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TITLE OF THE INVENTION

COIN STORING APPARATUS AND PUBLIC TELEPHONE USING THE
SAME

BACKGROUND OF THE INVENTION

5 Field of the Invention

The present invention relates to a coin storing apparatus for storing coins which have been inserted in vending machine or the like and, more particularly, a public telephone using this coin storing apparatus.

10 Related Background Art

Such a kind of coin storing apparatus has been disclosed in commonly-assigned Japanese Patent Laid-open Application No. 9-185755, for example.

15 As shown in Fig. 14, this coin storing apparatus 1, which is used in a public telephone set, for example, comprises a discriminating track 11 which is a path for selecting coins; a storing track 12 which is a path for the coins to be stored; a storing unit 13 for storing the coins; returning tracks 14, 15A, 15B which are paths for returning
20 the coins; an accepting track 16 which is a path for accepting the coins; and an accepting and returning track 17 for accepting and returning the coins.

25 When a coin is inserted into this apparatus, thus inserted coin C_A is detected by an insertion sensor 41, and then a diameter sensor 42 and a material sensor 43 in the discriminating track 11 judges whether the coin is a current



coin or not. When the inserted coin is judged to be a false coin, a selecting lever 50B is switched over toward the returning track 14, so that the coin is returned through the returning tracks 14, 15B as a coin to be returned C_c ,
5 which is detected by a return sensor 47.

In the case of a current coin, by contrast, the selecting lever 50B is switched over toward the storing track 12, whereby the coin passes through the storing track 12 and, after being detected by passage sensors 44A, 44B
10 disposed in the storing track 12, is stored in the storing unit 13 as a coin to be stored C_s .

The storing unit 13, comprising eight racks, is slid rightward or leftward in the drawing upon storing coins, such that an empty rack is located at the position aligning
15 with the storing track 12, thus storing the coins one by one into the respective racks.

After coins are thus stored in the storing unit 13, when a call is made by use of this public telephone set, the stored coins pass through the accepting track 16 so as
20 to be accepted in a non-depicted safe, while being detected by an acceptance sensor 46. At the end of the call, the coins remaining in the storing unit 13 are returned through the returning track 15A. Here, when accepting or returning the coins therein, the storing unit 13 is slid rightward or
25 leftward in the drawing such that the rack storing the coin is located at the position aligning with the accepting slot

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or returning slot.

In such an apparatus, when the power source voltage of the apparatus becomes lower, the amount of light emission in the sensor for detecting the position of the storing unit 13 decreases, whereby there may be cases where the inlet position of a rack in the storing unit 13 does not coincide with the exit position of the storing track 12. This case is disadvantageous not only in that coins cannot be stored in empty racks in the storing unit 13, but also in that the coins may be stuck in the storing track 12.

SUMMARY OF THE INVENTION

Therefore, it is an object of the present invention to provide an apparatus in which, even when its power source voltage is lowered, inserted coins judged to be current coins are correctly stored in its storing unit.

In order to achieve such an object, the present invention provides a coin storing apparatus comprising a coin track unit through which an inserted coin rolls, a coin storing unit having a plurality of racks integrally formed together each adapted to store one coin, a motor for moving the coin storing unit, a registration member to be detected which is disposed in the coin storing unit for detecting a reference position, and a position sensor, constituted by a light-emitting device and a light-receiving device, for detecting a position of the registration member, the racks being positioned with respect to the coin track unit



according to an output of the sensor, so as to store the coin into a vacant rack of the coin storing unit, and the apparatus further comprising detection means for detecting a response time of the sensor, and reference position setting means for setting a reference position of the coin storing unit according to the position of the registration member detecting by an output of the sensor in consideration of response time detected by the detection means.

The detection means may detect, as the response time, a period from a point of time when the light-emitting device is turned to be on till the light-receiving device detects an optical signal from the light-emitting device.

The reference position setting means controls the motor to move the coin storing unit in predetermined direction and the light-emitting device to emit optical signal trains, and set a position of the registration member, which the light-receiving device is not detected the optical signal in a period of the response time, to the reference position.

A CPU for controlling the coin storing apparatus is provided, and the response time is set as a cumulative execution instruction time of the CPU from a point of time when the CPU executes an instruction for emitting an optical signal to the light-emitting device till the optical signal is received by the light-receiving device.

The public telephone in accordance with the present

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invention comprises a main housing which has a coin inserting slot and a coin returning slot, a coin processing apparatus for selecting a current coin from coins inserted therein, the aforementioned coin storing apparatus, a safe
5 for keeping accepted coins, and communication means.

The present invention will become more fully understood from the detailed description given hereinbelow and the accompanying drawings which are given by way of illustration only, and thus are not to be considered as
10 limiting the present invention.

Further scope of applicability of the present invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific
15 examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

20 BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing the configuration of a public telephone set to which a coin storing apparatus of the present invention is applied;

Fig. 2 is a flowchart showing an operation of the
25 public telephone set shown in Fig. 1;

Figs. 3 to 7 are flowcharts showing operations of the



public telephone set;

Figs. 8A to 8C are views for explaining how coins are stored into a coin storing unit in the coin storing apparatus;

5 Figs. 9A to 9C are views showing how a sensor detects movement of the storing unit;

Figs. 10A and 10B are views for explaining characteristics of the sensor;

10 Figs. 11A to 11C are views showing how the sensor detects a home position;

Fig. 12 is a sectional view of the coin storing apparatus;

Figs. 13A to 13D are views showing the configuration of the storing unit;

15 Fig. 14 is a view schematically showing the configuration of a coin storing apparatus; and

Figs. 15A and 15B are respectively front and side views showing a public telephone in accordance with an embodiment of the present invention.

