage hold circuit (47), said plurality of window circuits (51,52,53,54) generating a coin discrimination output when an output of said first peak voltage hold circuit (46) lies within said first window and at the same time when an output of said second peak voltage hold circuit (48) lies within said second window;

judgment start signal generation means (49) for generating a judgment start signal after the output of said second peak voltage hold circuit (48) is established; and

discrimination means (300) for receiving the coin discrimination output of said plurality of window circuits (51,52,53,54) after said judgment start signal generation means (49) generates said judgment start signal and for discriminating the coin passed along said coin passage (3) on the basis of said coin discrimination output.

11. A coin processor including a coin discriminator/sorter section (100) for discriminating between true and false coins inserted in to said coin processor and for discriminating and sorting the coins by coin types and a coin accumulator/dispenser section (200) for accumulating some of the coins sorted by said coin discriminator/sorter section (100) to be used as change and for dispensing some of said accumulated coins for change, characterized in that

said coin discriminator/sorter section (100) and said coin accumulator/dispenser section (200) are integrally formed, and

control means (500) of an integral structure is provided for controlling said coin discriminator/sorter section (100) and said coin accumulator/dispenser section (200).

12. A coin processor as set forth in claim 11, characterized in that said coin discriminator/sorter section (100) includes a coin discrimination circuit (DS) for discriminating between the true or false coins inserted into said processor and also the type of the coin, and sorting means for sorting the inserted coins according to the true or false coins and the coin type on the basis of a discrimination output of said coin discrimination circuit (DS).

13. A coin processor as set forth in claim 12, characterized in that said coin discrimination circuit (DS) comprises:

a first reception coil (10b-1) provided on a coin passage (3);

a second reception coil (10b-2) connected in series with said first reception coil (10b-1) as opposed to said first reception coil (10b-1) with said coin passage (3) being sandwiched by said first and second reception coils;

a first oscillation coil (10a-1) provided as mounted on said first reception coil (10b-1) coaxially with said first reception coil (10b-1);

a second oscillation coil (10a-2) connected in series with said first oscillation coil (10a-1) as mounted on said second reception coil (10b-2) coaxially with said second reception coil (10b-2);

a third oscillation coil (20a-1) provided downstream of said first reception coil (10b-1) mounting position of said coin passage (3);

a fourth oscillation coil (20a-2) provided as shifted by a predetermined distance from said third oscillation coil (20a-1);

a third reception coil (20b-1) provided as opposed to said third oscillation coil (20a-1) with said coin passage (3) being sandwiched by said third oscillation and reception coils;

a fourth reception coil (20b-2) provided as opposed to said fourth oscillation coil (20a-2) with said coin passage (3) being sandwiched by said fourth oscillation and reception coils;

excitation means (3) for exciting and driving said first, second, third and fourth oscillation coils with use of an excitation signal having a predetermined frequency;

a first amplification/detection circuit (43) for amplifying and detecting an output of a series circuit of said first and second reception coils;

a second amplification/detection circuit (44) for amplifying and detecting an output of a series circuit of said third and fourth reception coils;

a first standby voltage hold circuit (45) for holding an output voltage of said first amplification/detection circuit (43) in a standby mode;

a second standby voltage hold circuit (47) for holding an output voltage of said second amplification/detection circuit (44) in a standby mode;

a first peak voltage hold circuit (46) for holding a peak voltage in an output voltage of said first amplification/detection circuit (43) in a coin passage mode;

a second peak voltage hold circuit (48) for holding a peak voltage in an output voltage of said second amplification/detection circuit (44) in a coin passage mode; and

a plurality of window circuits (51,52,53,54) corresponding in number to types of coins and having first and second windows which are set for material and diameter of each coin respectively, said first window varying with an output of said first standby voltage hold circuit (45), said second window varying with an output of said second standby voltage hold circuit (47), said plurality of window circuits (51,52,53,54) generating a coin discrimination output when an output of said first peak voltage hold circuit (46) lies within said first window and at the same time when an output of said second peak voltage hold circuit (48) lies within said second window.

14. A coin processor as set forth in claim 12, characterized in that said sorting means includes first sorting means for sorting the inserted coins by the true and false coins and second sorting means for sorting the true coins sorted by said first sorting means into one group for change and the other group.

15. A coin processor as set forth in claim 14, characterized in that said first sorting means includes a true/false coin sorting solenoid (SOL1) and a true/false coin sorting gate (G1) to be driven by excitation of said true/false coin sorting solenoid (SOL1).

16. A coin processor as set forth in claim 14, characterized in that said second sorting means includes a coin type sorting solenoid (SOL2) and a coin type sorting gate (G2) to be driven by excitation of said coin type sorting solenoid (SOL2).

17. A coin processor as set forth in claim 11, characterized in that said coin accumulator/dispenser section (100) includes coin accumulator means for sortingly accumulating the coins for change according to the coin type and coin dispenser means for paying back necessary ones of the coins of said coin accumulator means.

18. A coin processor as set forth in claim 17, characterized in that said coin accumulator means includes a plurality of coin tubes (8-1,8-2,8-3) corresponding in number to the coin types.

19. A coin processor as set forth in claim 18, characterized in that said coin dispenser means includes a coin pay-out solenoid (SOL-A,SOL-B,SOL-C) and a pay-out slide (885) driven by excitation of said coin pay-out solenoid (SOL-A,SOL-B,SOL-C) for paying out one by one necessary one of the coins accumulated in said coin accumulator means.

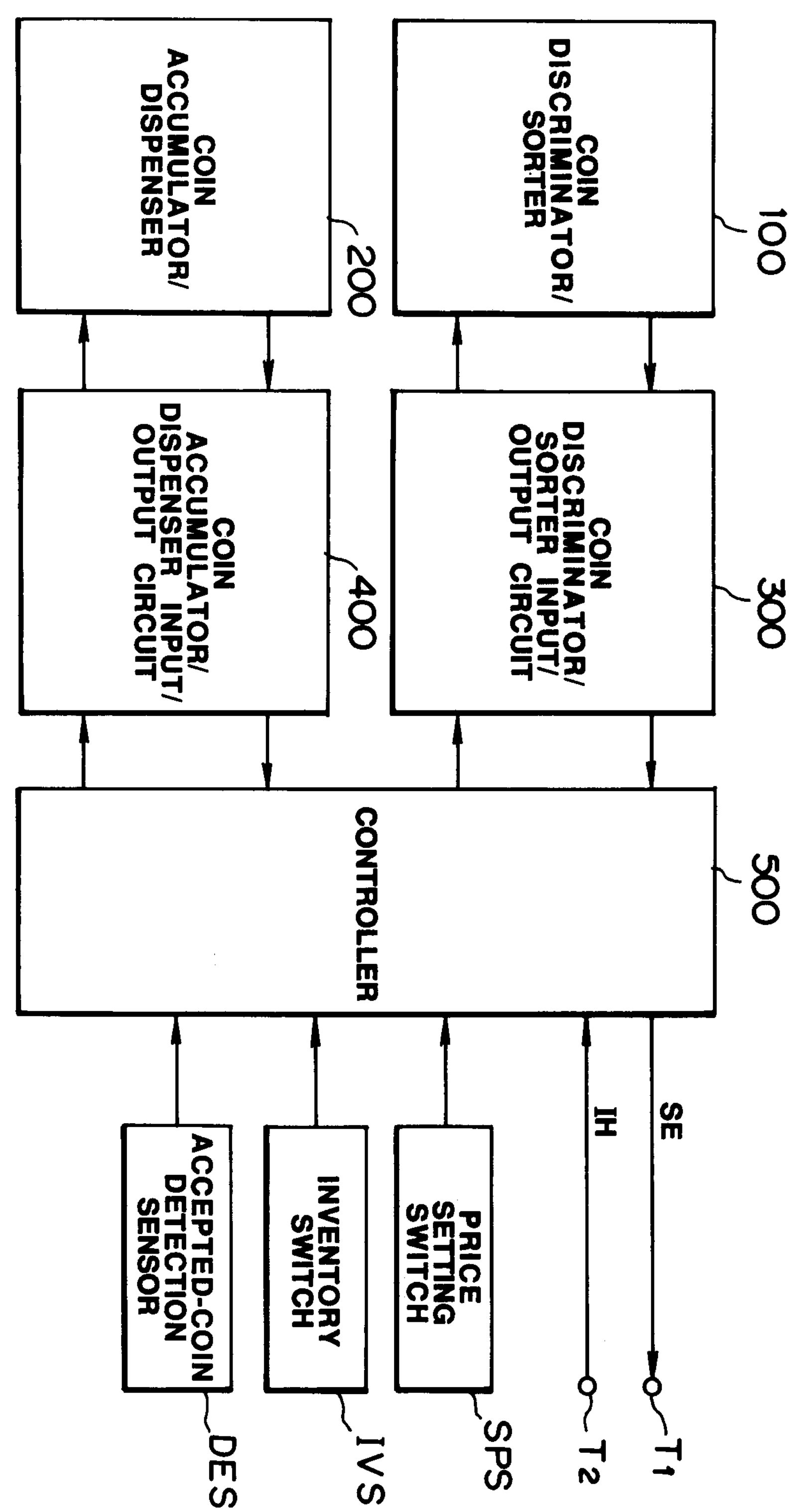
COIN DISCRIMINATOR/ SORTER
100
COIN ACCUMULATOR/ DISPENSER
200
COIN DISCRIMINATOR/ SORTER INPUT/ OUTPUT CIRCUIT
300
COIN ACCUMULATOR/ DISPENSER INPUT/ OUTPUT CIRCUIT
400
CONTROLLER
500
SE
IH
PRICE SETTING SWITCH
INVENTORY SWITCH
ACCEPTED-COIN DETECTION SENSOR
T1
T2
SPS
IVS
DES

