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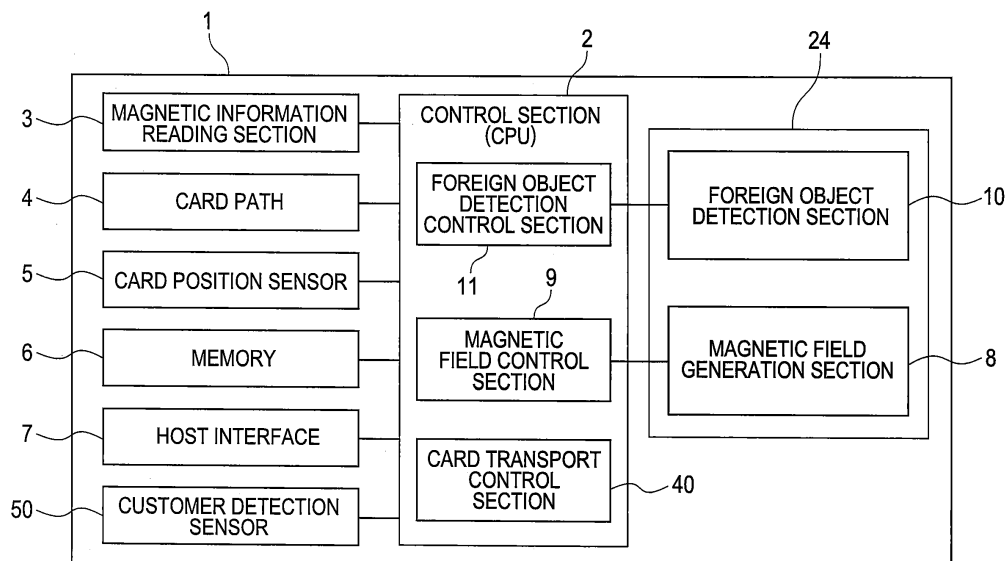
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(54) **Magnetic reader**

(57) A magnetic reader which does not allow magnetic information recorded on a magnetic recording medium to be stolen by an illicit magnetic reader is provided. The magnetic reader includes: a foreign object detection section 10 which determines whether there is a foreign object near a card slot 22 through which a magnetic card 21 is inserted or taken out; a magnetic field generation section 8 which generates a disturbing magnetic field in

a vicinity of the card slot 21 for disturbing a magnetic field radiated from a foreign object if present near the card slot 22; and a control section 9, 11 which determines whether the foreign object detection section 10 has detected a foreign object and which, when the foreign object detection section 10 determines to have detected a foreign object, changes the strength of the disturbing magnetic field generated by the magnetic field generation section 8.

FIG. 1



Description

FIELD OF THE INVENTION

[0001] The present invention relates to a magnetic reader which is used to read magnetic information recorded on a magnetic information recording medium and which has a function for preventing such magnetic information from being read illicitly.

BACKGROUND OF THE INVENTION

[0002] Skimming is a crime in which magnetic information recorded on a magnetic stripe is stolen using an illicit magnetic reader having a magnetic head. Such an illicit magnetic reader is, in many cases, installed over an insertion slot, through which a magnetic information recording medium is inserted, of a legitimate magnetic reader included in a device for processing cash transactions, for example, a cash dispenser (hereinafter referred to as a "CD") or an automated teller machine (hereinafter referred to as an "ATM") or included in a transaction processing terminal which performs processing using a medium such as a magnetic card or passbook carrying magnetic information recorded thereon. Techniques disclosed as measures against skimming include (1) measures to detect an illicit magnetic reader installed, (2) measures to make information stealing by an illicit magnetic reader difficult by having a magnetic information recording medium pulled in or discharged by intermittent driving, and (3) measures to use a magnetic field for obstructing information stealing by an illicit magnetic reader.

[0003] Among such techniques is a magnetic card transaction device designed to generate a magnetic field in space outside a card slot through which a magnetic card is inserted and discharged so as to obstruct information stealing by an illicit magnetic reader (see Unexamined Patent Publication No. 2001-67524). The magnetic card transaction device has magnetic field generation means which can generate a disturbing magnetic field, so that, even if an illicit magnetic head is attached to the outside of its card slot, the information recorded on a magnetic card being inserted into or removed from the magnetic card transaction device can be prevented from being read using the illicit magnetic head.

[0004] Another magnetic reader designed to obstruct attempted stealing of magnetic information in front of its slot for inserting a magnetic information recording medium has a loop antenna installed around the slot (see Unexamined Patent Publication No. 2005-266999). In addition to the loop antenna that is installed in a manner to surround the magnetic information recording medium being inserted into or removed from the magnetic reader, the magnetic reader has an oscillator used to cause the loop antenna to generate a magnetic field, and a medium detector for detecting a magnetic information recording medium inserted through its medium insertion slot. When a magnetic information recording medium is detected by

the medium detector, the oscillator causes the loop antenna to generate a magnetic field to prevent the magnetic information recorded on the magnetic information recording medium from being read by an illicit magnetic reader installed in front of the medium insertion slot.

SUMMARY OF THE INVENTION

[0005] In the magnetic card transaction device disclosed in Unexamined Patent Publication No. 2001-67524, a magnetic field generation section generates a magnetic field in a region outside the card slot where the magnetic stripe of a magnetic card passes, but the magnetic field that can be generated is not concretely described. In addition, the magnetic card transaction device poses a problem that, if an illicit magnetic reader is installed in a manner to block the magnetic field radiated from the magnetic field generation section (for example, using a magnetic plate), reading of magnetic information by the illicit magnetic reader cannot be prevented.

[0006] Also, as shown in FIG. 11, the magnetic field generation section generates a magnetic field when a magnetic information recording medium is inserted into and discharged from the magnetic card transaction device. Therefore, the magnetic information recorded on a magnetic information recording medium can be read by the illicit magnetic reader during the time (marked A in FIG. 11) between when the medium is inserted through the medium insertion slot and when the insertion of the medium is detected and also during the time (marked B in FIG. 11) between when the medium is discharged through the medium insertion slot and when the discharged medium is removed by the user.

[0007] In the magnetic reader disclosed in Unexamined Patent Publication No. 2005-266999, magnetic fields of plural frequencies are generated using a loop antenna installed to surround the card slot of the magnetic reader as a magnetic field generation section. In this case, too, like in the case of the above magnetic card transaction device, the magnetic information recorded on the card used in the magnetic reader can be read by an illicit magnetic reader installed in a manner to block magnetic fields.

[0008] An object of the present invention is to provide a magnetic reader which prevents magnetic information recorded on a magnetic recording medium from being stolen by an illicit magnetic reader even if the illicit magnetic reader is installed in a manner to block magnetic fields.

[0009] To achieve the above object, the magnetic reader according to the present invention includes: a foreign object detection section which determines whether there is a foreign object near a card slot through which a magnetic card is inserted or taken out; a magnetic field generation section which generates a disturbing magnetic field in a vicinity of the card slot for disturbing a magnetic field radiated from a foreign object if present near the

card slot; and a control section which determines whether the foreign object detection section has detected a foreign object and which, when the foreign object detection section determines to have detected a foreign object, changes the strength of the disturbing magnetic field generated by the magnetic field generation section.

[0010] The present invention can provide a magnetic reader which prevents the magnetic information recorded on a magnetic recording medium from being stolen by an illicit magnetic reader even if the illicit magnetic reader is installed in a manner to block magnetic fields.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

FIG. 1 is a block diagram showing the configuration of a main part of a magnetic reader according to an embodiment of the present invention;

FIGS. 2A to 2C schematically show the magnetic reader of the present embodiment; FIG. 2A showing an internal structure of the magnetic reader; FIG. 2B showing the positional relationship between a card slot and a core; and FIG. 2C showing an alternative configuration in which two loop antennas are disposed above and below the card slot;

FIGS. 3A and 3B are flowcharts of processing performed by the magnetic reader of the present embodiment; FIG. 3A showing an initial procedure performed after the magnetic reader is powered on; and FIG. 3B showing a foreign object detection procedure;

FIG. 4 is a flowchart of a processing procedure performed by the magnetic reader of the present embodiment to take in and read a card;

FIG. 5 is a flowchart of a card returning procedure performed by the magnetic reader of the present embodiment;

FIG. 6 shows a manner in which a magnetic field generation section is caused to increase the current applied to a loop antenna so as to enlarge the magnetic field generated thereby;

FIG. 7 shows a manner in which, when a foreign object is detected by the foreign object detection section, the magnetic field control section changes the frequency of the drive current;

FIG. 8 is a block diagram showing the configuration of a main part of a magnetic reader including an ammeter;

FIG. 9 is a flowchart of a processing procedure performed, by a magnetic reader having no core, to take a card in and read the magnetic information recorded on the card;

FIGS. 10A and 10B are timing charts for magnetic field generation; FIG. 10A showing a timing chart for magnetic field generation in which a magnetic field is kept generated in front of the card slot by the magnetic field generation section; and FIG. 10B showing

a timing chart for magnetic field generation performed according to the flowchart shown in FIG. 9; and

FIG. 11 is a timing chart for magnetic field generation performed based on an existing technique.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0012] An embodiment of the magnetic reader will be described in detail with reference to FIGS. 1 to 11.