20 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the following, the present invention will be explained with reference to the accompanying drawings.

25 Figs. 15A and 15B are respectively front and side views showing the public telephone in accordance with the present invention. In these drawings, a public telephone 100 comprises a main housing 102 shaped into a box form with



an opening on the front side and a door 103 which is attached to the main housing 102 by means of a hinge 104 on one side of the opening so as to be freely opened and closed. Also, a thin rack 105 shaped into a box form with an opening on the front side is fitted into the main housing 102 and fixed thereto by means of a non-depicted screw. Integrally formed with this rack 105 is a horizontal diaphragm 106. An accepting chamber 107 and a safe chamber for accommodating a safe 109 are respectively formed on the upper and lower sides of the diaphragm 106.

A coin processing apparatus 101 discriminates, among coins inserted from a coin inserting slot 132a, current and false coins from each other, and then returns the false coins by way of a coin returning slot 134, while accepting the current coins through a coin storing unit 1 to the safe 109.

Attached to an upper portion of the door 103 is an inserting slot member 132 having the coin inserting slot 132a. Disposed below the inserting slot member 132 is a plate 133 provided with dial buttons 133a and a display 140. Disposed below the plate 133 is a coin returning slot 134. A handset 135 is hung on a hook 136 which is attached to the front face of the door 103, whereas a lock 137 for securing the door 103 is attached to a side face of the door 103.

Fig. 12 is a sectional view of a coin storing apparatus in accordance with the present invention. This apparatus



1 comprises, not only the sensors disposed in the respective tracks shown in Fig. 14 that has been explained above and the like, but also a magnet 50A for driving the selecting lever 50B shown in Fig. 14, an accepting and returning lever (switching lever) 52B for guiding stored coins C_s in the storing unit 13 to the accepting track 16 or the returning track 15, a magnet 52A for driving this lever 52B, a storing gate 53B for storing and holding each coin to be stored C_s in the storing section 13, and a magnet 53A for driving the storing gate 53B to open and close.

Here, the storing unit 13 is provided with a plurality of racks integrally formed together, whereas coins can be respectively stored in eight of these racks. Each rack is moved as a motor M shown in Fig. 12 rotates. When a coin is to be stored, a predetermined empty rack and the exit of the storing track 12 shown in Fig. 14 are aligned with each other, whereby the coin is stored into the empty rack. When the coin stored in a predetermined rack of the storing unit 13 is to be accepted or returned, this rack is moved so as to align with the inlet of the accepting and returning track 17 shown in Fig. 14, and then the magnet 53A is driven so as to open the storing gate 53B of this rack, whereby the coin is accepted or returned. Here, the storing gates 53B of the respective storing gates 53B are commonly controlled by the single magnet 53A to open and close. Namely, when a rack is moved to the accepting and returning



position, the magnet 53A is driven to actuate an arm 53C, as shown in the top plan view of Fig. 13D that will be explained later, so as to open the storing gate 53B of this rack. Then, when the magnet 53A is restored to normal position, the storing gate 53B is closed by a spring which is not depicted.

Figs. 13A to 13D are views showing the configuration of main parts of the storing unit 13. Fig. 13A is a front view; Figs. 13B and 13D are top plan views; and Fig. 13C is a sectional side elevation. As shown in Figs. 13A and 13B, the storing unit 13 comprises eight racks Nos. 1 to 8 which can store coins, as well as two racks H and H' which are respectively disposed, with no storing gate 53B, at both side ends of the eight racks Nos. 1 to 8 and used for guiding the inserted coins to the returning track 15A.

With rotating the motor M, the storing unit moves in normal direction N or reverse direction R. The number of revolutions of the motor M for moving such racks is detected by an encoder E shown in Fig. 13A and is transmitted to a control circuit such as CPU. The storing unit 13 has opening sections (slits) 13A and 13B, which are detected by a rack position sensor 45 shown in Fig. 13C, and thus detected positions are transmitted to the control circuit, allowing the latter to recognize the state of movement of the racks.

When the slit 13A, which is an elongated hole here, is detected by the sensor 45, a home position of the storing



unit 13, which will be explained later, is found. The slits 13B are formed so as to correspond to the respective positions of the racks Nos. 1 to 8. As one of these slits 13B is detected by the sensor 45, the position of its corresponding one of racks Nos. 1 to 8 is found.

The sensor 45 shown in Fig. 13C is a photosensor constituted by an LED 45₂ and a light-receiving transistor (phototransistor) 45₁. As an optical signal from the LED 45₂, disposed on the rear side is received by the phototransistor 45₁, by way of the slits, the home position and rack positions of the storing unit 13 are recognized.

Namely, when the slit 13A is detected by the sensor 45, it is recognized that the rack H is located at a position defined as the above-mentioned home position facing to the inlet of the returning track 15A. Also, when the eight holes of the slits 13B formed so as to correspond to the racks Nos. 1 to 8 are successively detected by the sensor 45 as the racks are moved, and thus detected positions are transmitted to the control circuit, the latter recognizes that the racks are moving.