FIG.1

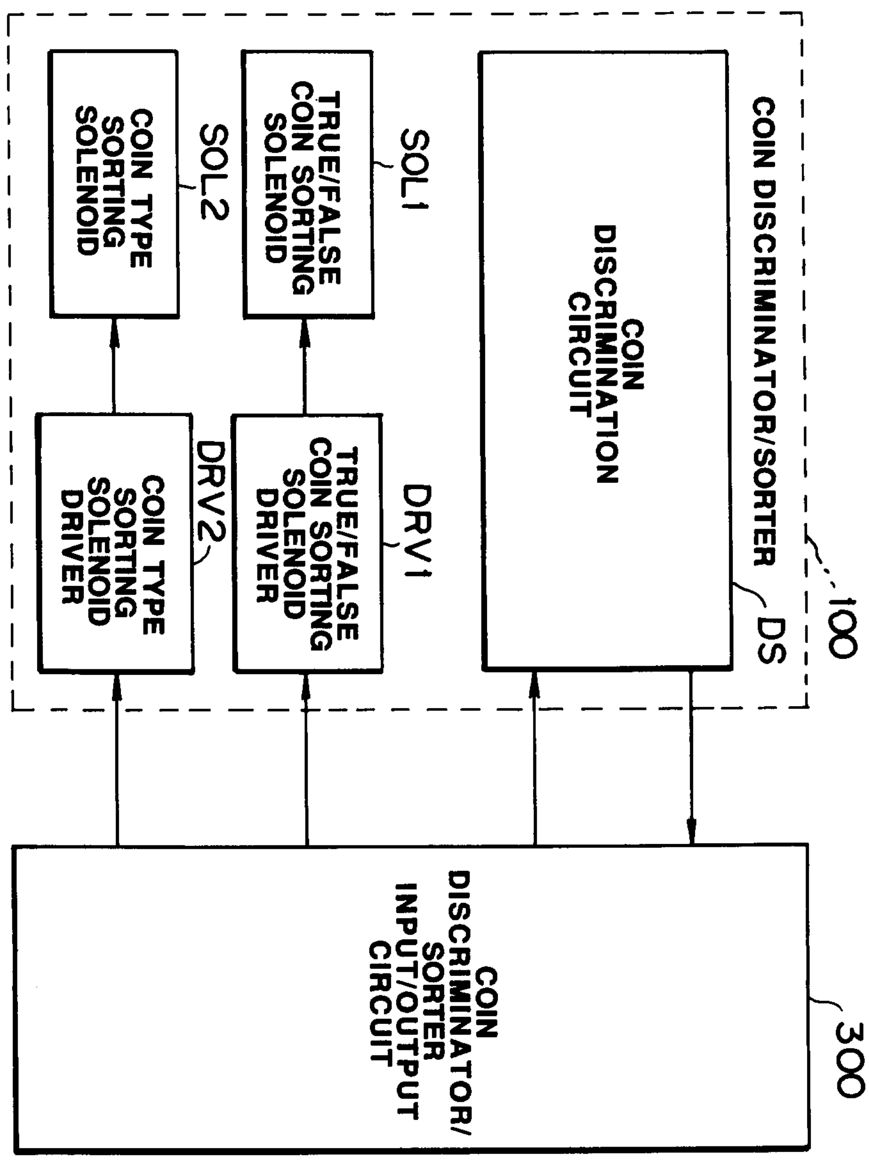
COIN DISCRIMINATOR/SORTER
100
DS
COIN DISCRIMINATION CIRCUIT
SOL1
TRUE/FALSE COIN SORTING SOLENOID
SOL2
COIN TYPE SORTING SOLENOID
DRV1
TRUE/FALSE COIN SORTING SOLENOID DRIVER
DRV2
COIN TYPE SORTING SOLENOID DRIVER
300
COIN DISCRIMINATOR/ SORTER INPUT/OUTPUT CIRCUIT

