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(54) **Device and method for detecting the amount of coins in a tank**

(57) A device for measuring the number of coins in a coin handling device (**G**) comprising: one or more substantially tubular tanks (**2**); emitter means (**4**) of a magnetic field including at least one inductor (**5**) arranged peripherally to the tanks (**2**) and powered to generating the magnetic field susceptible to impinge the coins contained in the tanks (**2**); detector means (**8**) to detect magnetic losses of the magnetic field due to the coins; calculation means (**9**) to calculate the number of coins in the tanks (**2**) as a function of the magnetic losses. The emitter means (**4**) comprise a partition circuit composed by two passive elements (**5**, **7**) one of which comprises the inductor (**5**). The detector means (**8**) include a measurement circuit (**10**) of the electric potential difference at the ends of the inductor (**5**) to measure the voltage value of the electric potential difference when the device (**1**) is powered so detecting the magnetic losses.

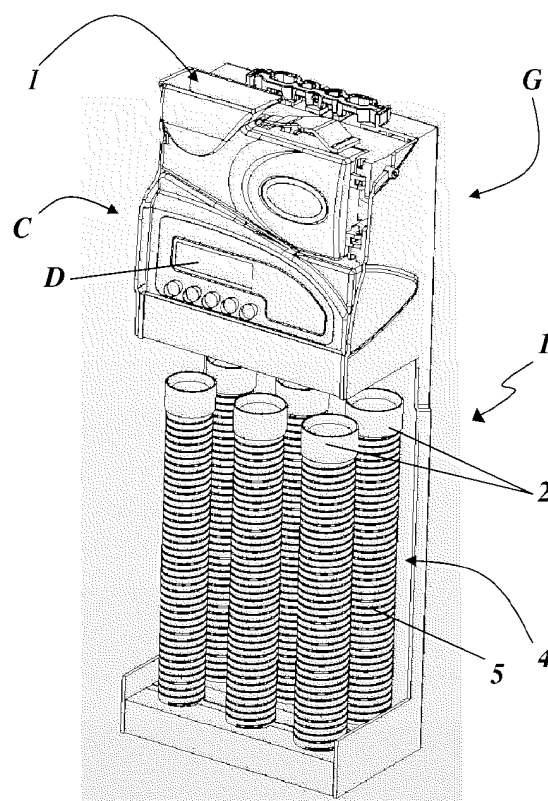


FIG. 1

Description

DESCRIPTION

Field of invention

[0001] The present invention is applicable to the field of coin handling devices inserted in coin, food, beverages or similar distributors, and in all devices that can receive and/or dispense coins.

[0002] More specifically, this invention relates to a device suitable to detect and count the coins in one or more tanks belonging to a coin handling device.

Background art

[0003] In the coin distributors, as well as in food or other things distributors, a fundamental role is played by the coin handling device, i.e. a device that receive coins for payment and/or dispense coins as change for a payment or in exchange for paper money.

[0004] The use of this coin handling device is increasingly being largely used automated devices that contain them. Another example in this sense it is their use for payment for products provided by vending machines or service machines such as payments of motorways, parking vehicles, etc..

[0005] The coin handling devices generally include an opening for the insertion of coins, one or more tanks for the inserted coins and electronic circuits to control the coin handling device in terms of identifying and counting the inserted coins.

[0006] Especially if the coin handling device should also provide money, it will be provided with more tanks, one for each type of currency accepted. In this case, the electronic circuits are also coupled to mechanical means which, after recognition of the inserted coins, it will route them in a corresponding tank.

[0007] It is clear that the use of the above coin handling devices have many drawbacks not only about the safety of the money contained therein, but also about functionality, that is to prevent failures or mistakes in the management of receiving and dispensing coins.

[0008] Thus it is important to accurately count the coins entering and exiting the coin handling device, but not only. For the incoming money, it is important to identify them to avoid receiving false coins, to count the amount of money inserted, and to route properly.

[0009] The coin handling devices of the prior art solve these drawbacks in some different ways, although the most used types use an electromagnetic solution, ie, as it can be seen in patent documents CA 2 426 462, U.S. 4,124,110 and JP 6,293,320, they use magnetic sensors.