Figs. 8A to 8C are schematic views for explaining the operation of the storing unit 13. These drawings show the storing unit 13 shown in Fig. 13A as viewed from the rear side.

The rack H is located at the home position shown in Fig. 8A upon its initial actuation such as the time when



the power supply to the apparatus 1 is stopped. Namely, the rack H is positioned such that its positions on the upper and lower sides of this drawing respectively coincide with the exit of the storing track 12 and the inlet of the returning track 15A. No storing gate is attached to the rack H, whereby an inserted current coin is immediately guided to the returning track 15A by way of this rack H.

Here, when a first coin is to be stored, the motor M is rotated in its normal direction as shown in Fig. 8B such that the position above the rack No. 1 coincides with the exit of the storing track 12 (and, consequently, the position below the rack No. 1 coincides with the inlet of the returning track 15A). Accordingly, an inserted current coin is stored in the rack No. 1. Then, when another coin is to be stored in the rack No. 8, for example, the motor M is further rotated in the normal direction as shown in Fig. 8C such that the position above the rack No. 8 coincides with the exit of the storing track 12 (and, consequently, the position below the rack No. 8 coincides with the inlet of the returning track 15A). Accordingly, an inserted current coin is stored in the rack No. 8.

Figs. 9A to 9C are views for explaining positional relationships between the sensor 45 and the single slit 13A and eight slits 13B1 to 13B8 formed in the storing unit 13. As shown in Figs. 9A to 9C, the storing unit 13 is provided with a slit 13A', disposed obliquely above the slit 13A in



the drawings, having a size identical to that of the slit 13A. As the slit 13A is detected by a sensor 45a (corresponding to the sensor 45 explained in the foregoing), and as the slit 13A' is detected by a separately disposed sensor 45b, both of phototransistors 45_a, 45_b in sensors 45a, 45b receive optical signals from the LED 45_a, 45_b respectively, whereby it is recognized that the storing unit 13 is located at the home position (see Fig. 9A).

When a coin is to be stored into the rack No. 1, the motor M is rotated in its normal direction (represented by arrow), such that the coin is stored at the point of time when only the sensor 45a detects the slit 13B1 (Fig. 9B). Similarly, when a coin is to be stored into the rack No. 8, the motor M is rotated in its normal direction, and the coin is stored at the point of time when only the sensor 45a detects the slit 13B8 (Fig. 9C).

When a coin is to be stored into the rack No. 7 after a coin has been stored into the rack No. 8, the motor M is rotated in reverse.

Thus, when an inserted coin is to be stored into a rack, the motor M is rotated in the normal or reverse direction, its corresponding slit is detected by the sensor 45a so that the position of the desired rack aligns with the exit of the storing track 12, and then the coin is stored into the rack. When a coin stored in a rack is to be accepted or returned, the motor M is similarly rotated in the normal



or reverse direction so that the position of the desired rack aligns with the inlet of the accepting and returning track 17, and then the coin is accepted or returned. Accurate positioning of the rack is determined according to an output of the encoder E that detects the number of revolutions of the motor M.

Fig. 1 is a block diagram showing the configuration of control systems in a public telephone set of a central office power supply type employing the coin accepting apparatus 1 in accordance with the present invention.

In this drawing, 21 is a GS relay driving circuit for closing a DC loop of telephone lines (simply referred to as "lines" hereinafter) L1, L2; 22 is a safe pullout detecting circuit for detecting the pullout of a safe in which coins are accepted; 23 is an off-hook detecting circuit; 24 is a reset circuit 24; and 25 is an incoming call detecting circuit. Also, 26 is a charging signal receiving circuit for receiving a charging signal arriving at the lines L1, L2; 27 is a reversing and line-disconnection detecting circuit for detecting the reversing and disconnection of the lines L1, L2; 29 is a modem for transmitting and receiving various kinds of information for the telephone set; and 30 is a power circuit for inputting a central office's power and supplying it to each section of the telephone set.

Further, 31 is a forced release circuit for forcibly



disconnecting the loop of the lines L1, L2 upon shortage of the charge for a call or the like; 32 is a mute circuit for reducing the volume of voice signal or the like; 33 is a talking circuit; 34 is an MF signal transmitting circuit for transmitting dial signals and various kinds of tone signals to the lines L1, L2; 35 is an MF signal receiving circuit for receiving MF signals arriving from the lines L1, L2; 36 is a DT signal receiving circuit for receiving dial tone (DT) arriving at the lines L1, L2; 37 is a theft detecting circuit for detecting the theft of a handset comprising a transmitter T and a receiver R.

Also, 40 is a control circuit comprising a CPU or the like which controls this telephone set as a whole. Connected to the control circuit 40 are the sections mentioned above and the sensors explained with reference to Figs. 8A to 8C and 9A to 9C, as well as driving circuits 50, 52, and 53 for driving the respective magnets and a driving circuit 51 for driving the motor M. In addition, the encoder E for detecting the state of rotation of the motor M, an LCD (display) 55, a keyboard 56 such as dial keys, and the memory 57 are connected to the control circuit 40.

In the following, operations of the control circuit 40 of thus configured public telephone set will be explained with reference to flow charts of Figs. 2 to 7. First, the flow chart of Fig. 2 will be explained.