FIG.2

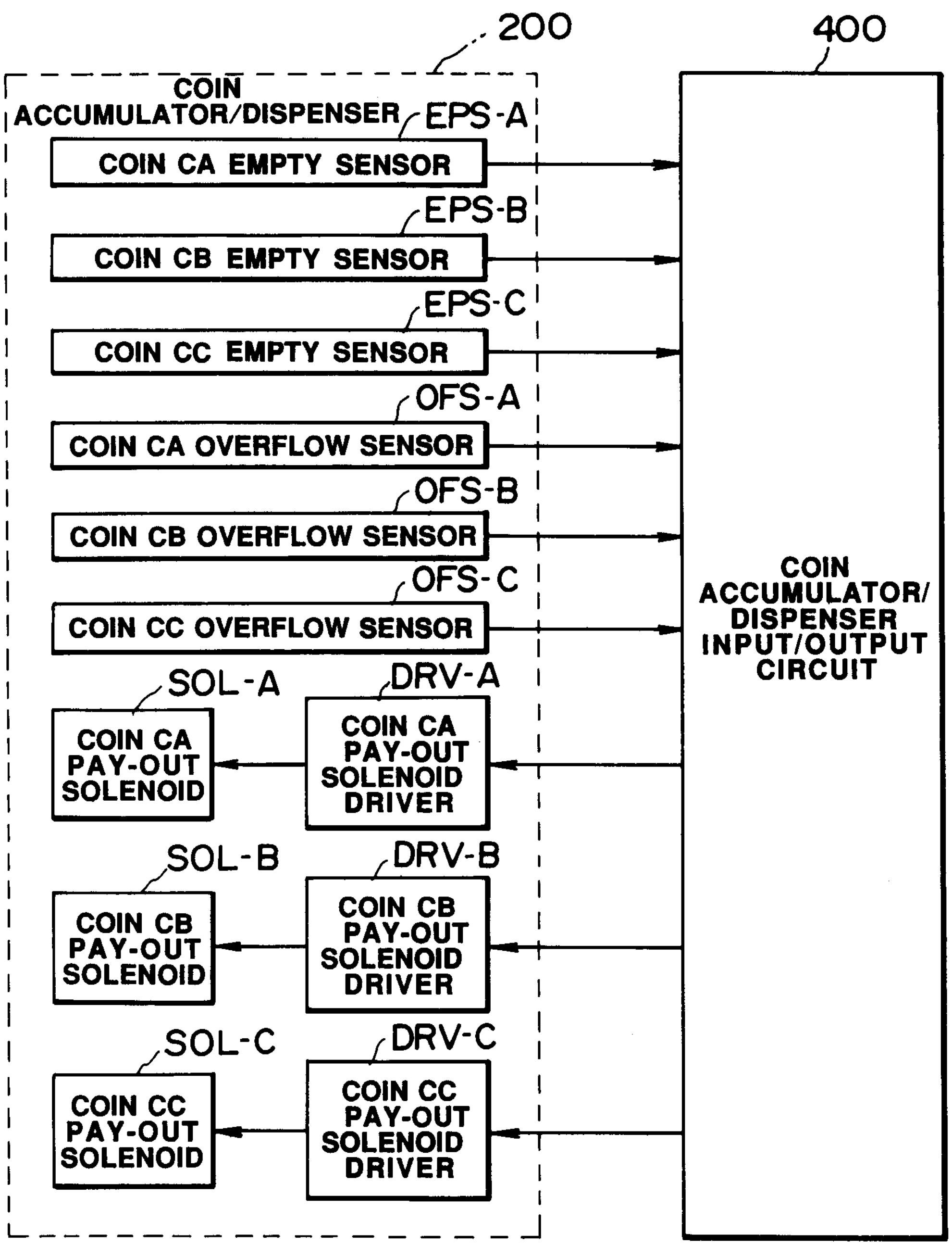
200
400
COIN ACCUMULATOR/DISPENSER
EPS-A
COIN CA EMPTY SENSOR
EPS-B
COIN CB EMPTY SENSOR
EPS-C
COIN CC EMPTY SENSOR
OFS-A
COIN CA OVERFLOW SENSOR
OFS-B
COIN CB OVERFLOW SENSOR
OFS-C
COIN CC OVERFLOW SENSOR
SOL-A
COIN CA PAY-OUT SOLENOID
DRV-A
COIN CA PAY-OUT SOLENOID DRIVER
SOL-B
COIN CB PAY-OUT SOLENOID
DRV-B
COIN CB PAY-OUT SOLENOID DRIVER
SOL-C
COIN CC PAY-OUT SOLENOID
DRV-C
COIN CC PAY-OUT SOLENOID DRIVER
COIN ACCUMULATOR/ DISPENSER INPUT/OUTPUT CIRCUIT

FIG.3

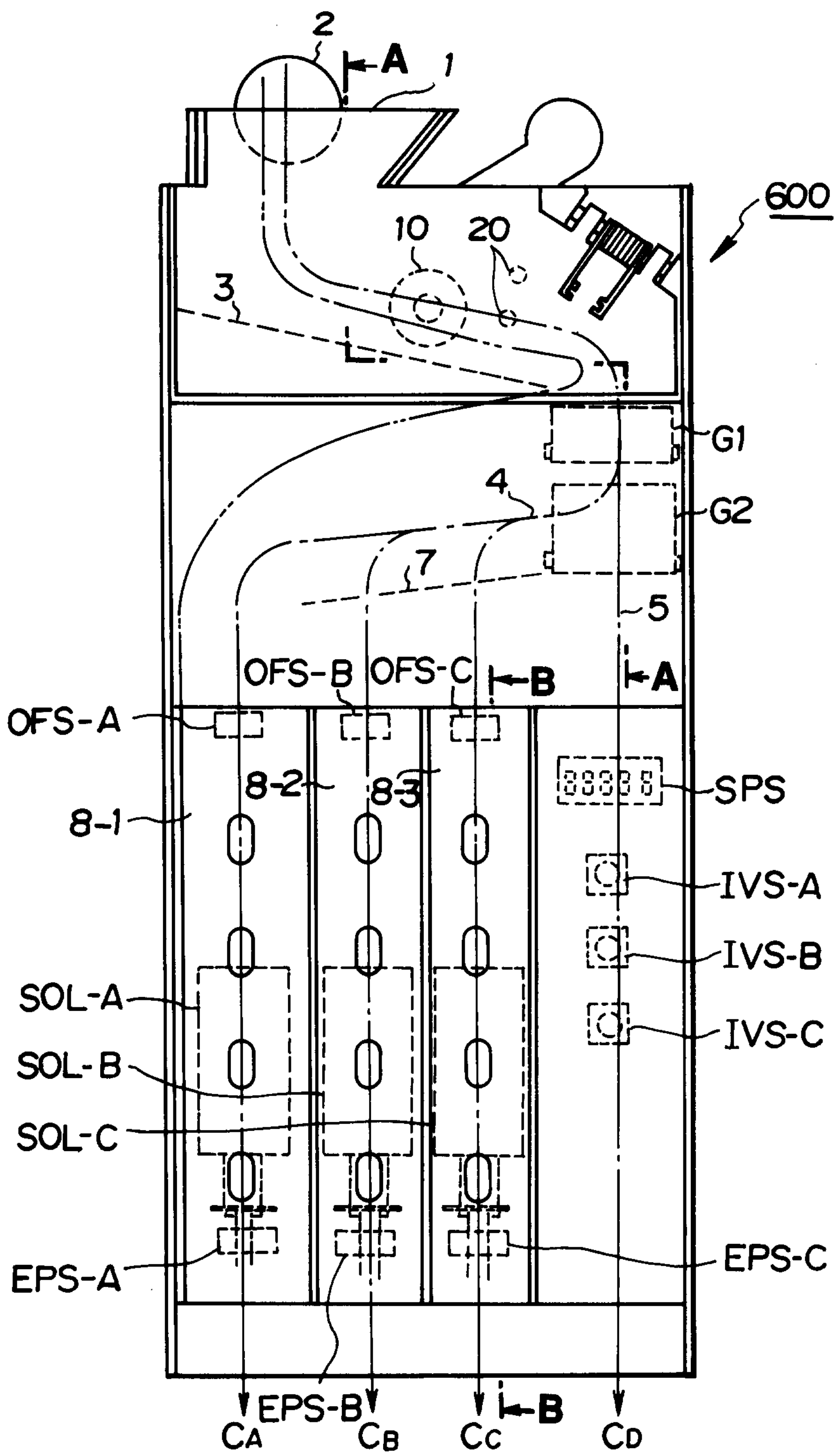
2
A
1
600
10
20
3
G1
4
G2
7
5
OFS-B
OFS-C
B
A
OFS-A
SPS
8-2
8-3
8-1
IVS-A
IVS-B
SOL-A
IVS-C
SOL-B
SOL-C
EPS-A
EPS-C
EPS-B
B
CA
CB
CC
CD