[0010] More specifically, in such coin handling devices is exploiting the disruption of the rest state of one or more oscillators, having the inductor, which is the reactive part of the oscillator circuit, projected and positioned so that the magnetic flux impinge the coin in transit in the meas-

uring channel. Essentially, in these coin handling devices it is generated an electromagnetic field that impinge the inserting path of coins. On said coins they are generated the Foucault currents, i.e. parasitic currents which develop on metals when they are impinged by alternated magnetic fields and which are electromagnetic losses for said generated field. The extent of these losses, being dependent on the metal type and size, allow to identify and count the inserted coins.

[0011] The storing of the number of counted inserted/dispensed coins allow not only to display the amount received and/or dispensed, but also to verify the amount of money contained in the coin handling device.

[0012] However, the coin handling devices described have some drawbacks one of which is the insertion or the extraction of coins from the device in the off state and directly from the tanks by an operator or as a result of a theft.

[0013] In fact, during the life of a coin handling device, it happen that an operator, at regular intervals or upon a specified notification, proceed to at least partially fill the empty tanks by inserting coins directly, i.e. without inserting them in the monitoring and selection circuit previous described. In this case, the electronic control of the coin handling device is not able to know which type and how many coins are present in the tanks.

[0014] Moreover, it may happen that some coins get stuck in a tank or the supply of coins is affected by errors for which they are provided a wrong number or a wrong type of coins. In this case the coin handling device not only could not detect the error, but it will have stored in the memory an incorrect number of coins really stored in the tanks.

[0015] To overcome these drawbacks, they are known coin handling devices taking a direct counting of the coins in each tank. In particular, a first category of coin handling devices use optical sensors that detect the level of coins in each tank. These sensors, however, return a crude measure because generally limited to detect the passing of predetermined threshold levels, typically located round 10%, 50% and 90% of maximum capacity of the tanks. Moreover, optical sensors require constant cleaning and often have a cumbersome wiring.

[0016] They are also known coin handling devices using the phenomenon of reflection of an acoustic wave sent toward the stack of coins present in the tanks to detect their number. Some examples are described in the patents EP 1 413 991 and EP 1 242 979. This solution, however, have some limitations. At first the generated acoustic wave should have a short length and a great amplitude so as it is usually generated by an electrical discharge. In this case, however, this generation is a source of electrical and magnetic noise on the surrounding electronic circuits.

[0017] Furthermore, also this solution, which utilize the measurement of the time it takes the wave to reach the coins and come back after reflection, returns an inaccurate measure. In particular, in addition to the precision of

the detection time, on the tanks will inevitably develop a plurality of parasitic reflected waves that make uncertain the exact detection of the main reflected wave arrival time.

[0018] Other known devices use electrically powered inductors positioned close the tanks to generate a magnetic field which impinge them. In particular, the inductor is, for the power supply circuit, a load variable with the number of coins in each tank.

[0019] The document US 6,267,662 B1 describes a device in which the power supply circuit provides AC power supply to the inductor with a variable frequency to find the resonant frequency of the inductor. The latter is dependent on the number of coins in the tank. It is clear, however, that this method is really expensive.

[0020] The document DE 38 02 121 describes a device in that at first the inductor is powered to generate the magnetic field that impinge the coins, then the power is turned off. This makes it possible to measure the magnetic field induced on the coins which is directly dependent on the number of coins. This solution, besides being expensive, is really complicated. The induced magnetic field is indeed very limited and dissolves quickly so it need an evolved and very accurate measurement circuit. Otherwise, the measure may not be possible or to be affected by a significant error.

[0021] It is also known the document DE 42 26 611 in which the inductor is powered to generate a magnetic field that impinges the coins. The power supply is then turned off to measure the residual magnetic field, led on coins during the inductor popowering period, and its discharge time. In particular, measurement of residual magnetic field is repeated several times at regular intervals after switching off the power supply to get away from that moment to avoid getting a measure affected by residual spurious power. One more, the measure, as in the previous described circuit, is particularly expensive since it must be an accurate and fast measurement.

Summary of the invention

[0022] One general object of the present invention is to create a device for measuring the number of coins in a coin handling device which can overcome the drawbacks of the known coin handling devices.

[0023] Within these general object, a specific object of the invention is to create a device for measuring the number of coins in a coin handling device that provides an indication as accurate as possible of the number of coins in each tank.

[0024] Another object to be reached is that the proposed device allow to perform an accurate counting of the coins stored in each tank and to detect and report failures or malfunctions caused by mechanical problems on dispensing coins or determined by get stuck of coins in the tanks.