When the public telephone set is taken off the hook in order to make a call, a hook switch HS in Fig. 1 is closed, whereby the DC loop of the lines L1, L2 is closed. At the same time, the off-hook detecting circuit 23 is actuated so as to drive the GS relay driving circuit 21, whereby the contacts of the GS relay are closed (step S1). Subsequently, external electric power is supplied to the power circuit 30 by way of the closed lines L1, L2, an electric current is outputted to each of the sections such as the control circuit 40, whereby the control circuit 40 is powered on (step S2).

When the control circuit 40 is powered on and actuated, it initially controls the storing motor driving circuit 51 so as to rotate the motor M and checks whether the racks in the coin storing unit 13 are moved correctly or not (step S3). If the rack operation is correctly performed here, then it is detected and judged by means of the rack position sensor 45 whether or not the rack H shown in Figs. 13A and 13B is located at the home position where it aligns with the exit of the storing track 12 (step S4).

If the rack H is located at the home position here, then a DT (dial tone) detecting timer is started (step S5). After it is confirmed that the timer does not run out (step S6), the respective contacts of the R1 and R2 relays are switched over toward the mute circuit 32, and it is judged whether or not the DT arriving from the lines L1, L2 is



detected by way of the DT signal receiving circuit 36 (step S7).

Here, a predetermined area of the memory 57 can memorize whether or not coins are stored in the respective racks. When the DT is detected, the control circuit refers to this area of the memory 57 so as to confirm that coins are not stored in all the racks Nos. 1 to 8 in the coin storing unit 13 (step S8). Then, empty racks are checked (step S9). If an empty rack faces to the exit of the storing track 12 (case with "Y" in step S10), then the flow shifts to step S31 in Fig. 3.

If it is judged that the empty rack does not face to the exit of the storing track 12, by contrast, then it is judged whether the motor M should be rotated in the normal or reverse direction to face the empty rack to the exit of the storing track 12 (step S11). If it is judged that the motor M should be rotated normally, an operation for rotating the motor M in the normal direction is performed (step S12). If it is judged that the motor M should be rotated in reverse, then an operation for rotating the motor M in the reverse direction is performed (step S13). Thereafter, it is judged whether or not a timer started at the motor driving operation (in the normal or reverse direction) runs out (step S14). If a predetermined empty rack has been moved to the exit of the storing track 12 before the timer runs out, information indicative of a correct rack operation is set



in the memory 57 (step S15), and then the flow shifts to step S31 in Fig. 3.

If the predetermined empty rack cannot be moved before the timer runs out (case with "Y" in step S14), then, by way of "N" in step S20, the LCD 55 indicates at step S22 that use of the telephone set is prohibited, and an on-hook state is waited for (step S17). Then, when an on-hook state is detected by way of the off-hook detecting circuit 23, the forced release circuit 31 is controlled so as to effect a line-breaking operation for disconnecting the DC loop of the lines L1, L2 for one second (step S18). Thereafter, the GS relay driving circuit 21 is driven to restore the GS relay (step S19), whereby the telephone set is powered down.

An error processing operation beginning at step S22 is similarly effected in the case where the judgment at step S3 is "N" when the racks are not moved correctly since the operation for moving them is effected while the telephone set is powered on. Also, when the judgment at step S6 becomes "Y" since the DT is not detected before the DT detecting timer runs out, the LCD 55 indicates an instruction for on-hooking (step S16), and then the error processing operation at step S17 and thereafter is executed. Further, when the judgment at step S4 becomes "N" since the racks cannot be moved to the home position, the flow shifts to an abnormal processing operation beginning at step S101 in



Fig. 6 which will be explained later. Here, when the judgment at step S8 becomes "Y" as the storage of coin is detected in all the racks after the DT is detected, it is judged that the fee necessary for a call is stored in the storing unit 13, and the flow shifts to step S42 in Fig. 3 to allow dialing.

In the processing beginning at step S31 in Fig. 3, first, based on the information memorized in the memory 57, if the storing unit 13 contains coins to be accepted or returned, they are accepted or returned as well. Namely, it is judged whether or not the rack storing the coin to be accepted is located at the position for accepting the coin (i.e., position of the inlet of the accepting and returning track 17; step S31). If the judgment is "Y" at this step, executed is a coin accepting operation in which the switching lever 52B is switched over so as to guide the coin toward the accepting track 16 and then the storing gate 53B of the rack is opened such that the stored coin is accepted in the safe by way of the accepting and returning track 17 and the accepting track 16 (step S32). Then, it is checked whether or not there is an output from the acceptance sensor 46 so as to judge whether the coin is correctly accepted in the safe or not (step S35). If it is correctly accepted, then the corresponding storage information in the memory 57 is cleared (step S36).

Also, if the rack storing the coin to be returned is



currently located at the position of the inlet of the accepting and returning track 17 (case with "Y" in step S33), executed is a coin returning operation in which the switching lever 52B is switched over so as to guide the coin toward the returning track 15B and then the storing gate 53B of the rack is opened such that the stored coin is returned therefrom by way of the accepting and returning track 17 and the returning track 15A (step S34). Then, it is checked whether or not there is an output from the return sensor 47 so as to judge whether the coin is correctly returned or not (step S35). If it is correctly returned, then the corresponding storage information in the memory 57 is cleared (step S36). Here, immediately after on-hooking, since no coins to be accepted or returned exist in the storing unit 13, the flow directly shifts to step S37.