[0013] FIG. 1 is a block diagram showing the configuration of a main part of a magnetic reader 1 according to an embodiment. The magnetic reader 1 includes a control section (CPU) 2 for controlling operation of the main unit of the magnetic reader 1, a magnetic information reading section 3 for reading magnetic information recorded on a magnetic card inserted in the main unit, a card path 4 along which the card inserted in the main unit is transported, a card position sensor 5 for detecting the position of the card on the card path 4, a memory 6 for storing magnetic information read by the magnetic information reading section 3, a host interface 7 for connection with a higher-order device, a card slot unit 24 installed in a front portion of the main unit, a magnetic field generation section 8 installed in the card slot unit 24 to generate a magnetic field, a magnetic field control section 9 for controlling operation of the magnetic field generation section 8, a foreign object detection section 10 installed in the card slot unit 24 to detect a foreign object installed outside the magnetic reader 1, a foreign object detection control section 11 for controlling operation of the foreign object detection section 10, a card transport control section 40 for controlling the card transport, and a customer detection sensor 50 for detecting a user.

[0014] FIG. 2A is a schematic diagram showing an internal structure of the magnetic reader 1 of the present embodiment. In FIG. 2A, reference numeral 21 denotes a magnetic card (hereinafter referred to as a "card 21"). A card slot 22 through which the card 21 is inserted is formed in the front of the main unit of the magnetic reader 1. A card insertion sensor 23 for detecting the card 21 inserted into the card slot 22 is provided near the card slot 22. The card insertion sensor 23 is a pressure sensor and is disposed where it is pressed by the card 21 inserted into the card slot 22.

[0015] Pairs of transport rollers 25 to 28 which, holding the card 21, transport the card 21 are disposed along the direction of card transport. In the magnetic reader 1, the card path 4 is formed by the transport rollers 25 to 28. Each pair of the transport rollers 25 to 28 includes a drive roller to which the rotary force of a motor is transmitted and a driven roller which is caused to rotate by the drive roller. The transport rollers 25 to 28 are driven by the single motor (not shown).

[0016] The card transport control section 40 causes the card 21 to be taken into and discharged (for recovery by the user) from the magnetic reader 1 by controlling driving (direction and speed of rotation) and stopping of

the motor. The magnetic information reading section 3 has a magnetic head 29 for reading the magnetic information recorded on the magnetic stripe of the card 21 being transported along the card path 4 configured by the transport rollers 25 to 28. Sensors 30 to 33 for detecting the card 21 are arranged along the card path 4. The sensors 30 to 33 are spaced apart by a distance shorter than the length along the transport direction of the card 21. The sensors 30 to 33 are optical sensors each having a light emitting section and a light receiving section (neither is shown) which are disposed to oppose each other across the card path 4.

[0017] The sensor 30 is for detecting the card 21 when the card has come to be held by the transport rollers 25 that are, among the transport rollers 25 to 28, the closest to the card slot 22. The sensor 33 is for detecting the card 21 when the card being transported along the card path 4 has reached a card pause position (not shown) where it is temporarily kept. The sensors 31 and 32 are for detecting the position of the card 21 being transported along the card path 4. Thus, the card insertion sensor 23 and the sensors 30 to 33 make it possible to determine whether the card 21 has been inserted in the main unit of the magnetic reader 1 and where along the card path 4 the card 21 is positioned. The distance between the magnetic head 29 and the sensor 33 is a little longer than the length along the transport direction of the card 21. Therefore, when the card 21 reaches the card pause position, namely, when the leading edge of the card 21 comes to be detected by the sensor 33, the magnetic information recorded on the card 21 has been read by the magnetic information reading section 3.

[0018] A foreign object detector 36 is provided in front of the magnetic reader 1. If a foreign object is placed in front of the card slot 22, the foreign object detector 36 detects it and outputs a foreign object detection signal to the control section 2.

[0019] A core 34 is installed also in front of the magnetic reader 1 such that it surrounds, as shown in the left part of FIG. 2A, the card slot 22. A loop antenna 35 formed by winding a conductor into a single or multiple loops is disposed to surround the card slot 22 also as shown in the left part of FIG. 2A. The core 34 is made of a high magnetic permeability material such as ferrite. FIG. 2B shows the positional relationship between the card slot 22 and the core 34. As shown in FIG. 2B, the core 34 is formed to surround the card slot 22 and cover the rear side (the side toward the magnetic head 29 of the magnetic reader 1) of the loop antenna 35. The loop antenna 35 is disposed to surround the core 34. When a drive signal from the magnetic field control section 9 is applied to both ends of the loop antenna 35, the loop antenna 35 generates a magnetic field around the card slot 22. If an illicit magnetic reader is attached in front of the card slot 22, the magnetic field generated by the loop antenna 35 obstructs stealing by the illicit magnetic reader of the magnetic information recorded on the magnetic card 21.

[0020] The core 34 has, as shown in FIG. 2A, an L-

shaped section (or a laterally-reversed L-shaped section) so as to absorb the magnetic field radiated from the loop antenna 35 inwardly of the magnetic reader 1 and radiate the magnetic field toward the card slot 22. Thus, the core 34 inhibits the magnetic field radiated from the loop antenna 35 from affecting the inside of the magnetic reader 1. Namely, the card 21 inserted through the card slot 22 and transported along the card path 4 and the magnetic head 29 are not affected by the magnetic field radiated from the loop antenna 35, so that the magnetic head 29 can read the magnetic information recorded on the card 21 normally.

[0021] The core 34 shaped as described above can enlarge the magnetic field radiated toward the front side of the card slot 22. With the core 34 kept disposed as described above, a magnetic field can be kept generated in front of the card slot 22 as shown in FIG. 10A. Furthermore, since, as will be described later, the magnetic field radiated from the loop antenna 35 can be enlarged, the electric current made to flow through the loop antenna 35 can be reduced to save the electric power consumed by the main unit of the magnetic reader 1.

[0022] Even though the following description is based on the assumption that the loop antenna 35 is disposed to surround the core 34 as shown in FIG. 2A, an alternative configuration may be used in which two loop antennas 35a and 35b are disposed above and below the card slot 22 as shown in FIG. 2C or disposed in symmetrical positions on both sides of the card slot 22. In such cases where more than one loop antenna is used, providing a corresponding number of magnetic field generation sections 8 makes it possible to generate a larger magnetic field than possible using the single loop antenna 35 disposed to surround the core 34, so that information stealing by an illicit magnetic reader can be obstructed more effectively. Furthermore, when the configuration including plural magnetic field generation sections 8 as shown in FIG. 2C is used, the magnetic field control section 9 may cause the plural magnetic field generation sections 8 to generate magnetic fields of different frequencies. In this case, the energy loss caused by iron loss is smaller for magnetic fields of lower frequencies, so that lower-frequency magnetic fields can obstruct information stealing by an illicit magnetic reader more effectively.

[0023] Next, the operation of the magnetic reader 1 according to the present embodiment will be described. FIG. 3A is a flowchart of an initial processing procedure performed by the magnetic reader 1 after it is powered on. As shown, after the magnetic reader 1 is powered on, the magnetic field control section 9 of the magnetic reader 1 drives the magnetic field generation section 8 to cause a magnetic field to be generated around the card slot 22 (step S1), and the foreign object detection control section 11 of the magnetic reader 1 starts foreign object detection by driving the foreign object detector 36 (step S2).

[0024] FIG. 3B is a flowchart of a foreign object detection procedure. As shown in FIG. 3B, first in the foreign

object detection procedure, the foreign object detection control section 11 determines whether any foreign object has been detected by the foreign object detector 36 (step S31). When it is determined that the foreign object detector 36 has detected a foreign object (step S31 = Yes), the magnetic field control section 9 controls the magnetic field generation section 8 to cause the current applied to the loop antenna 35 to be increased, as shown in FIG. 6, so as to enlarge the magnetic field generated by the magnetic field generation section 8 (step S32). When, in step S31, it is determined that the foreign object detector 36 has detected no foreign object (step S31 = No), the foreign object detection control section 11 remains standing by.