FIG.4

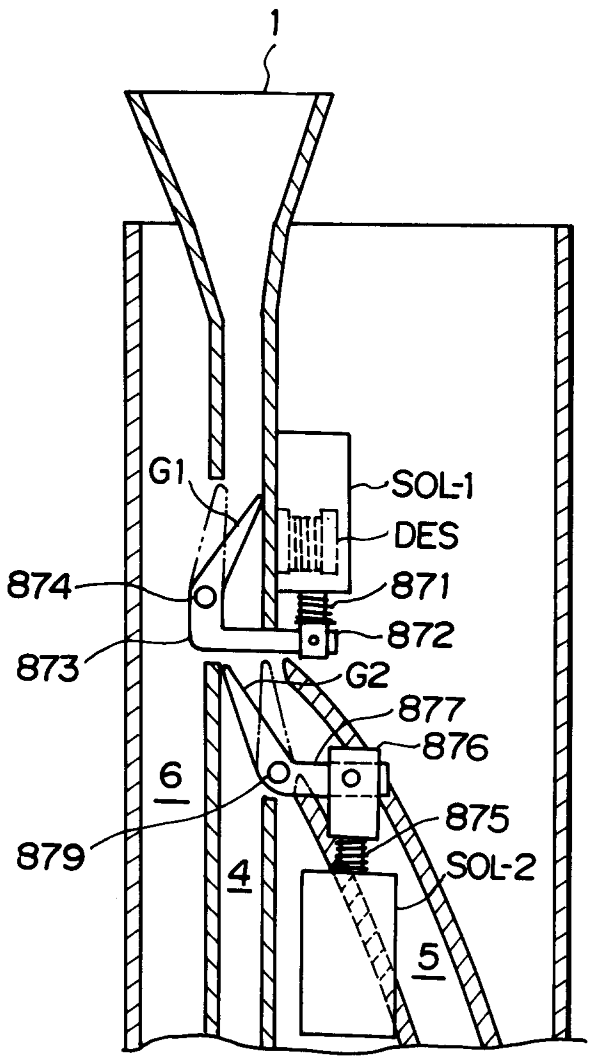

FIG.5

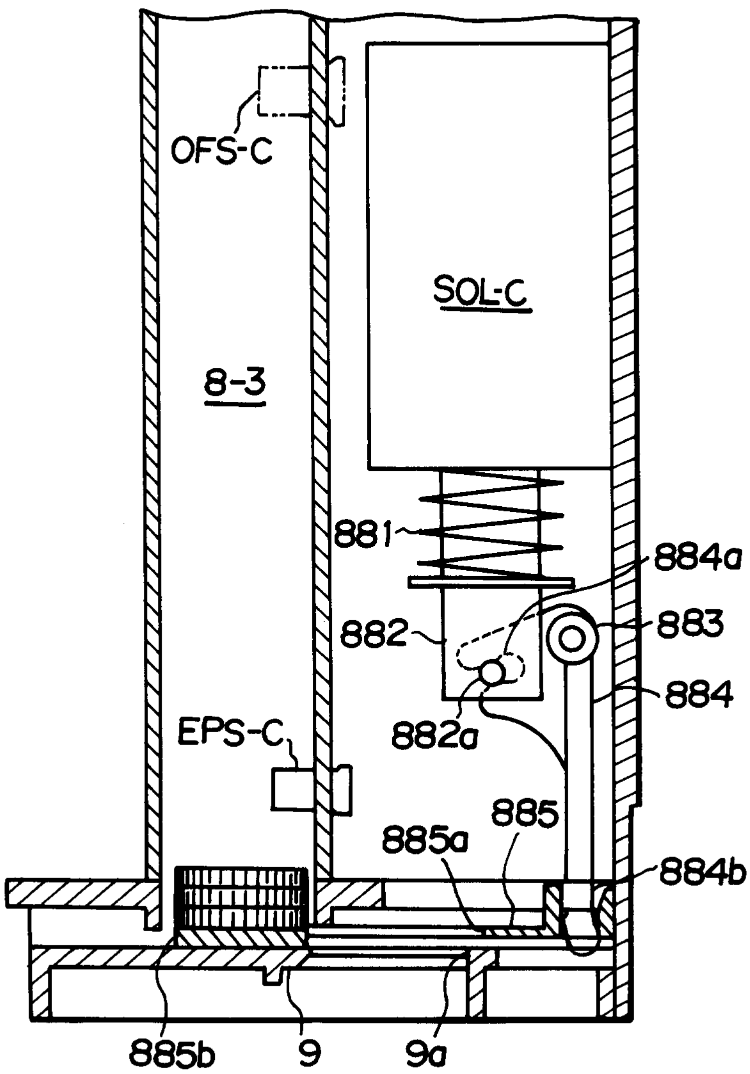
OFS-C
SOL-C
8-3
881
884a
882
883
884
882a
EPS-C
885
885a
884b
885b
9
9a

FIG.6

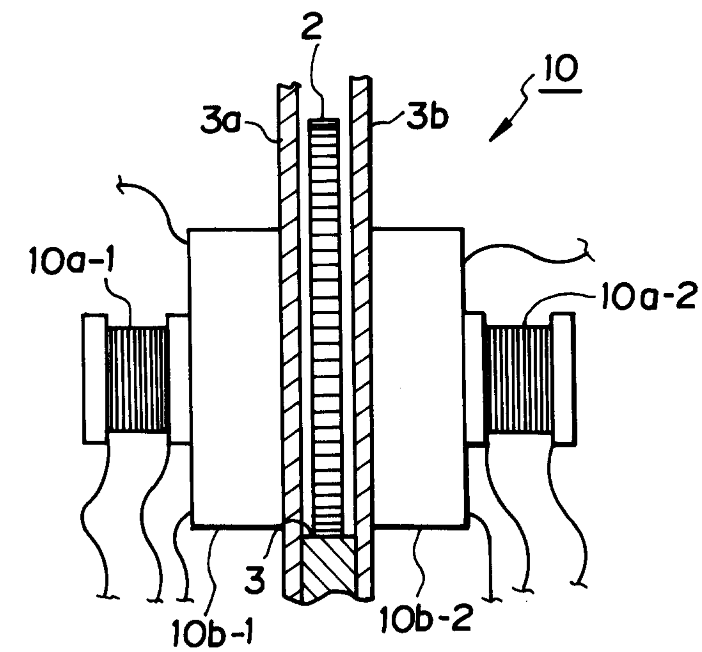

FIG.7

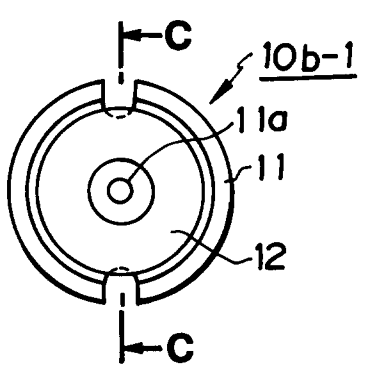

FIG.8(a)

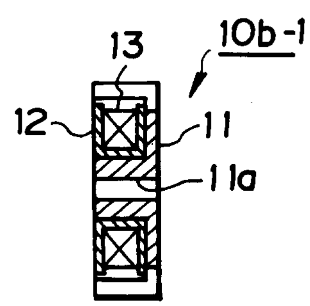

FIG.8(b)

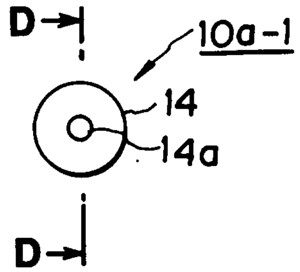

FIG.9(a)

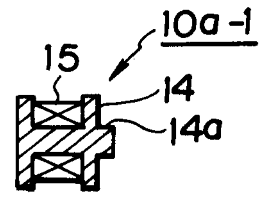

FIG.9(b)

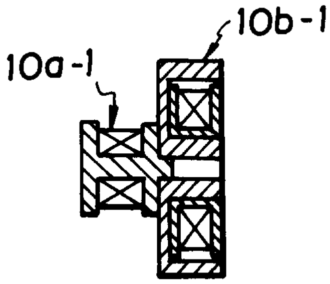

FIG.10

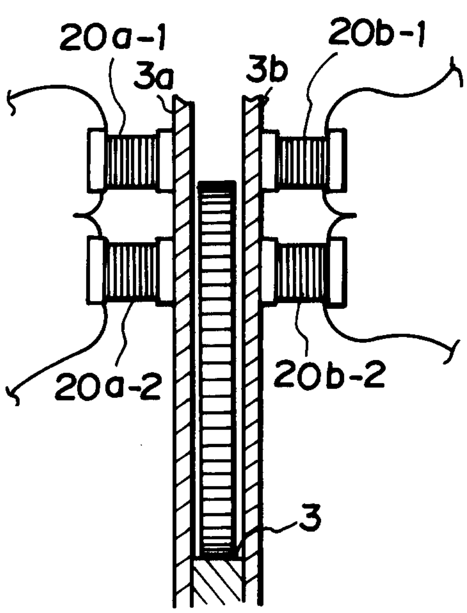

FIG.11

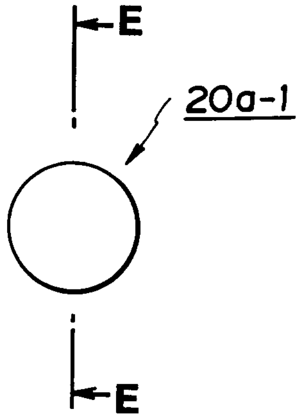

FIG.12(a)