At step S37, it is judged whether an empty rack aligns with the storing position (position of the exit of the storing track 12) or not. If it does not align with the storing position here, the flow shifts to step S8 in Fig. 2, and then the motor M is rotated normally or in reverse in the processing beginning at step S11 to move the empty rack and make it align with the storing position.

When the empty rack coincides with the storing position, coins are allowed to be inserted (step S38), and credit (amount of stored coins) and tariff (charge for a call per unit time) are compared with each other in terms



of magnitude (step S39). Here, initially, since the amount of coins stored in the coin storing unit 13 is zero, the LCD 55 indicates thereon that coins are allowed to be inserted (step S40).

5 Then, after the power is supplied to the insertion sensor 41, diameter sensor 42, and discriminating sensor 43, it is detected and judged by way of the insertion sensor 41 whether a coin is inserted or not (step S41). If the judgment is "Y" at this step, then the flow proceeds to step
10 S51 in Fig. 4.

 At step S51 in Fig. 4, the inserted coin is discriminated by means of the diameter sensor 42 and discriminating sensor 43. When the coin is judged to be a current coin (case with "Y" in step S52), a coin
15 discrimination terminating operation (step S53) for terminating the supply of power to each of the above-mentioned sensors is effected, and the SM magnet (selecting magnet) 50A is driven (step S54) so as to switch over the selecting lever 50B toward the storing track 12, thereby
20 guiding the inserted coin to the storing track 12. Here, the power is supplied to the passage sensors 44A, 44B.

 Then, a storage timer is started (step S55), and it is judged whether or not the inserted coin passes through the positions of the passage sensors 44A, 44B in the storing
25 track 12 before this timer runs out (steps S57 and S60). Here, if the inserted coin passes through the passage sensor



44A before the timer runs out, then the SM magnet 50A is restored (step S58). If the inserted coin further passes through the passage sensor 44B, it is judged that this coin is stored in the empty rack of the coin storing unit 13, and the amount of thus stored coin is added to and memorized in the memory 57 (step S61), while this amount is indicated on the LCD 55 (step S62). Then, after coin storage information is set into the memory 57 (step S63), the flow shifts to step S8 in Fig. 2, and the movement of the next empty rack to the storing position or the like is performed in the processing operation beginning at step S8.

Thus, inserted coins are successively stored into empty racks. Here, in the case where a coin does not pass through the passage sensor 44A before the storage timer runs out, the SM magnet is restored at step S64 in Fig. 4, and then the flow returns to step S37 in Fig. 3. Also, if an inserted coin is not a current coin, after the coin discrimination terminating operation is performed at step S65, the flow similarly returns to step S37 in Fig. 3.

When the amount of the coins thus stored in the empty racks exceeds the charge for a call per unit time so as to make the judgment "Y" at step S39 in Fig. 3, the LCD 55 indicates that dialing is allowable (step S42). Here, when the operation of the keyboard 56 is inputted and this operational information indicates a dialing input (case with "Y" in step S43), after it is confirmed at step S44



that a call is not in progress, the LCD 55 indicates the dial number operated (step S45), and the dialing signal is transmitted from the MF signal transmitting circuit 34 toward the lines L1, L2 (step S46).

5 As thus operated dials are successively transmitted to lines L1, L2 as dialing signals, the addressed party is called. When a response of the addressed party is detected by the reversing and line-disconnection detecting circuit 27, it is judged "Y" at step S44 to indicate that a call
10 in progress.

 When a charging signal which arrives at the lines L1, L2 and is received by the charging signal receiving circuit 26 or a charging signal based on an autonomous charging system is inputted so as to make the judgment "Y" at step
15 S47, the flow shifts to a charging processing operation beginning at step S71 in Fig. 5. Also, when an on-hook operation is effected during a call (step S48), the flow shifts to a clearing processing operation beginning at step S103 in Fig. 6.

20 Here, the charging processing operation in Fig. 5 is executed as follows. Namely, first, the charge for a call per unit time is subtracted from the amount of stored coins and memorized into the memory 57, while the result thereof is indicated on the LCD 55 (steps S71 and S72). Then,
25 executed is an accepted coin selecting operation in which the position of the rack storing the coin to be accepted



is selected on the basis of the information memorized in the memory 57 (step S73). Then, a coin accepting request which is a result of selection in this coin selecting operation is set (step S74).

5 Subsequently, it is judged whether the coin stored in the rack having the accepting request can be accepted or not (step S75).

 Here, if the coin stored in the rack having the accepting request is judged to be acceptable, then it is
10 judged whether the position of this rack coincides with the position of the inlet of the accepting and returning track 17 (accepting position) or not (step S76). If it does, then the processing proceeds to step S82.

 If the rack does not coincide with the accepting
15 position, after it is judged at step S77 whether the motor M should be rotated in the normal or reverse direction, a motor normal rotating operation (step S78) or motor reverse rotating operation (step S79) is effected so as to move the rack to its desired accepting position. If the rack moves
20 to the desired accepting position before the timer which has started in the motor normal or reverse rotating operation runs out, the flow shifts to step S82 by way of "N" at step S80 and "Y" at step S76. Here, if the rack does not move
25 to the desired accepting position before the timer started in the motor normal or reverse rotating operation runs out, thereby making the judgment "Y" at step S80; the lines are



disconnected for one second (step S81), and then the flow proceeds to the error processing operation beginning at step S20 in Fig. 2.