[0025] Subsequently, the foreign object detection control section 11 determines whether any foreign object is no longer detected by the foreign object detector 36 (step S33). When it is determined that any foreign object is no longer detected by the foreign object detector 36 (step S33 = No), the magnetic field control section 9 controls the magnetic field generation section 8 to cause the increased current applied to the loop antenna 35 to be reduced to its original magnitude (step S34) and ends the procedure. When, in step S33, it is determined that the foreign object detector 36 is still in a state of having detected a foreign object (step S33 = Yes), the magnetic field control section 9 causes the increased current applied to the loop antenna 35 to be maintained. When step S34 is finished, the procedures shown in FIGS. 3A and 3B have been completed.

[0026] In the example shown in FIG. 6, when a foreign object is detected by the foreign object detector 36, the magnetic field generation section 8 increases the drive current to value P2 which is greater than value P1 applied to the loop antenna 35 with no foreign object detected by the foreign object detector 36. Subsequently, when no foreign object is detected by the foreign object detector 36, the magnetic field generation section 8 decreases the drive current to the original value P1. Enlarging the magnetic field upon detection of a foreign object by the foreign object detector 36 makes it possible to obstruct, even when an illicit magnetic reader (for example, a magnetic foreign object) is placed in front of the card slot 2, an illicit operation, such as skimming, attempted by the illicit magnetic reader targeting the magnetic reader 1.

[0027] FIG. 4 is a flowchart of a processing procedure performed by the magnetic reader 1 of the present embodiment to take in and read the card 21. The processing procedure will be described below based on the flowchart and on the assumption that, in the magnetic reader 1, the card insertion sensor 23 and the sensors 30 to 33 have not yet detected the card 21. It is also assumed that a drive current is applied to the loop antenna 35 by the magnetic field generation section 8 causing the loop antenna 35 to radiate a magnetic field.

[0028] As shown in FIG. 4, the control section 2 determines whether the card insertion sensor 23 has detected the card 21 (step S41). When it is determined that the

card insertion sensor 23 has detected the card 21 (step S41 = Yes), it is determined that the card 21 has been inserted and the card transport control section 40 causes the transport rollers 25 to 28 to start rotating (step S42). When, in step S41, it is determined that the card insertion sensor 23 has not detected the card 21 (step S41 = No), the control section 2 remains standing by.

[0029] In step S42 described above, the transport rollers 25 to 28 start rotating in the direction (hereinafter referred to as the "forward direction") for inwardly transporting the card 21 in the main unit of the magnetic reader 1. Subsequently, the card transport control section 40 causes the card 21 to be transported to the card pause position at a constant speed. While the card 21 is being transported toward the card pause position by the card transport control section 40, the magnetic head 29 comes into contact with the magnetic stripe of the card 21 allowing the magnetic information reading section 3 to read the magnetic information recorded on the card 21 (step S43).

[0030] The control section 2 determines whether the sensor 33 disposed adjacently to the transport rollers 28 has detected the card 21 (step S44). When it is determined that the sensor 33 has detected the card 21 (step S44 = Yes), the card 21 is determined to have reached the end of the card path 4 and the card transport control section 40 causes the transport rollers to stop rotation (step S45). When, in step S44, it is determined that the sensor 33 has not detected the card 21 (step S44 = No), the control section 2 remains standing by. When step S45 is finished, the procedure shown in FIG. 4 has been completed.

[0031] The operation to return the card 21 from the card pause position to the user (card recovery operation) will be described below. FIG. 5 is a flowchart of a processing procedure performed in the magnetic reader 1 of the present embodiment to return the card 21 to the user.

[0032] First, the card transport control section 40 causes the transport rollers 25 to 28 to start rotating (step S51) in the direction (hereinafter referred to as the "backward direction") for transporting the card 21 from the card pause position toward the card slot 22, and the card 21 is transported to the card slot 22 at a constant speed. During this time, too, the magnetic field control section 9 controls the magnetic field generation section 8 to keep a disturbing magnetic field radiated from the loop antenna 35. The control section 2 determines whether the sensor 30 disposed adjacently to the transport rollers 25 has detected the trailing edge of the card 21 (step S52).

[0033] When the control section 2 determines that the trailing edge of the card 21 has been detected by the sensor 30 (step S52 = Yes), the card transport control section 40 causes the transport rollers 25 to 28 being rotated in the backward direction to stop rotating (step S53). When, in step S52, the control section 2 determines that the sensor 30 has not detected the trailing edge of the card 21 (step S52 = No), the control section 2 remains standing by. Note that the leading edge or trailing edge

of the card 21 referred to in the present description is relative to the direction of card transport. Namely, the trailing edge of the card 21 being forwardly transported for card take-in operation or card reading operation corresponds to the leading edge of the card 21 being backwardly transported for card recovery operation.

[0034] The control section 2 determines whether the sensor 30 has changed from a state of having detected the card 21 to a state of no longer detecting the card 21 (step S53). When it is determined that the sensor 30 has changed to a state of no longer detecting the card 21, i.e. the trailing edge of the card 21 has been detected by the sensor 30 (step S53 = Yes), the card transport control section 40 stops the transport rollers 25 to 28 causing the card 21 being transported to be also stopped (step S54). When, in step S53, it is determined that the sensor 30 has not detected the trailing edge of the card 21 (step S53 = No), the control section 2 remains standing by. When the trailing edge of the card 21 has been detected by the sensor 30, the card 21 is held between the transport rollers 25 with its leading edge projecting from the card slot 22, so that the user can hold the leading edge of the card 21 and pull it out.

[0035] The control section 2 determines whether the card insertion sensor 23 has changed from a state of having detected the card 21 to a state of no longer detecting the card 21 (step S55). When it is determined that the card insertion sensor 23 has changed to a state of no longer detecting the card 21, i.e. the card 21 has been removed (step S55 = Yes), the control section 2 ends the processing. When, in step S55, it is determined that the card 21 has not been removed (step S55 = No), the control section 2 remains standing by. When step S55 is finished, the processing shown in FIG. 5 has been completed.

[0036] In the above embodiment, the magnetic field radiated by the loop antenna 35 is enlarged by increasing the electric current applied to the loop antenna 35. In an alternative method, the frequency of the drive current generated by the magnetic field control section 9 may be changed upon detection of a foreign object by the foreign object detection section 10.

[0037] FIG. 7 shows a manner in which, when a foreign object is detected by the foreign object detection section 10, the magnetic field control section 9 changes the frequency of the drive current. As shown in FIG. 7, when a foreign object is detected by the foreign object detection section 10, the magnetic field control section 9 changes the frequency F2 of the drive current applied to the loop antenna 35 to F1 which is lower than F2. When the drive current frequency F2 is decreased to F1, the frequency of the magnetic field generated by the loop antenna 35 lowers. Therefore, the energy loss caused, when a magnetic foreign object is placed in front of the card slot 22, by iron loss is reduced. This makes it possible to obstruct illicit operation, for example, skimming attempted by an illicit magnetic reader placed in front of the card slot 22 targeting the magnetic reader 1.

[0038] Even though in the above embodiment, the foreign object detector 36 is used, an ammeter 12 to measure the electric current value applied to the loop antenna 35 may be installed replacing the foreign object detector 36. FIG. 8 is a block diagram showing the configuration of a main part of a magnetic reader 1 including the ammeter 12. The ammeter 12 measures the value of current flowing through the loop antenna 35 so as to detect a foreign object made of a high magnetic permeability material such as iron plate or ferrite if placed in front of the loop antenna 35. When a foreign object with high magnetic permeability is placed in front of the loop antenna 35, the inductance of the loop antenna 35 changes causing the amount of current flowing through the loop antenna 35 to change. The magnetic field control section 9 determines whether the measured amount of current is within a predetermined range. When it is determined that the measured amount of current is not within the predetermined range, the magnetic field control section 9 determines that a foreign object is present. The magnetic field control section 9 can then increase the drive current for the loop antenna 35 to enlarge the magnetic field generated by the loop antenna 35.

[0039] Also, even though, in the above embodiment, the core 34 is used to prevent reading, by the magnetic head 29, of the magnetic information recorded on the card 21 from being obstructed, an alternative configuration without including the core 34 may be used. When the core 34 like the one shown in FIG. 2A is not used, the magnetic field generated by the loop antenna 35 cannot be prevented from being radiated toward the magnetic head 29. It is, however, possible to change, when the card 21 is taken into or read in the magnetic reader 1, the magnetic field generated under the control of the magnetic field control section 9 and thereby prevent reading by the magnetic head 29 of the magnetic information recorded on the card 21 from being affected by the magnetic field radiated from the loop antenna 35.