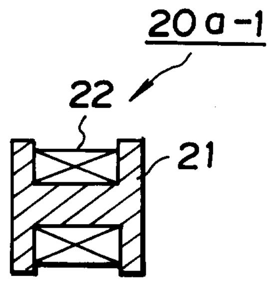

FIG.12(b)

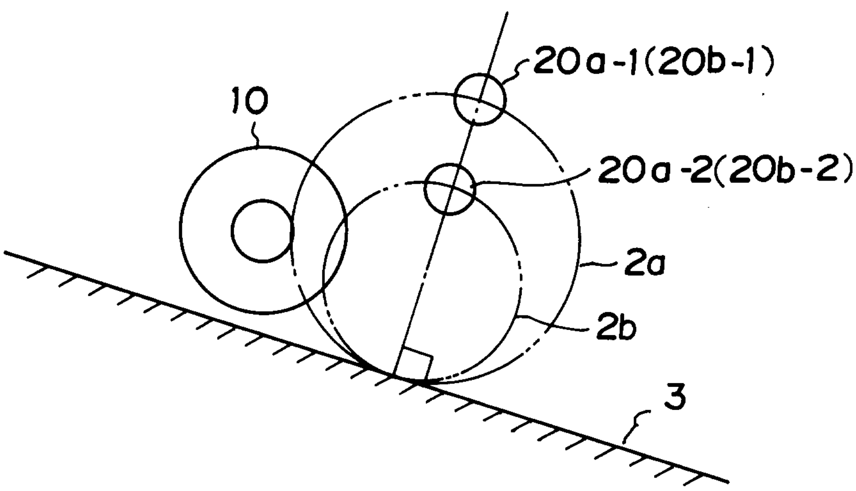

FIG.13

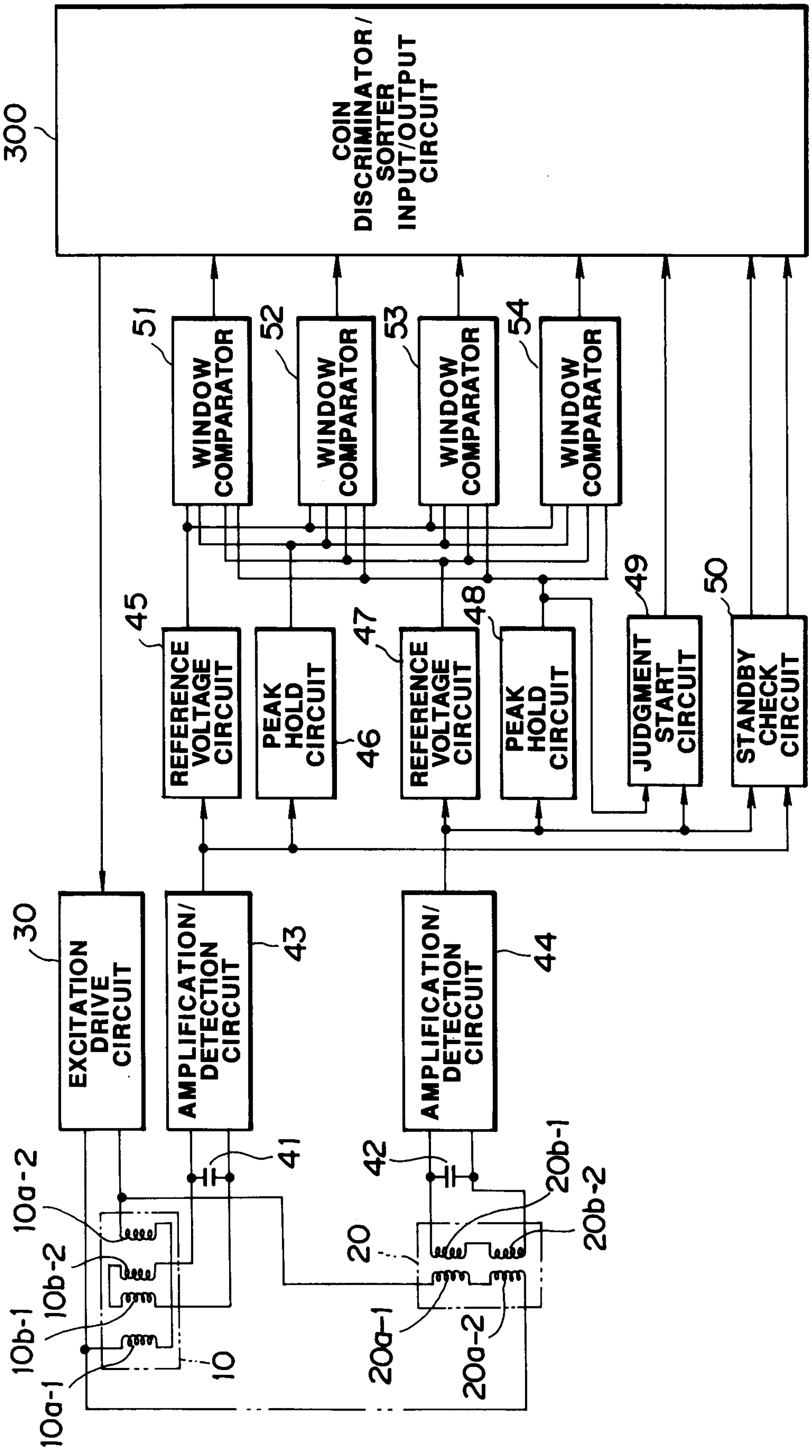
300
COIN DISCRIMINATOR/ SORTER INPUT/OUTPUT CIRCUIT
51
WINDOW COMPARATOR
52
WINDOW COMPARATOR
53
WINDOW COMPARATOR
54
WINDOW COMPARATOR
45
REFERENCE VOLTAGE CIRCUIT
PEAK HOLD CIRCUIT
46
47
REFERENCE VOLTAGE CIRCUIT
48
PEAK HOLD CIRCUIT
49
JUDGMENT START CIRCUIT
50
STANDBY CHECK CIRCUIT
30
EXCITATION DRIVE CIRCUIT
AMPLIFICATION/ DETECTION CIRCUIT
43
AMPLIFICATION/ DETECTION CIRCUIT
44
10a-2
10b-2
10b-1
10a-1
10
41
42
20
20b-1
20b-2
20a-1
20a-2