At step S82, the switching lever 52B is switched over so as to guide the coin toward the accepting track 16. Subsequently, the storing gate of the rack is opened at step S83. Then, the coin stored in this rack passes through the accepting and returning track 17 and the accepting track 16 so as to be guided to and accepted in the safe. At steps S84 and S88, it is judged by way of the acceptance sensor 46 whether or not the acceptance of the coin is detected and it is judged by way of the return sensor 47 whether or not the returning of the coin is detected, respectively. Here, if the acceptance of the coin is detected, thereby making the judgment "Y" at step S84, it is judged that the stored coin is correctly accepted. Consequently, an addition to the coin amount information in the safe and its memorization into the memory 57 (step S85), closing of the storing gate (step S86), and clearing of the stored information (step S87) are effected. Thereafter, the flow returns to step S75 in order to accept the next coin.

Here, in the case where the coin stored in the rack is attempted to be accepted in the safe but is detected by the return sensor 47, thereby making the judgment "Y" at step S88; the storing gate is immediately closed (step S89), the storage information is cleared (step S90), the lines



are disconnected for one second (step S91), and then the flow shifts to the abnormal processing operation beginning at step S101 in Fig. 6.

First, in the abnormal processing operation of Fig. 6, an instruction for on-hooking is indicated on the LCD 55 (step S101). Then, it is judged by means of the off-hook detecting circuit 23 whether an on-hooking operation is effected or not. If on-hooking is detected, then the flow proceeds to step S103. In the case where an on-hooking operation is effected during a call (case with "Y" in step S48 in Fig. 3), the flow shifts to step S103 as well.

At step S103, "THANK YOU" is initially indicated on the LCD 55. Subsequently, with reference to the information memorized in the memory 57, it is judged whether or not each rack of the coin storing unit 13 stores a coin which has not been accepted or returned yet (step S104). If it is judged that such a coin is stored here, then the flow proceeds to step S106.

If neither the coin to be accepted nor the coin to be returned is stored, after the home position where the position of the rack H coincides with the exit of the storing track 12 is confirmed (step S105), the flow shifts to step S18 in Fig. 2, so that the GS relay is restored and so on, thereby terminating the processing. If the rack H is not located at the home position, then the processing proceeds to step S106 so as to return the rack H to the home position.

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At step S106, the loop of the lines L1, L2 is disconnected for one second. Subsequently, when there exists a coin to be accepted or returned, an accepting/returning schedule is determined on the basis of the state of memorization in the memory 57 (step S107).

Here, when the rack storing the first coin to be accepted or returned according to this schedule is located at the inlet position of the accepting and returning track 17, thereby making the judgment "Y" at step S108, the flow proceeds to the processing operation beginning at step S113. If the position of this rack does not align with the accepting and returning track 17, then the motor M is rotated normally or in reverse at the processing of steps S109 to S112 so as to move the rack to the inlet position of the accepting and returning track 17. Here, as the rack corresponding to the first coin to be accepted or returned, the rack located farthest from the home position is selected.

At steps S113 and S115, it is judged whether the stored coin is a coin to be accepted or not and whether the stored coin is a coin to be returned or not, respectively. If the coin is to be accepted, an operation for accepting the coin is effected (step S114). If the coin is to be returned, an operation for returning the coin is effected (step S116). Then, after the storage information memorized on the memory 57 in conjunction with the corresponding rack is cleared (step S117), it is judged whether the position of the rack



H coincides with the home position or not (step S118). Here, in the case where neither the coin to be accepted nor the coin to be returned exists in each rack, the flow immediately shifts to step S118.

5 Here, when the rack H is located at the home position, the flow shifts to step S18 in Fig. 2, where the GS relay is restored and so on, thereby terminating the processing. When the rack H is not located at the home position, by contrast, an operation for rotating the motor M in reverse
10 is effected so as to move the rack toward the home position by one rack (step S119). Then, after it is confirmed at step S120 that a timer started in the processing for rotating the motor in reverse does not run out, the coin accepting operation (step S114) or the coin returning operation (step
15 S116) is executed by way of step S113 or S115 until the rack H reaches the home position.

 Here, if the timer runs out before the rack reaches its desired position in the operation for rotating the motor M normally or in reverse, thereby making the judgment "Y"
20 at step S112 or S120; then the flow returns to step S20 in Fig. 2 so as to effect the error processing operation. In this error processing operation, it is judged whether or not the number of errors reaches 5 (step S20). If it reaches 5, a rack operation NG indicating that the rack operation
25 is not good is set in the memory 57 (step S21). Thereafter, the LCD 55 indicates that use of the telephone set is



prohibited (step S22), and the restoration of the GS relay (step S19) and so forth are effected, thereby terminating the processing.

5. Meanwhile, when the power source voltage decreases in this apparatus, the capability of the rack position sensor (photosensor) 45 for detecting whether the position of the rack H is located at the home position or not deteriorates, whereby the position recognized by the control circuit 40 may fluctuate.