[0040] FIG. 9 is a flowchart of a processing procedure performed to take the card 21 into and read the magnetic information recorded on the card 21 in a magnetic reader without including the core 34. The processing procedure will be described below based on the flowchart and on the assumption that, in the magnetic reader 1, the card insertion sensor 23 and the sensors 30 to 33 have not yet detected the card 21. It is also assumed that a drive current is applied to the loop antenna 35 by the magnetic field generation section 8 causing the loop antenna 35 to radiate a magnetic field.

[0041] As shown in FIG. 9, the control section 2 determines whether the card insertion sensor 23 has detected the card 21 (step S91). When it is determined that the card insertion sensor 23 has detected the card 21 (step S91 = Yes), the control section 2 determines that the card 21 has been inserted through the card slot 22 and the card transport control section 40 causes the transport rollers 25 to 28 to start rotating in the forward direction (step S92). Subsequently, the card transport control sec-

tion 40 transports the card 21 to the card pause position at a constant speed. The card 21 while being transported toward the card pause position passes over the sensors 30 to 33.

[0042] The control section 2 determines whether the sensor 31 positioned closer to the card slot 22 than the magnetic head 29 has detected the card 21 (step S93). When it is determined that the sensor 31 has detected the card 21 (step S93 = Yes), the control section 2 discontinues the drive signal transmitted to the loop antenna 35 to stop the magnetic field generation by the loop antenna 35 (step S94). Since the distance between the sensor 31 and the card slot 22 is longer than the length along the transport direction of the card 21, even when the loop antenna 35 stops generating a magnetic field, the magnetic information recorded on the card 21 cannot be read by an illicit magnetic reader if installed in front of the card slot 22. When, in step S93, it is determined that the sensor 31 has not detected the card 21 (step S93 = No), the control section 2 remains standing by.

[0043] Subsequently, the magnetic head 29 comes into contact with the magnetic stripe of the card 21 allowing the magnetic information reading section 3 to read the magnetic information recorded on the card 21 (step S95). The control section 2 determines whether the sensor 33 disposed adjacently to the transport rollers 28 has detected the card 21 (step S96). When it is determined that the sensor 33 has detected the card 21 (step S96 = Yes), it is determined that the card 21 has reached the end of the card path 4 and the card transport control section 40 causes the transport rollers to stop rotation (step S97). Subsequently, the magnetic field generation section 8 applies, in response to an order from the control section 2, a drive signal to the loop antenna 35 causing the loop antenna 35 to generate a magnetic field again (step S98). The procedure for card recovery operation to be subsequently performed is similar to that shown by the flowchart of FIG. 5, so that its description is omitted here.

[0044] FIG. 10B is a timing chart of magnetic field generation carried out according to the flowchart shown in FIG. 9. As shown in FIG. 10B, when the sensor 31 detects the leading edge of the card 21, the magnetic field control section 9 causes the loop antenna 35 to stop magnetic field generation. Subsequently, when the sensor 33 detects the leading edge of the card 21, the magnetic field control section 9 causes the loop antenna 35 to start magnetic field generation again. Thus, even without the core 34 installed, not allowing the loop antenna 35 to generate a magnetic field during the time when the magnetic information recorded on the card 21 is read by the magnetic head 29 (i.e. during the time between when the card 21 is detected by the sensor 31 and when the card 21 is detected by the sensor 33) makes it possible to obstruct illicit operation, for example, skimming, attempted by an illicit magnetic reader when the card 21 is inserted or removed through the card slot 22.

[0045] As described above: the foreign object detection section 10 determines whether there is an illicit mag-

netic reader placed near the card slot 22 through which the card 21 is inserted or removed; the magnetic field generation section 8 is positioned near the card slot 22 and generates a magnetic field for obstructing the magnetic field radiated from the illicit magnetic reader; and the magnetic field control section 9 determines whether the foreign object detection section 10 has detected any illicit magnetic reader and, when the foreign object detection section 10 is determined to have detected an illicit magnetic reader, the strength of the magnetic field generated by the magnetic field generation section 8 to obstruct illicit operation is changed. In this way, even when an illicit magnetic reader is installed in a manner to block external magnetic fields, the magnetic information recorded on the card 21 can be prevented from being read by the illicit magnetic reader.

[0046] For example, when an illicit magnetic reader structured to block external magnetic fields with a magnetic plate is installed near the magnetic reader 1, the foreign object detection section 10 detects the illicit magnetic reader and the magnetic field generated by the magnetic field generation section 8 is enlarged so as to obstruct the magnetic field generated by the illicit magnetic reader. Also, when the illicit magnetic reader is detected by the foreign object detection section 10, the magnetic field generated by the magnetic field generation section 8 is largely changed, so that the magnetic information recorded on the card 21 is prevented from being read by the illicit magnetic reader during the time from when the card 21 is inserted through the card slot 22 until when the insertion of the card 21 is detected.

[0047] Furthermore, as shown in FIG. 2C, plural magnetic field generation sections 8 may be provided, so that, when the foreign object detection section 10 detects a foreign object such as an illicit magnetic reader, a magnetic field is generated by each of the plural magnetic field generation sections. In such a configuration, even if an illicit magnetic reader as described above is installed, it is detected by the foreign object detection section 10 and magnetic fields are generated by the plural magnetic field generation sections 8. This enlarges the total size of magnetic fields to obstruct the operation of the illicit magnetic reader.

[0048] Also, when a foreign object is detected by the foreign object detection section 10, the magnetic field control section 9 can change the frequency of the generated magnetic field. Therefore, when an illicit magnetic reader as described above is installed, the frequency of the magnetic field can be changed to reduce the energy loss caused by iron loss so as to effectively obstruct operation of the illicit magnetic reader.

[0049] Furthermore, the magnetic fields generated by the plural magnetic field generation sections 8 have different frequencies. Even if an illicit magnetic reader shielded with a magnetic plate to block magnetic fields is installed, the operation of the illicit magnetic reader can be obstructed by low-frequency magnetic fields which are generated by the magnetic field generation

sections 8 and the energy losses of which caused by iron losses are small.

[0050] Also, only when a foreign object is detected by the foreign object detection section 10, the magnetic field generation sections 8 generate magnetic fields to prevent the magnetic information recorded on the card 21 from being stolen. When no illicit magnetic reader is installed, the magnetic field generation sections 8 generate no magnetic field so as not to waste electric power.

[0051] In the above embodiment, the foreign object detection section 10 detects an illicit magnetic reader and the magnetic field control section 9 controls the size of the magnetic field generated by the magnetic field generation section 8. An alternative arrangement may be made such that, when, for example, the user detection sensor 50 detects a user by using infrared rays, the magnetic field control section 9 causes the magnetic field generation section 8 to enlarge the magnetic field it generates. Such an arrangement will make it possible to obstruct stealing of the magnetic information recorded on the card 21 attempted by an illicit magnetic reader when the user brings the card 21 close to the magnetic reader 1 (just before inserting the card 21 into the magnetic reader 1).

[0052] The present invention is not limited to the above embodiment. In applying the invention, its constituent elements may be appropriately modified without departing from the spirit and scope of the invention. The invention can also be modified in various manners using appropriate combinations of plural constituent elements described above. For example, some of the constituent elements of an embodiment of the invention may be removed, or constituent elements of different embodiments of the invention may be used in appropriate combinations.

Claims

1. A magnetic reader, comprising:

a foreign object detection section (10) for determining whether there is a foreign object near a card slot (22) through which a magnetic card (21) is insertable or can be taken out;
a magnetic field generation section (8) for generating a disturbing magnetic field in a vicinity of the card slot (22) for disturbing a magnetic field radiated from a foreign object if present near the card slot (21); and
a control section (9, 11) for determining whether the foreign object detection section (10) has detected a foreign object and which is, when the foreign object detection section (10) determines to have detected a foreign object, configured to change the strength of the disturbing magnetic field generated by the magnetic field generation section (8).