FIG.14

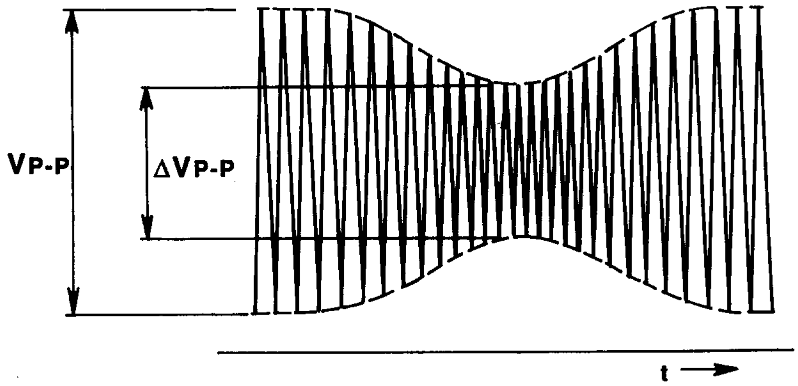

FIG.15

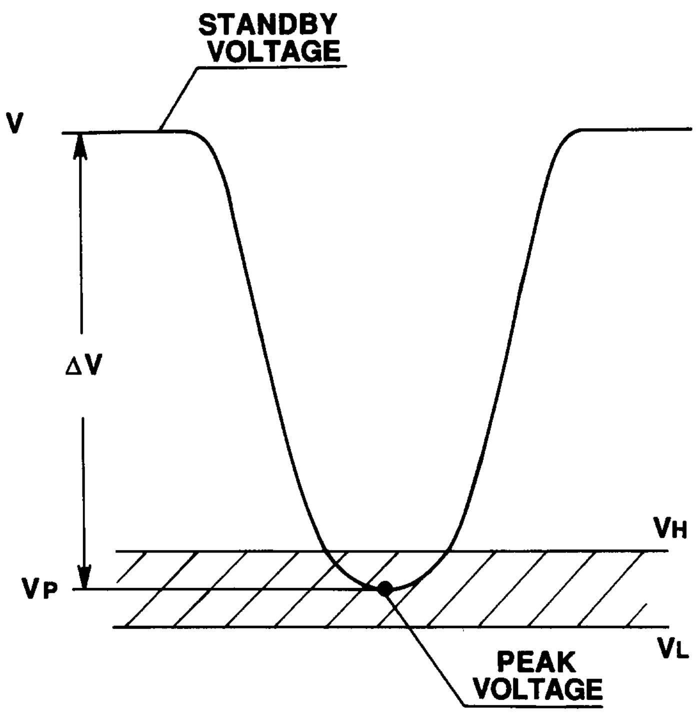

FIG.16

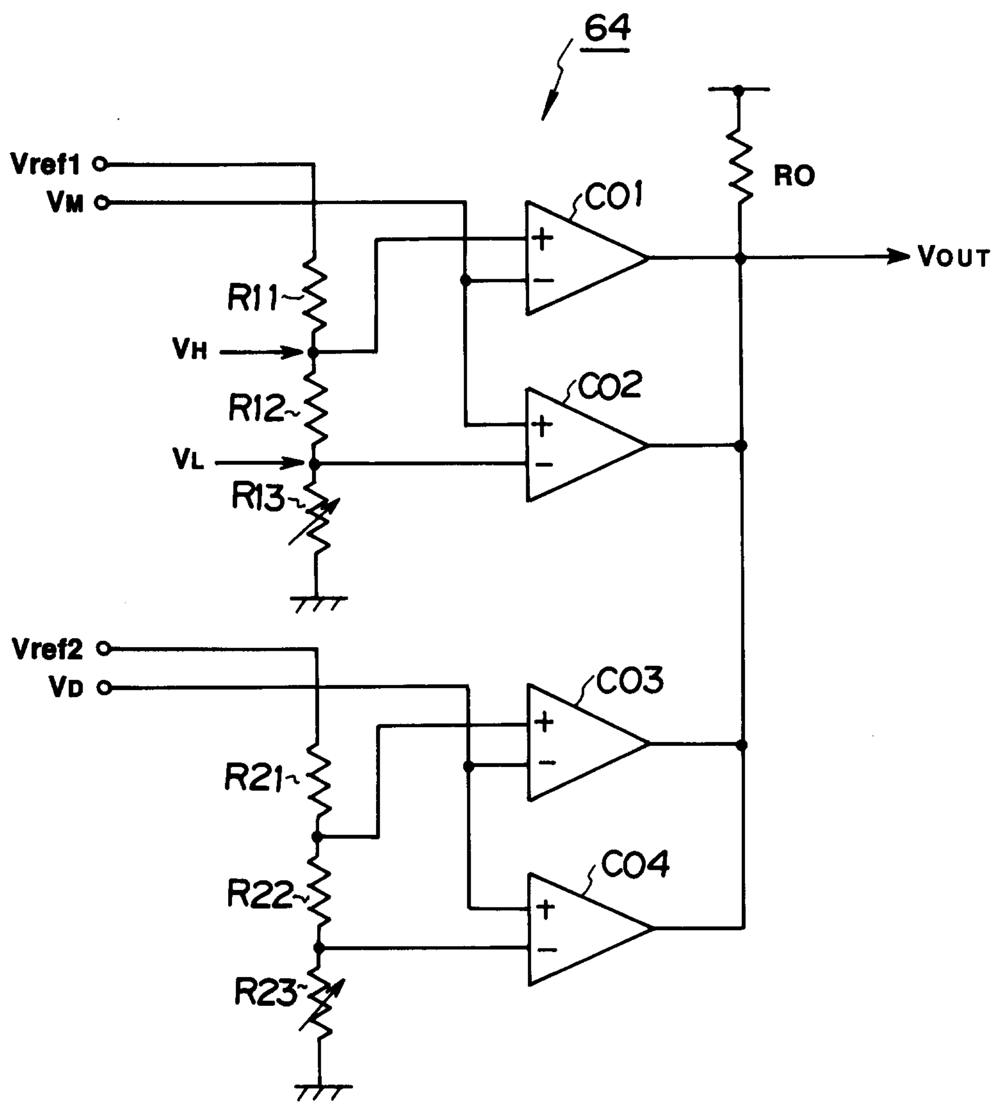
64
Vref1
VM
CO1
RO
VOUT
R11
VH
R12
CO2
VL
R13
Vref2
VD
CO3
R21
R22
CO4
R23

FIG.17

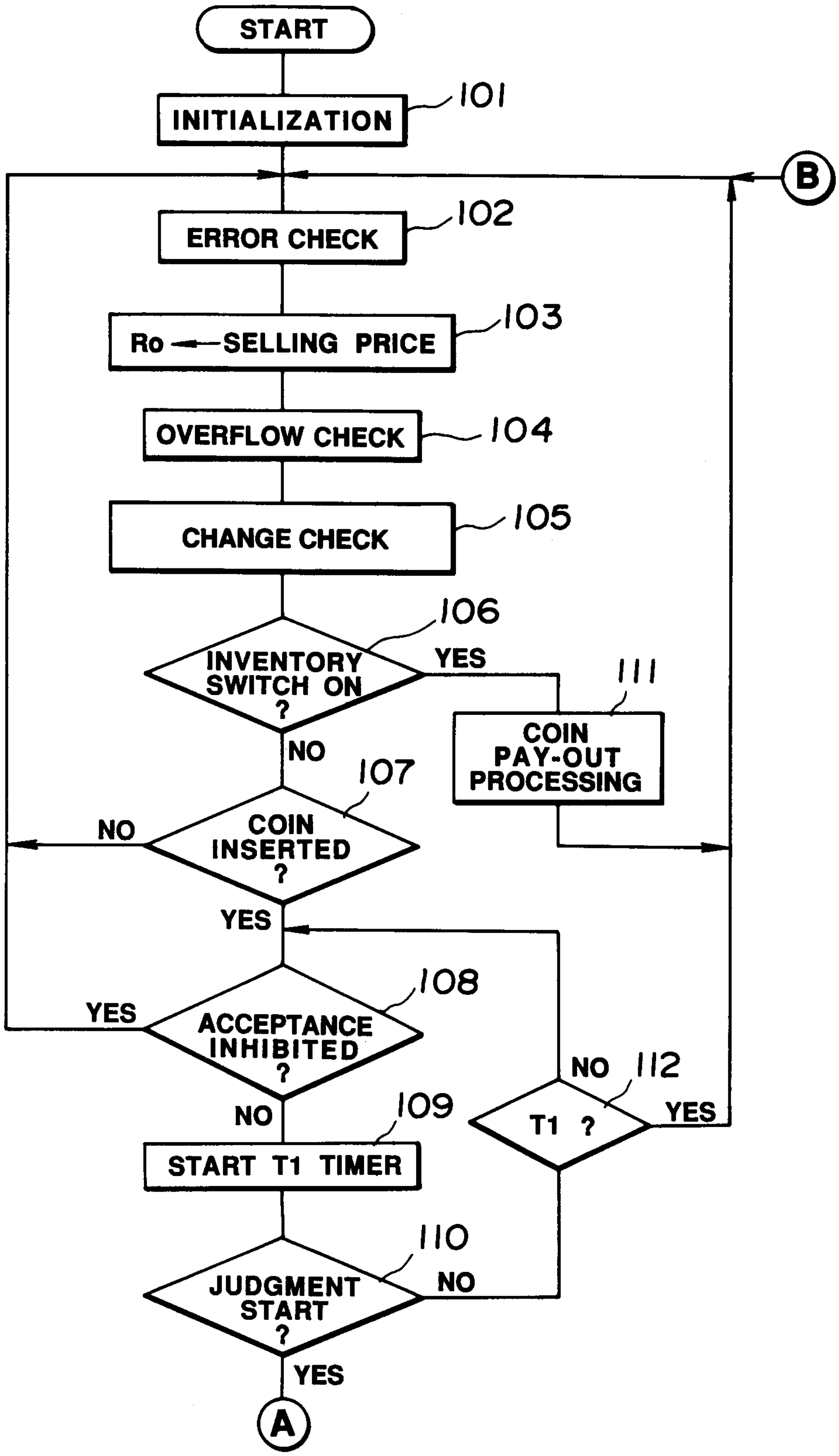
START
INITIALIZATION
101
B
ERROR CHECK
102
Ro ← SELLING PRICE
103
OVERFLOW CHECK
104
CHANGE CHECK
105
106
INVENTORY SWITCH ON ?
YES
111
COIN PAY-OUT PROCESSING
NO
107
COIN INSERTED ?
NO
YES
108
ACCEPTANCE INHIBITED ?
YES
NO
112
T1 ?
NO
YES
109
START T1 TIMER
110
JUDGMENT START ?
NO
YES
A