10 Figs. 10A and 10B show states of such detecting capability of the photosensor 45. Figs. 10A shows the state where the power source voltage of the apparatus is at a normal level, whereas Fig. 10B shows the state where the power source voltage of the apparatus has decreased.

15 Namely, as shown in Fig. 10A, when the power source voltage of the apparatus is normal or when the sensor 45 is not deteriorated, an LED 45,a for supplying an optical signal to a phototransistor 45,a has a high luminance of emission. Accordingly, the emission signal of the LED 45,a
20 is transmitted toward its opposing phototransistor 45,a through a small portion of the slit 13A, whereby the phototransistor 45,a detects an optical signal.

By contrast, as shown in Fig. 10B, when the power source voltage of the apparatus is low or when the sensor
25 45 is deteriorated, the LED 45,a for supplying an optical signal to the phototransistor 45,a has a low luminance of



emission. Accordingly, the emission signal of the LED 45,a cannot be transmitted toward its opposing phototransistor 45,a unless passing through a major part of the slit 13A, so as to be detected by the phototransistor 45,a.

5 Thus, depending on whether the detecting capability of the sensor 45a is high or low, the position of the slit 13A with respect to the home position, i.e., the position of the rack H may fluctuate. The maximum value of this positional fluctuation corresponds to the diameter of the
10 sensor 45a.

 Therefore, it is desirable that the home position of the apparatus be accurately set without being influenced by the detecting capability of the sensor 45a.

 Fig. 7 is a flowchart showing an operation of the
15 control circuit 40 for setting the home position. Operations of major parts of the apparatus will be explained with reference to this flowchart.

 The flowchart of Fig. 7 shows a detailed operation of the home position judging process at step S4 in the flowchart
20 of Fig. 2. Operations of major parts in the present invention will be explained with reference to the flowchart of Fig. 7 and the explanatory views of Figs. 11A to 11C.

 When on-hooking is effected in the public telephone set, as mentioned above, after the GS relay operation at
25 step S1 in Fig. 2, power supply to the apparatus at step S2, and normal rack operation at step S3, power is supplied



to both of the sensors 45a, 45b at step S401 in Fig. 7 so as to activate them (both LED 45₁a, 45₁b are turned on), and then a standby state is kept for 200 μ sec (step S402).

5 After being waited for 200 μ sec, it is judged whether each of the sensors 45a, 45b detected or not (i.e., whether the output of each of the phototransistors 45₁a, 45₁b receiving the light emitted from their corresponding LEDs 45₂a, 45₂b is on or not; steps S403 and S404). Here, if the any one of the sensors cannot detect optical signal, then
10 it is recognized as a home position error, whereby each of the sensors is deactivated (each LED 45₁a, 45₁b is turned off) (step S405), and the flow shifts to the processing operation beginning at step S101 in Fig. 6, whereby an on-hooking instruction is displayed so as to cause on-
15 hooking. Subsequently, when on-hooking is detected, the motor M is controlled and rotated so as to move the rack H to the home position, and then the lines are disconnected. Thereafter, when on-hooking is detected again, the processing operation beginning at step S401 in Fig. 7 is
20 started by way of steps S1, S2, and S3 in Fig. 2.

By contrast, when both of the sensors 45a, 45b detect optical signal after being waited for 200 μ sec, each sensor is deactivated and is waited for 10 msec, in view of the fact that the apparatus is operated intermittently at
25 intervals of 10 msec for saving its power consumption. Then, after being waited for 10 msec, a counter CNT is set to zero



when, for example, the positional relationship between the sensor 45a and the slit 13A coincides with that shown in Fig. 11A, and the power is supplied to only the sensor 45a again and activate it (steps 407 and S408). Subsequently, addition is effected in the counter CNT till the sensor 45a (i.e., phototransistor 45_a) can detect the optical signal (steps S409 and S410). Measured here is the sensor response time from when the LED 45_a constituting the sensor 45a outputs an optical signal till its opposing phototransistor 45_a detects this signal. The value of the counter CNT is the cumulative execution time of an instruction word with which the control circuit (i.e., CPU) 40 repeatedly executes the respective processing operations of steps S409 and S410.

When the sensor 45a detects the optical signal, the value of the counter CNT is multiplied by a coefficient X, and the resulting value is stored in a loop counter LPC (step S411). This value of the loop counter LPC is a value corresponding to the time by which the control circuit 40 repeatedly executes the respective processing operations of steps S417 to S420 which will be explained later.

Subsequently, after the sensor 45a is deactivated, starting the motor M to rotate in the normal direction (steps S412 and S413). As a result, the slit 13A of the storing unit 13 moves rightward as arrow in Fig. 11A. Here, the sensor 45a has been fixed and does not move. Thereafter,



a standby state is kept for 10 msec (step S414). The motor keeps its normal rotation even during this standby period, whereby the storing unit 13 continuously moves rightward in Fig. 11A.

5 After being waited for 10 msec, the value of the loop counter LPC is set into the counter CNT (step S415). Then, the sensor 45a is activated (step S416). Subsequently, subtraction is effected in the counter CNT till the value therein becomes zero (step S417). When the value of the
10 counter CNT becomes zero, the sensor 45a is deactivated (S419), and then it is immediately judged whether the sensor 45a (i.e., the phototransistor 45₁a) detected signal or not (step S420). Here, when the sensor 45a is simply activated at step S419, the output of the phototransistor 45₁a would
15 not turn off at the time of step S420 as long as the optical signal from its opposing LED 45₁a reaches there through the slit 13A.