[0025] Last but not least object is to provide a device for measuring the number of coins in a coin handling

device that is simpler and less expensive than the equivalent known coin handling devices.

[0026] These objects, and others who appear more clearly below, are achieved by a device for detecting the number of coins in a coin handling device, or similar apparatus, in accordance with the main claim.

[0027] In particular, the coin handling device may include at least one substantially tubular tank for storing, loading and dispensing coins.

[0028] Furthermore, it may comprises emitter means of a magnetic field including at least one inductor arranged peripherally to the tank and powered to generate a magnetic field capable of impinging the coins.

[0029] According to another aspect of the invention, the device may also comprise detector means, for detect magnetic losses in the magnetic field due to the coins presents in the tank, and calculating means operatively connected to the detector means to determine the number of coins in the tank as a function of the magnetic losses caused by them.

[0030] According to another aspect of the invention, the emitter means may include at least one partition circuit composed of at least two passive elements, one of which is the inductor, while the detector means may include at least one voltage measuring circuit connected to the ends of the inductor to measure the electrical potential difference during the power supply of the inductor so detecting the magnetic losses caused by the coins.

[0031] It is so shown that one aspect of the invention is to use the measurement of electromagnetic losses caused by the coins in a field that impinges them in order to determine their number. This differs from the closest prior art where it is measured a magnetic field induced in the coins instead the losses caused by them to a magnetic field during its generation. In other words, the prior art teaches to measure the electromagnetic charge of the coins, charge measured after switching off the magnetic field that induces said charge. On the contrary, the proposed device measure the interference caused by coins to the magnetic field during its life.

[0032] Clearly, the measurement of magnetic losses is easier and more precise than the measure of a field of limited value and especially having a very short life. The measure contextual to the power supply can also limit the time thereof. All this features helps to get a device whose electronic circuits are particularly simple and inexpensive compared to equivalent known devices.

[0033] It is clear that this measure is correct even if one or more coins get stuck somewhere in the tank. It is also clear that the same measure is not affected by error due to dirt, dust or other, as it is, for example, the measure carried by the optical method.

[0034] The previous object are then joined also by a method of measuring the number of coins in at least one tank of a coin handling device, or of a similar system, comprising the following steps:

- generating and emitting a magnetic field through a

powered inductor, said magnetic field investing said at least one tank so that the coins contained thereof cause magnetic losses in said magnetic field;

- measuring of said magnetic losses;
- calculating the number of coins by subtracting to the measured value of said magnetic losses the measured value of the magnetic losses in absence of coins inside said tank and dividing said difference by a predetermined value of magnetic losses generated by the presence of one coin inside said tank, and that is characterized by the fact that the measure of said magnetic losses is performed by measuring the electrical potential difference at the ends of said inductor during said generation and emission of said magnetic field.

[0035] The predetermined value of magnetic losses is obtained during a calibration step.

Brief description of the drawings

[0036] Further features and advantages of the invention will be more apparent upon reading the detailed description of a preferred, non-exclusive embodiment of a device according to the invention, which is described as a non-limiting example with the help of the annexed drawings, in which:

FIG. 1 represents a partially sectioned axonometric projection of a coin handling device where it is visible the device of the invention for detecting the number of coins;

FIG. 2 represents a schematic view of electronic control circuits of a device according to the invention;

FIG. 3 represents a part of a device according to the invention in an axonometric projection view;

FIG. 4 represents another schematic view of electronic control circuits of a device according to the invention.

Detailed description of a preferred example of realization

[0037] With reference to FIGS. 1 and 2, they are illustrated a coin handling device **G**, containing a device **1** for detecting the number of coins presents in at least one substantially tubular tank **2**, and the circuit diagram of the electronic control circuits **3** of that device **1**.

[0038] In the coin handling device **G** there are an insertion area **I** of coins and a control unit **C** generally provided with a display **D** on which are displayed information about coins and the total amount inserted and, where appropriate, information about the coins and the total amount to be dispensed.

[0039] Although not shown, the coin handling device **G** comprises pipes for the passage of coins from the insertion area **I** to the tanks **2**. In correspondence of the pipes, the coin handling device **G** generally comprises identification means of the coins inserted, usually but not

necessarily, of electromagnetic type as known by many devices of the prior art, and sorting means to direct the identified coins to the correspondent tank **2**.