FIG.18

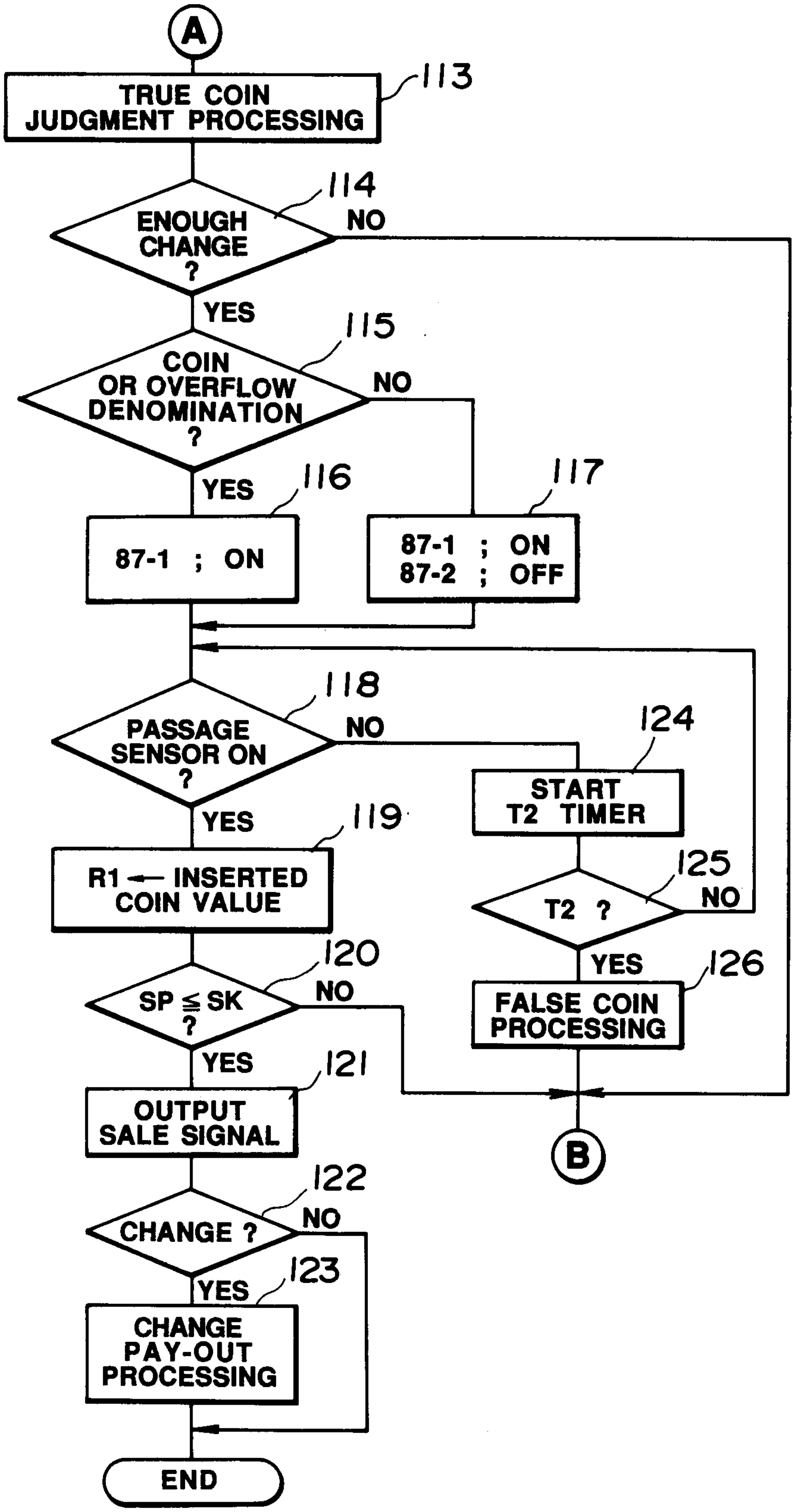
A
TRUE COIN JUDGMENT PROCESSING
113
ENOUGH CHANGE ?
114
NO
YES
COIN OR OVERFLOW DENOMINATION ?
115
NO
YES
116
87-1 ; ON
117
87-1 ; ON
87-2 ; OFF
PASSAGE SENSOR ON ?
118
NO
124
START T2 TIMER
YES
119
R1 ← INSERTED COIN VALUE
125
T2 ?
NO
YES
126
FALSE COIN PROCESSING
SP ≦ SK ?
120
NO
YES
121
OUTPUT SALE SIGNAL
B
CHANGE ?
122
NO
YES
123
CHANGE PAY-OUT PROCESSING
END