2. The magnetic reader according to claim 1, wherein a plurality of the magnetic field generation sections are provided near the card slot (22); and the control section (9, 11) is configured to change, when the foreign object detection section (10) detects a foreign object, the strength of the disturbing magnetic field generated by each of the magnetic field generation sections.
3. The magnetic reader according to claim 1 or 2, wherein, when the foreign object detection section (10) determines to have detected a foreign object, the control section (9, 11) is configured to increase the strength of the disturbing magnetic field.
4. The magnetic reader according to at least one of claims 1 to 3, wherein, when the foreign object detection section (10) determines to have detected a foreign object, the control section (9, 11) is configured to change a frequency of the disturbing magnetic field generated by the magnetic field generation section (10).
5. The magnetic reader according to at least one of claims 1 to 4, further comprising a member (34) for absorbing a portion, radiated inwardly of the magnetic reader, of the disturbing magnetic field generated by the magnetic field generation section.
6. The magnetic reader according to at least one of claims 1 to 5, further comprising a detection section for detecting a user, wherein, when the detection section detects a user, the control section (9, 11) is configured to change the strength of the disturbing magnetic field generated by the magnetic field generation section (8).

FIG. 1

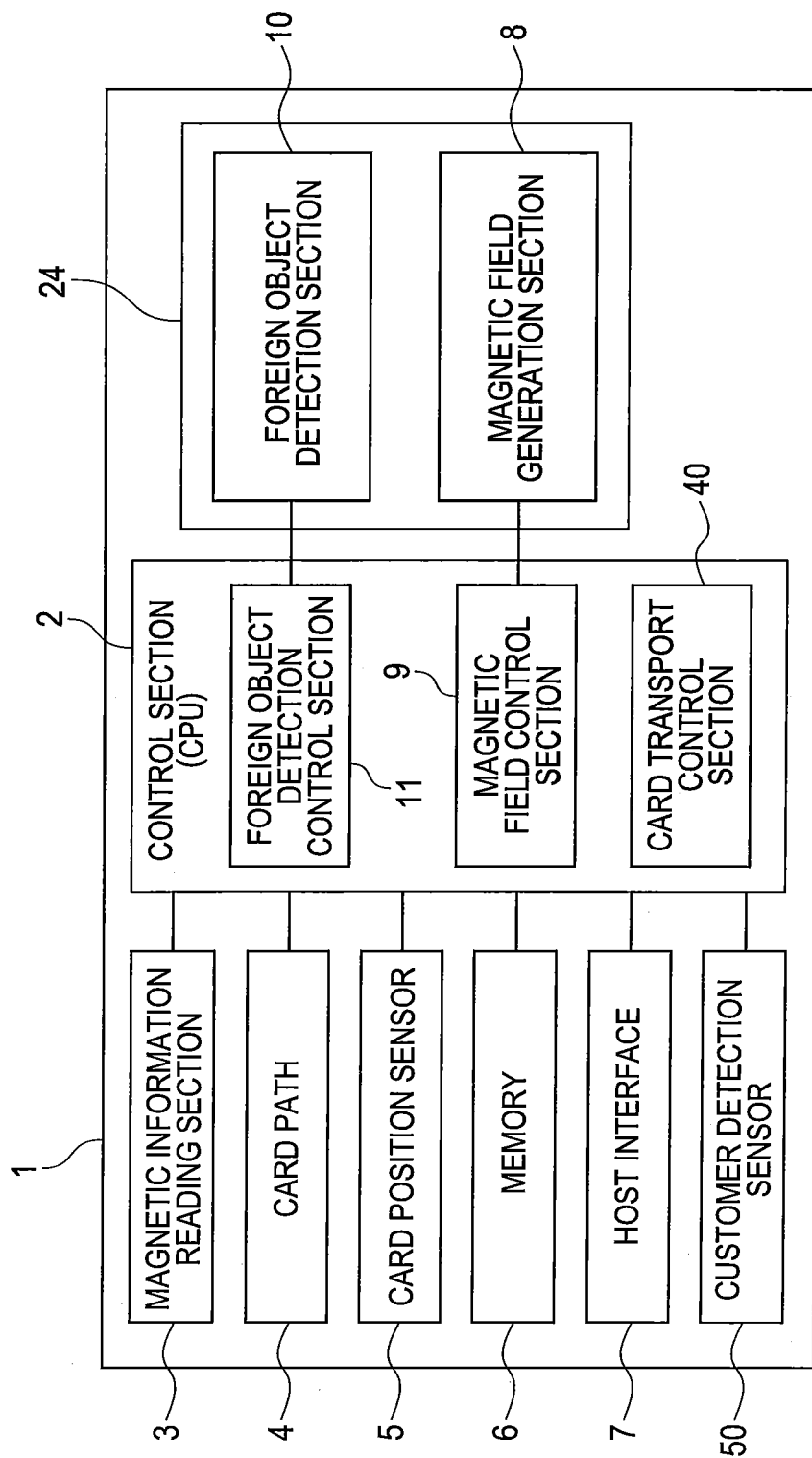


FIG. 2A

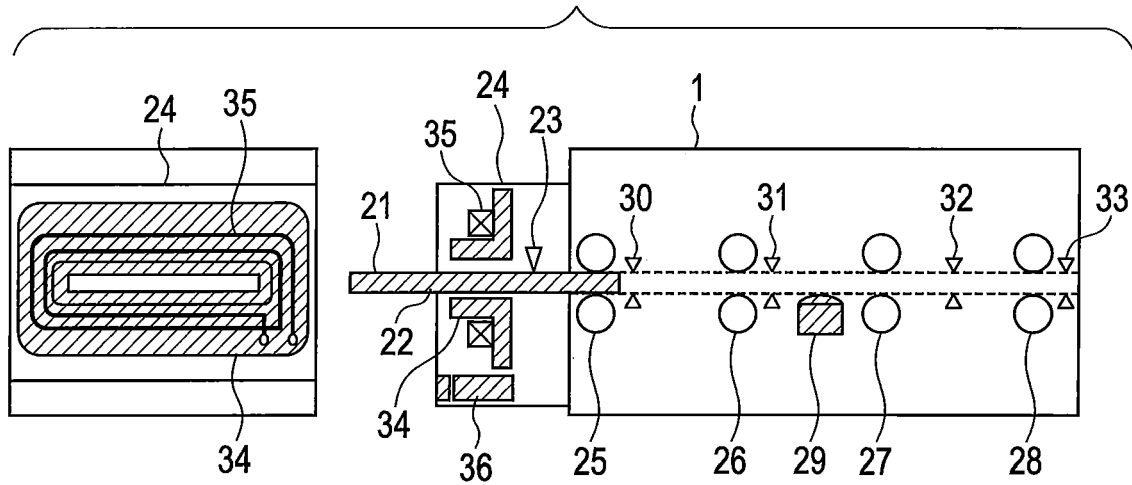


FIG. 2B

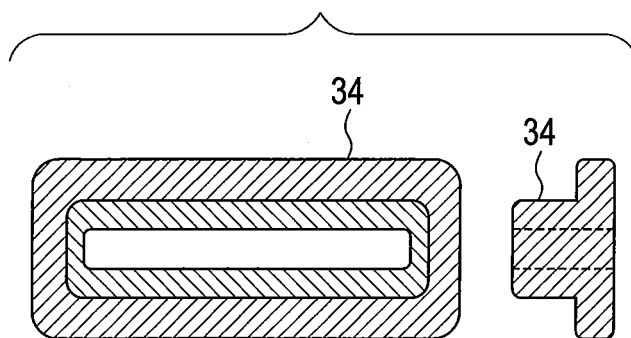


FIG. 2C

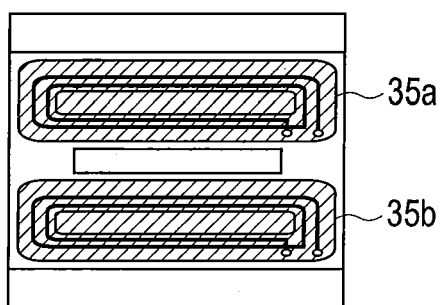


FIG. 3A

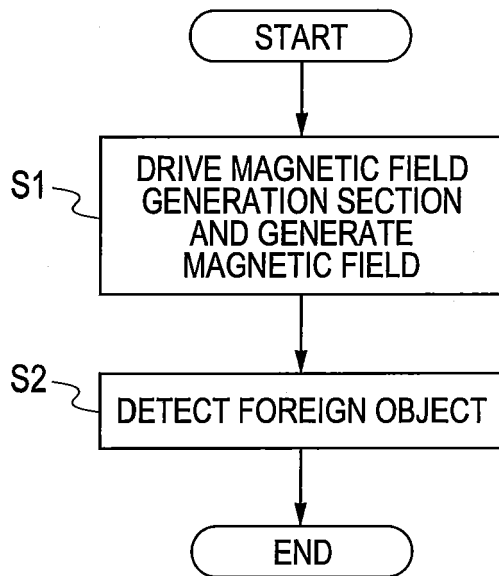


FIG. 3B

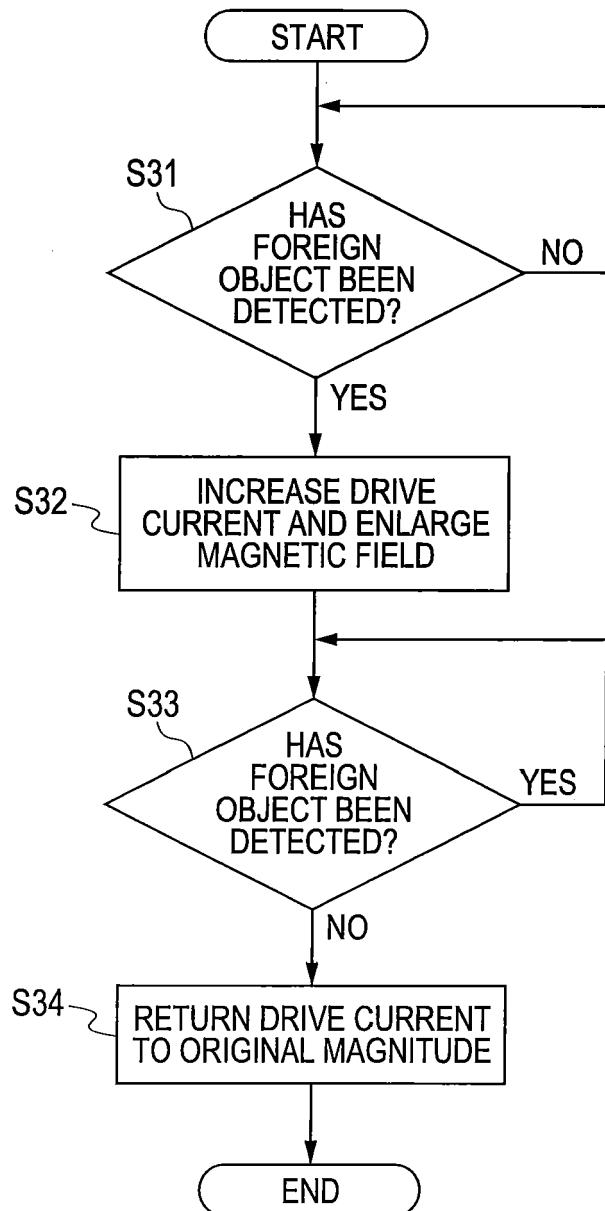


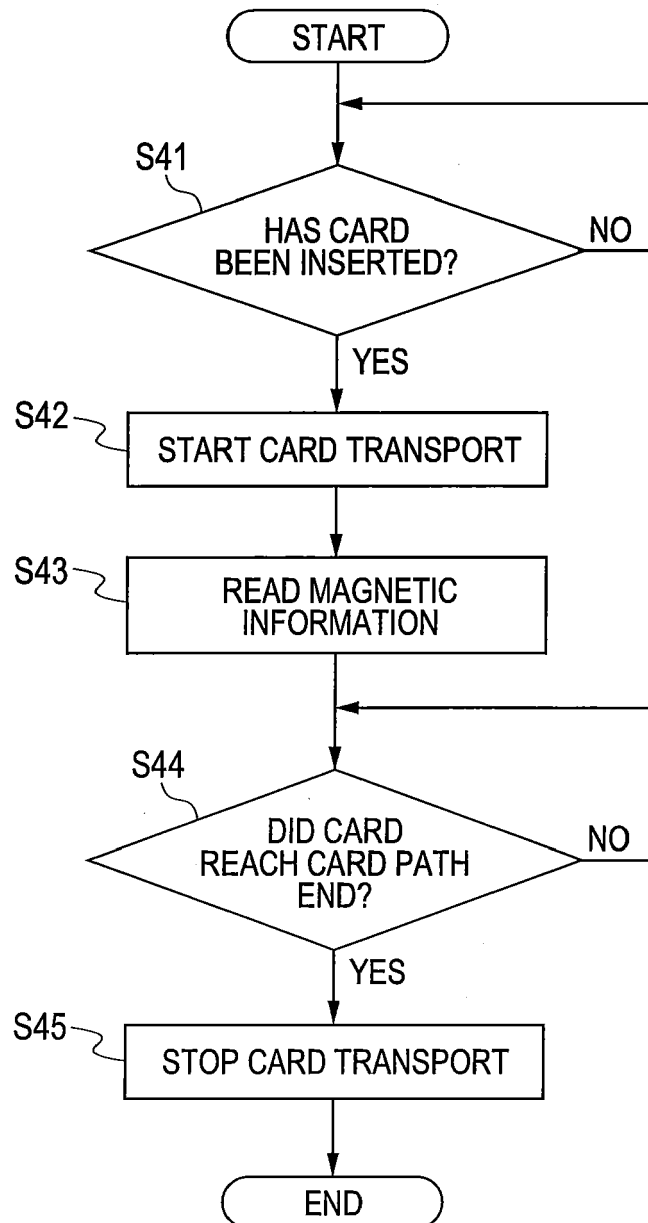
FIG. 4

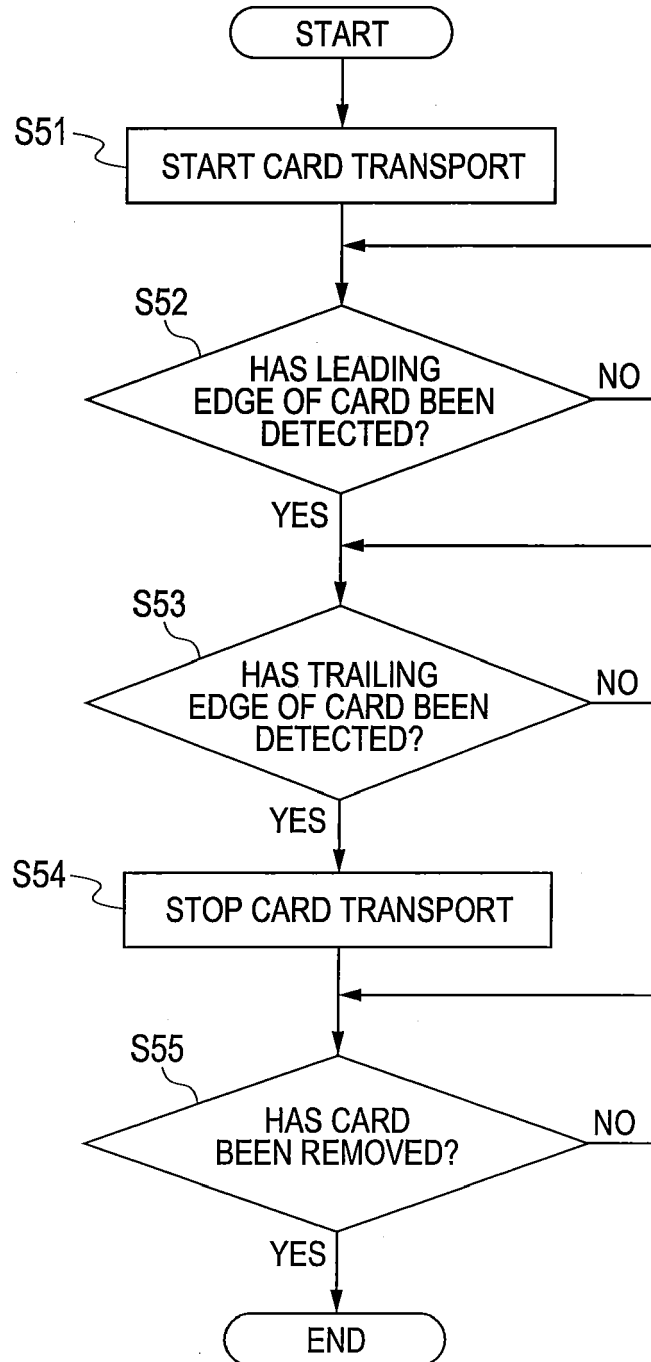
FIG. 5

FIG. 6

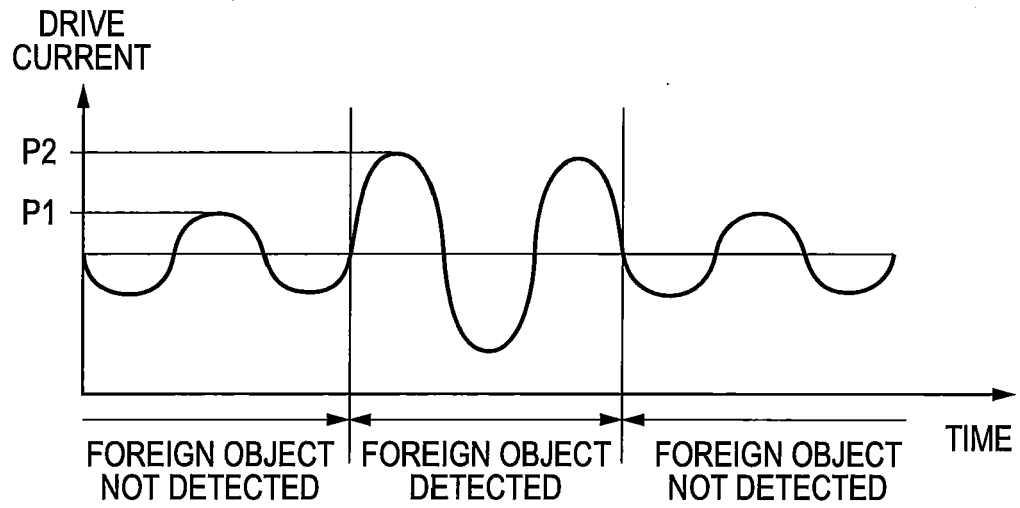


FIG. 7

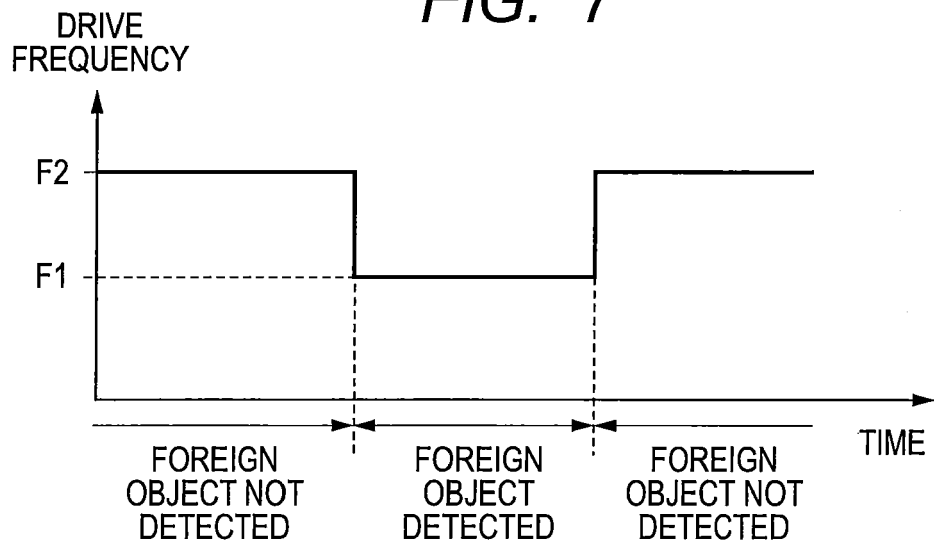


FIG. 8

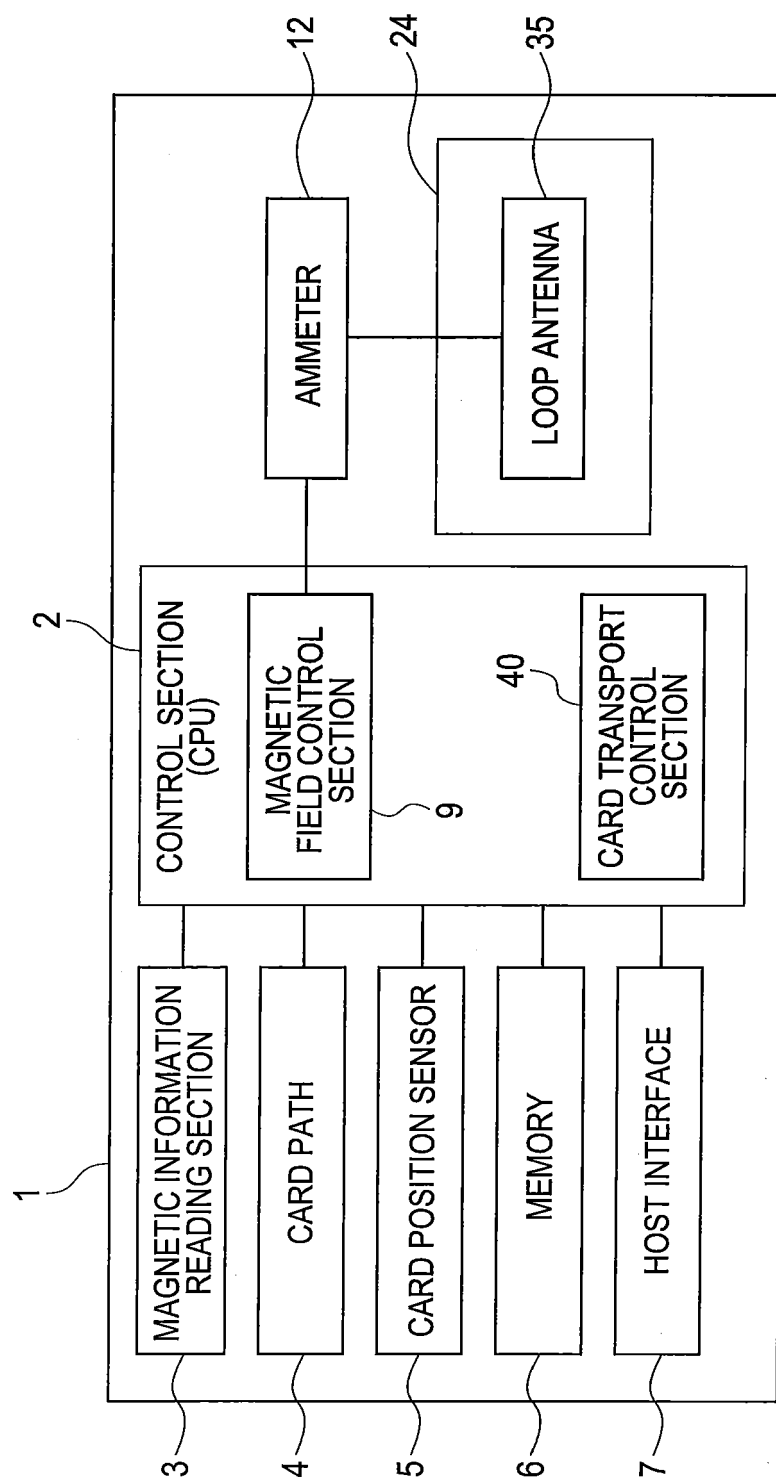


FIG. 9