[0040] According to an aspect of the invention, the device **1** for detecting the number of coins present in the tanks **2** comprises emitter means **4** for generating a magnetic field capable of impinging the coins contained in each tank **2**.

[0041] Preferably, the emitter means **4** comprise at least one inductor **5**, generally consisting in a coil as can be seen in FIG. 3, arranged peripherally to each tank **2** and electrically powered by an AC generator **6**.

[0042] As noted above, the magnetic field generated causes the induction, on the coins which it impinges, of parasitic currents, also named Foucault's currents, which determine magnetic losses on the magnetic field.

[0043] In particular, the magnetic losses increase with the number of coins according to a substantially linear progression. The linearity of this progression is very important since it will allow to detect the number of coins presents in each tank **2**.

[0044] Thus, the AC generator **6** comprises a sinusoidal generator closed by a resistor **7** on an inductive load consists of the inductor **5** arranged around a corresponding tank **2**.

[0045] The current generated by the generator **6** flows on a partition circuit made by the resistor **7** and the inductor **5**, the latter being, as mentioned, a load with its own impedance.

[0046] In the absence of metal materials inside the tank **2**, the magnetic losses of the inductor **5** have a minimum value due to parasitic resistance of the inductor **5** and to the magnetic losses of any real and not ideal magnetic field. Consequently, the load impedance offered by the inductor **5** have a maximum value. This translates into a maximum value of the electric potential difference presents at the ends of the inductor **5**.

[0047] Inserting coins into the tanks **2**, the magnetic losses in the coins proportionally decreases the load impedance and consequently also decreases the electric potential difference measured at the ends of the inductor **5**.

[0048] In other words, the voltage value measurable at the ends of the inductor **5** is inversely proportional to the number of coins introduced in the tanks **2**. This result, to be easily used, must be as linear as possible.

[0049] Consequently, to maximize the linearity of the response is desirable that the inductor **5** will be fed by a generator **6** which approximates as better as possible a "constant current generator".

[0050] In the describing embodiment, this condition is approximated by placing in series with the generator **6**, that is a constant voltage generator, the resistor **7** dimensioned to cause a high voltage drop. This is achieved by ensuring that its value is comparable with the impedance load provided by the inductor **5**.

[0051] It is clear that this embodiment of the AC generator **6** is just an execution example and it must not to

be intended as a limit for different embodiments.

[0052] Any technician of that field certainly understand the importance that have the choice of the oscillation frequency of the alternating current for the linearity mentioned above. In particular, it belongs to a frequency range dependent on the inductance value of the inductor **5**. In other words, the range frequency is related exclusively to construction parameters of the inductor **5** and it is therefore advantageously determined during the assembling and calibration steps of the device **1** and it will not change during its use. This allows to ensure accuracy in detecting the number of coins in each tank **2**.

[0053] It is pointed out that for frequencies above that range, the capacitive effect becomes dominant which means that the generated magnetic field suffers a significant influence by external factors such as, for example, the other tanks, the case of the coin handling device, the body of the distributor device that contains the coin handling device, and any other metallic element or magnetic field nearby.

[0054] On the contrary, for frequencies below that range it is missed the linear variation of the magnetic field due to the magnetic losses caused by coins.

[0055] According to another aspect of the invention, the device **1** comprises detector means **8** to detect of the magnetic losses, and calculation means **9**, operatively connected to the detector means **8**, to determine the number of coins stored in each tank **2** as a function of the magnetic losses detected.

[0056] In particular, as mentioned earlier, the detector means **8** include at least one measurement circuit **10** of the electric potential difference at the ends of the inductor **5**. This measurement circuit **10** is generally connected to the calculation means **9**.

[0057] Appropriately, these latter comprise at least one programmable logical unit **12**. Although, as noted above and as it will be seen later, the calculations are particularly simple to perform, it is also obvious that this embodiment can provide additional processing and functionality steps.

[0058] For this reason, between the measurement circuit **10** and the programmable logical unit **12** is interposed an A/D converter **13**, preferably, but not necessarily, built-in the programmable logical unit **12**.

[0059] Since this A/D converter **13** can correctly convert only voltage value within a predetermined range, it is generally appropriate, although not necessary, connect an amplifier circuit **14** between the measurement circuit **10** and the A/D converter **13**. This amplifier circuit **14** allows to adjust, advantageously, the voltage value detected at the ends of the inductor **5** to the interval of the acceptable voltage values of the A/D converter **13**.