FIG.19

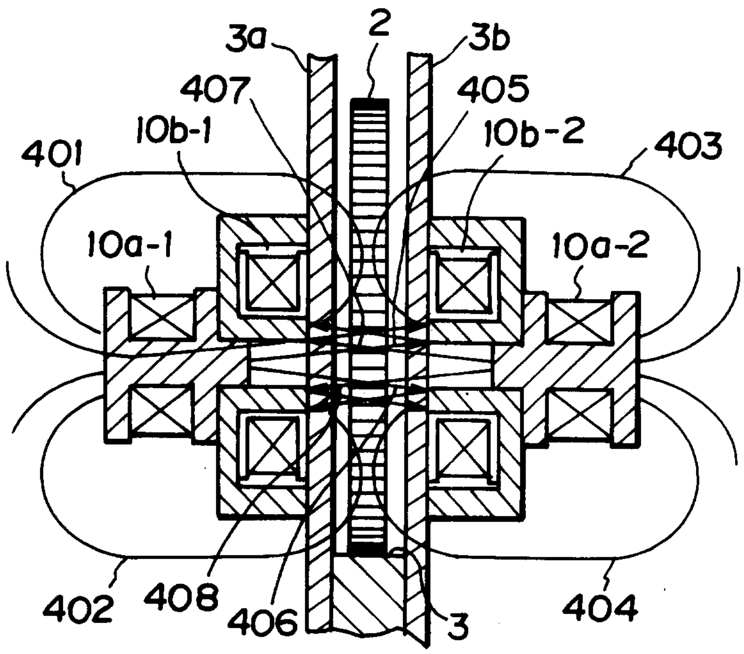

FIG.20

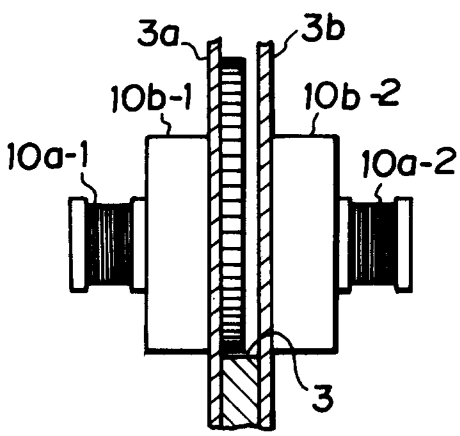

FIG.21

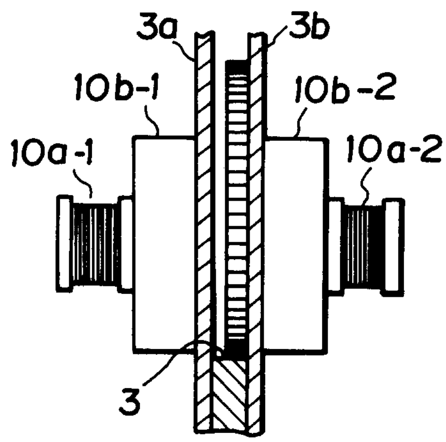

FIG.22

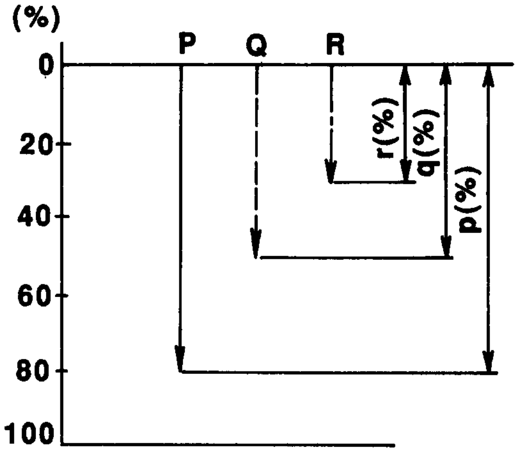

FIG.23

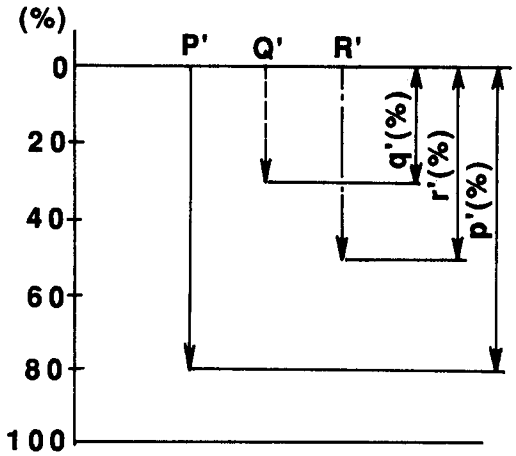

FIG.24

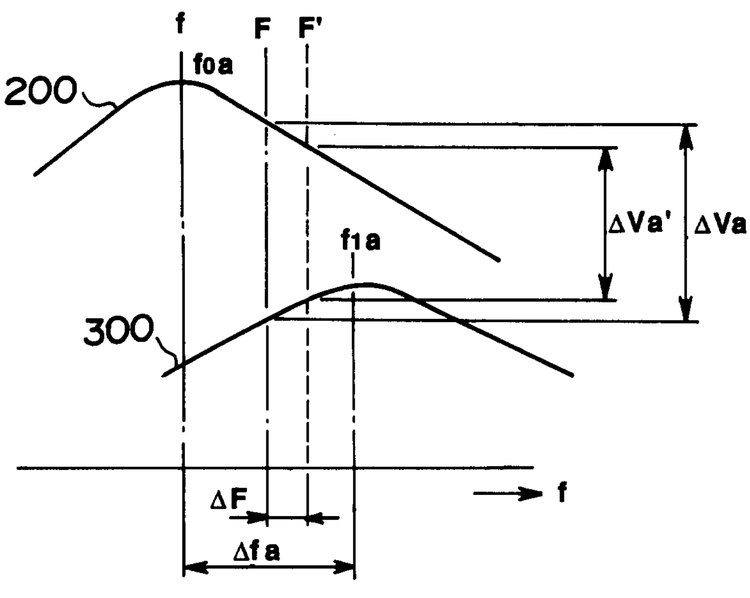

FIG.25

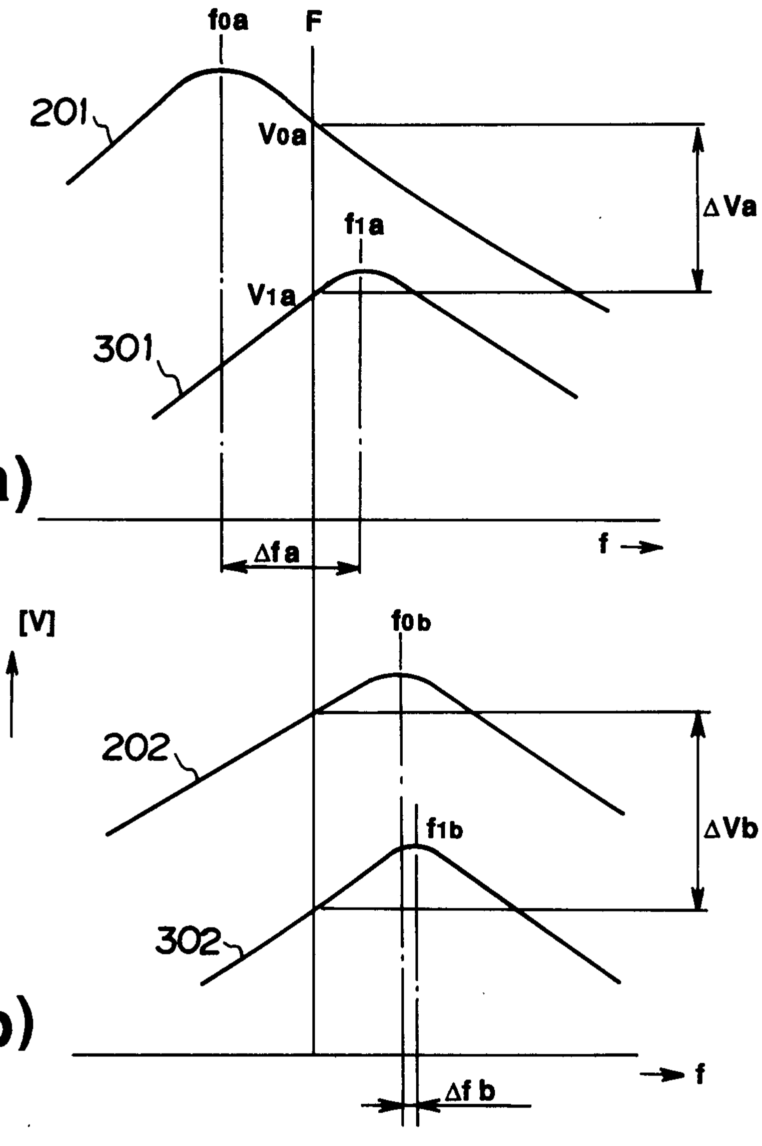

FIG.26(a)

FIG.26(b)

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 93 10 6298

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	EP-A-0 392 110 (NIPPON CONLUX)	1-3,5-7	G07F3/02 G07D5/08 G07D5/02
	* the whole document *		
Y		4,8, 10-14	
A		9,15-19	

Y	US-A-4 385 684 (O. SUGIMOTO)	4,8, 10-14	
	* the whole document *		
A		1,5, 15-19	

A	GB-A-2 066 541 (NIPPON COINCO)	1,4, 10-19	
	* abstract; claims; figures *		

A	EP-A-0 202 378 (MATSUSHITA)		

A	US-A-4 124 111 (Y. HAYASHI)		

A	US-A-4 108 296 (Y. HAYASHI)		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

G07F
G07D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	24 JUNE 1993	DAVID J.Y.H.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons
& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P0401)