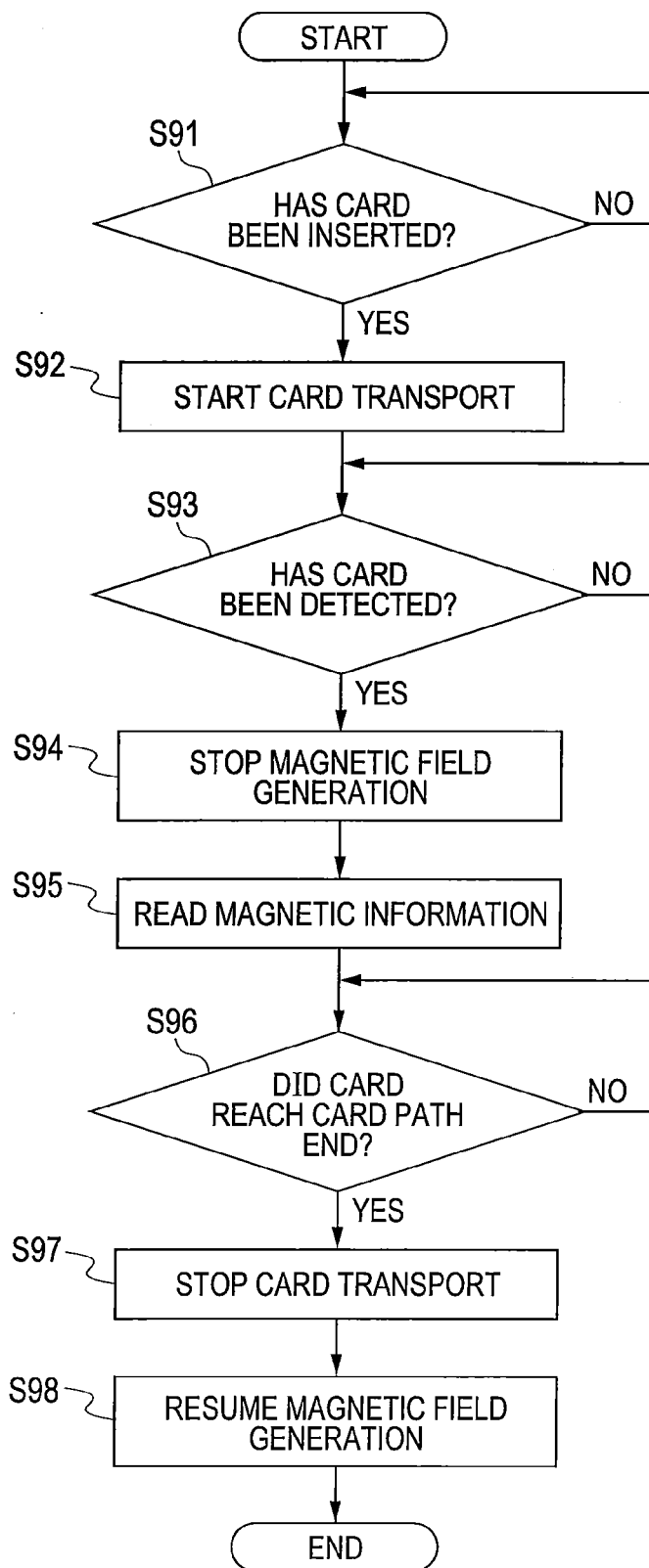


FIG. 10A

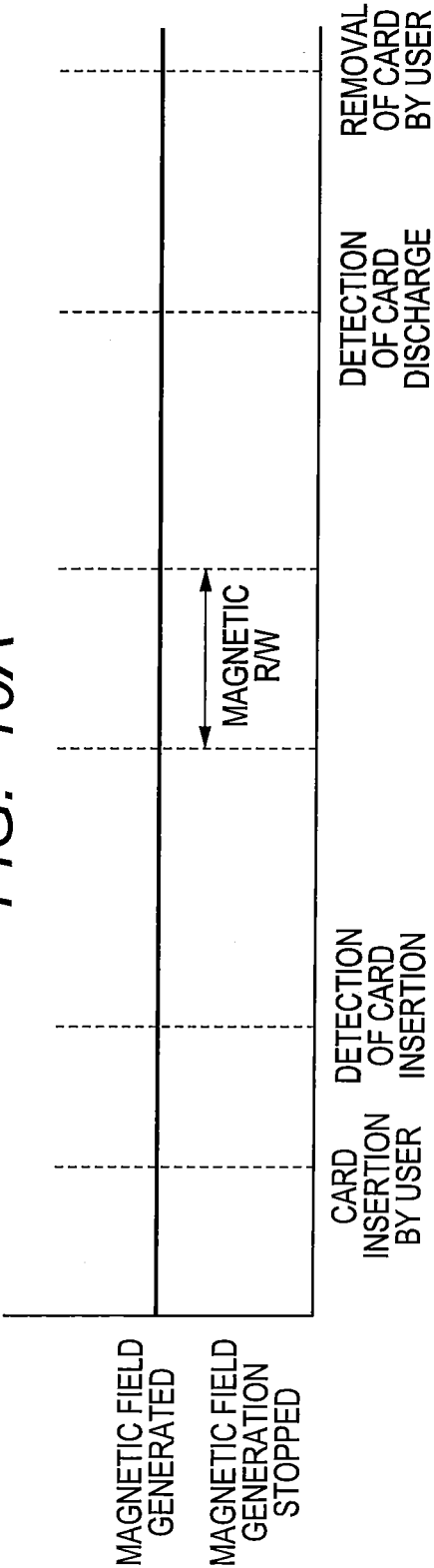


FIG. 10B

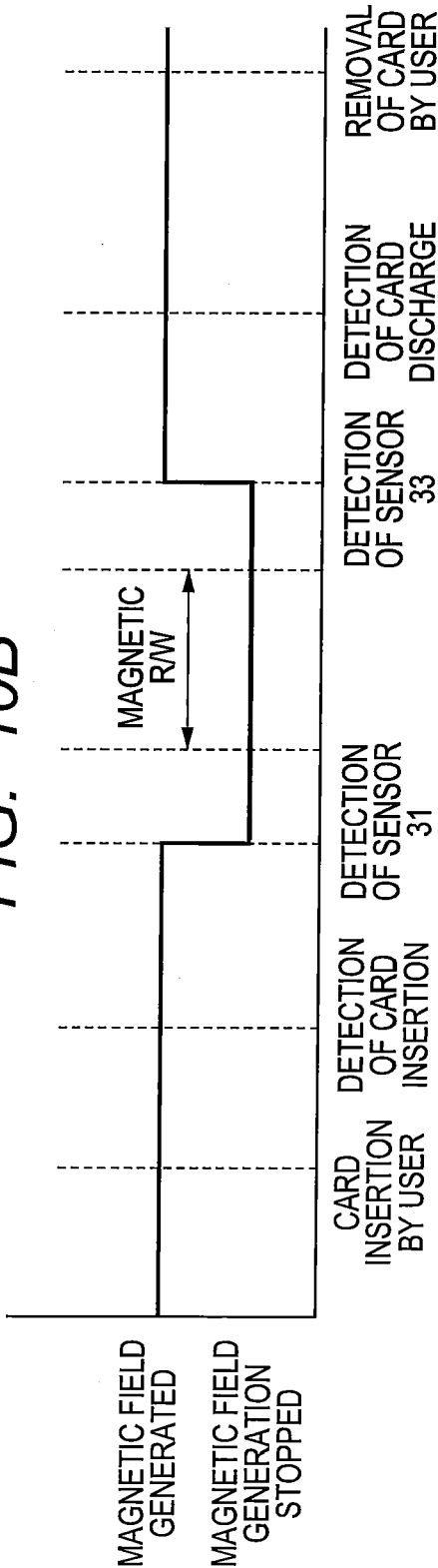
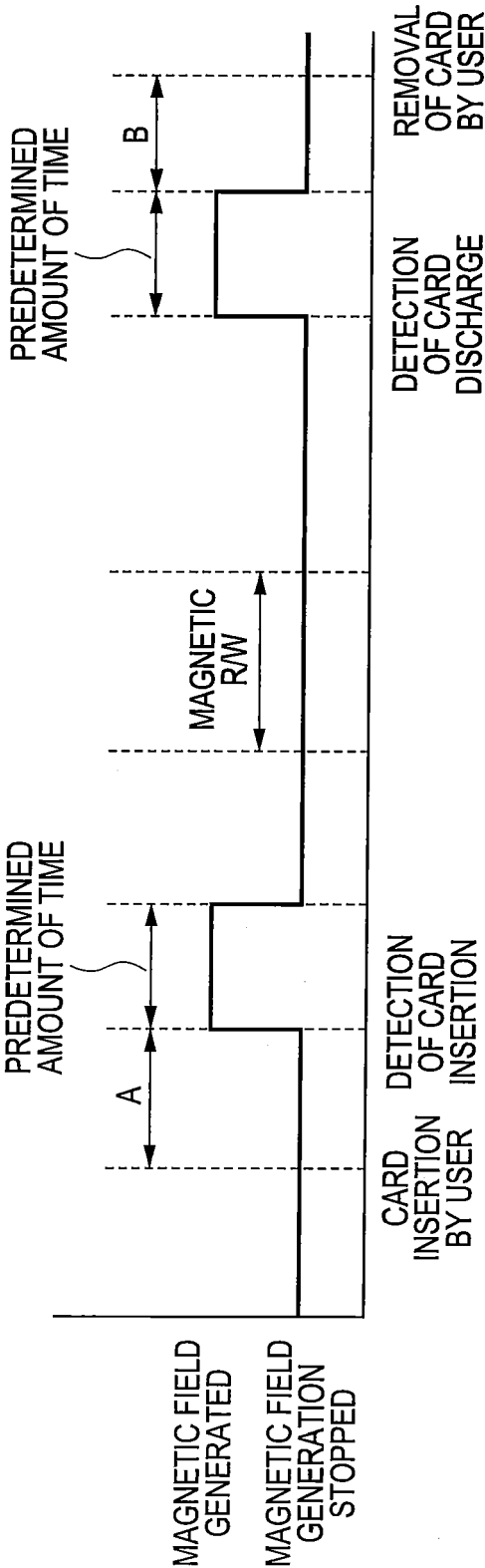


FIG. 11





EUROPEAN SEARCH REPORT

Application Number
EP 11 15 1103

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	* the whole document *	1	
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			G07F
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 18 May 2011	Examiner Van Dop, Erik
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			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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18-05-2011

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