 Namely, when the slit 13A moves rightward in Fig. 11A due to the normal rotation of the motor M, such that the
20 positional relationship between the sensor 45a and the slit 13A coincides with that shown in Fig. 11B, the output of the phototransistor 45₁a would not immediately turn off even when the sensor 45a is deactivated (LED 45₁a stops emitting light signal), whereby it is judged "Y" at step S420.

25 In this case, the flow returns to step S414, and after being waited for 10 msec, the processing operation beginning



at step S415 is executed similarly.

While the slit 13A keeps on moving due to the normal rotation of the motor M, the processing through steps S414 to S420 is repeatedly executed at intervals of 10 msec. When
5 the positional relationship between the sensor 45a and the slit 13A coincides with that shown in Fig. 11C as a consequence, the optical signal from the LED 45_a fails to reach the phototransistor 45_a, whereby the output of the latter turns off. When the output of the phototransistor
10 45_a is turned off, so that it is judged "N" at step S420, the motor M is stopped (step S421). This position is set as the home position, and then the flow shifts to the processing operation beginning at step S5 in Fig. 2.

Thus, upon starting the apparatus, the sensor 45a is
15 activated for detecting a home position, so as to determine a response time required for the optical signal from the LED 45_a to reach the phototransistor 45_a and thereby turn on the latter; and the slit 13A for detecting a home position of the storing unit 13, detected by the sensor 45a, is moved
20 so as to determine as a home position, in consideration to the response time, the position where the sensor 45a starts failing to detect the slit 13A. Accordingly, even when a characteristic of the sensor 45a has changed due to a decrease in the power source voltage applied to the sensor
25 45a, deterioration in the sensor 45a, or the like, an appropriate home position for the apparatus can be set



according to this characteristic. Thereafter, the amount of movement of each rack in the storing unit 13 can be determined accurately according to the number of revolutions of the motor M. Also, since each rack or the like is attached to its correct position, each rack in the storing unit 13 can be accurately positioned when the revolution number output from the encoder E for detecting the motor M is counted from thus determined home position thereafter, whereby the exit position of the storing track 12 and the inlet position of the rack of the storing unit 13 can correctly align with each other. As a result, inserted current coins can be accurately stored in the storing unit 13.

Though the foregoing explains an example in which the coin storing apparatus in accordance with the present invention is employed in a public telephone set, this coin storing apparatus is similarly applicable to various kinds of apparatus handling coins, such as vending machines, for example, while yielding similar effects.

In accordance with the present invention, as explained in the foregoing, even when a characteristic of the sensor has changed due to a decrease in the power source voltage applied to the sensor, deterioration of the sensor, or the like, an appropriate home position for the apparatus can be set according to this characteristic. Accordingly, each rack in the storing unit can be accurately positioned when



the number of revolutions of the motor is counted from thus determined home position thereafter. Consequently, as the exit position of the storing track and the inlet position of the rack of the storing unit can correctly align with each other, inserted current coins can be accurately stored in the storing unit.

According to the present invention, the response time inherent in the apparatus can be detected accurately. Further, the home position inherent in the apparatus can be correctly set by a simple method. And the sensor response time can be detected without using any separate means such as timer.

From the invention thus described, it will be obvious that the invention may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications as would be obvious to one skilled in the art are intended for inclusion within the scope of the following claims.

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WHAT IS CLAIMED IS:

1. A coin storing apparatus comprising a coin track unit through which an inserted coin rolls; a coin storing unit having a plurality of racks integrally formed together each adapted to store one coin; a motor for moving said coin
5 storing unit; a registration member to be detected which is disposed in said coin storing unit for detecting a reference position; and a sensor, constituted by a light-emitting device and a light-receiving device, for
10 detecting a position of said registration member, said racks being positioned with respect to said coin track unit according to an output of said sensor, so as to store the coin into a vacant rack of said coin storing unit;

said apparatus further comprising detection means for
15 detecting a response time of said sensor, and reference position setting means for setting a reference position of said coin storing unit according to the position of the registration member detecting by an output of said sensor in consideration of response time detected by said detection
20 means.

2. A coin storing apparatus according to claim 1, wherein said detection means detects, as said response time, a period from a point of time when the light-emitting device is turned to be on till the light-receiving device detects
25 an optical signal from said light-emitting device.

3. A coin storing apparatus according to claim 1,





wherein, when said reference position setting means controls said motor to move said coin storing unit in predetermined direction and said light-emitting device to emit optical signal trains, and set a position of said registration member, which said light-receiving device is not detected said optical signal in a period of said response time, to said reference position.

4. A coin storing apparatus according to claim 1, further comprising a CPU for controlling said coin storing apparatus, wherein said response time is set as a cumulative execution instruction time of said CPU from a point of time when said CPU executes an instruction for emitting an optical signal to said light-emitting device till said optical signal is received by said light-receiving device.

5. The public telephone comprising;
a main housing which has a coin inserting slot and a coin returning slot;
a coin processing apparatus for selecting a current coin from coins inserted therein;
said coin storing apparatus according to claim 1;
a safe for keeping accepted coins; and
communication means.

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