[0060] An example is the case in that the programmable logical unit **12** comprises a microprocessor powered with 5 V.

[0061] In this case, the A/D converter **13** properly converts electrical signals with a voltage not exceeding 5 V. Consequently, the amplifier **14** is designed to bring the

maximum detectable voltage value at the ends of the inductor **5**, corresponding to an empty tank **2**, at a value close to 5 V. However, having to take into account the tolerances of all components of the electronic circuit, generally it is chosen to reduce by 10% the maximum voltage value, which means that the amplifier **14** is designed to bring the maximum value of detected voltage value to a value close to 4.5 V.

[0062] According to another aspect of the invention, not represented in the attached figures, it is possible to think that the amplification value of the amplifier is adjustable during the testing and calibration steps of the device of the invention. In addition, the amplifier could be controlled by the programmable logical unit that will vary the amplification bringing the output signal of the amplifier close to 5 V in the absence of coins in each tank. It is enhanced, therefore, the use of the A/D converter allowing to obtain an optimal detection accuracy without the use of high precision electronic components.

[0063] The programmable logical units **12** may also allow a process of linearisation of the system, if they were known the deviations from the ideal behaviour of the device **1**, information that can be acquired during the initial calibration step. Equipping the microcontroller by a temperature sensor it will be possible also to correct any drifts due to temperature changes.

[0064] Regarding the AC generator **6**, a possible embodiment consists on the use a gate **15** of the programmable logical unit **12**. More specifically, as can be seen in FIG. 4, the gate **15** is controlled by at least one timer element comprised in the programmable logical unit **12** so as to allow the output from said gate **15** of an electrical signal square shaped and with a desired frequency. Afterwards there is at least one low pass filter **16**, generally made by an LC circuit, which provides an output electrical signal with sinusoidal waveform. Before and after the filter **16** they are generally provided some amplifier circuits **17** suitable to ensure that the input and the output signals of the low pass filter **16** have a desired voltage value and a desired current value.

[0065] It is pointed out that according to a possible embodiment, the timer element can be an external element to the programmable logical unit.

[0066] In the example case mentioned above, the voltage value of the sinusoidal electrical signal is typically equal to 3 V RMS, which is about 8 V peak to peak. It binds to the circuit because said voltage value, if it were detected at the ends of the inductor **5**, at the output of the measurement circuit **10** become an electrical signal having a maximum voltage value about 5 V.

[0067] It was said before that object of the invention is also a method for measuring the number of coins in at least one tank **2** of a coin handling device **G** or a similar device.

[0068] This method comprises a first step of generating and emitting a magnetic field which impinges the tank **2** so that the coins stored in it cause magnetic losses in the magnetic field. The reasons for the magnetic losses

has been extensively described previously and is therefore not repeated.

[0069] Contextually to that step there is the measuring step of the magnetic losses to which it follows the calculation of the number of coins stored obtained by subtracting the present value of magnetic losses measured, to the value of magnetic losses in absence of coins and dividing that difference by a predetermined value of magnetic losses generated by the presence of one coin in the tank **2**.

[0070] Appropriately, before the measuring step is executed, therefore, a calibration step to fix that predetermined value of magnetic losses and the value of magnetic losses with the tank **2** empty.

[0071] The calibration step comprises at least the following steps:

- a first generating step of a magnetic field which impinges the tank **2** when it is empty, i.e. in the absence of coins;
- a first measurement step of magnetic losses in the magnetic field in vacuum;
- a loading step, inside the tank **2**, of a predetermined number of coins;
- a second generating step of a magnetic field that impinges the tank **2** containing the predetermined number of coins;
- a second measurement step of magnetic losses in the magnetic field also due to the loaded coins;
- a calculating step of the magnetic losses due to each inserted coin executed by subtracting the value of magnetic losses detected in the second measurement step to the magnetic losses detected in the first measurement step and dividing that difference by the number of loaded coins.

[0072] It is pointed out that after the first measurement step of the magnetic losses in the magnetic field in vacuum, it is foreseeable a storage step, in a storage support, of said data in order to retrieve it at any time following the calibration step even after a total shut-down of the device **1**.

[0073] Similarly, after the second measurement step of the magnetic losses in the magnetic field due to the loaded coins, it is foreseeable a storage step in the storage support of said last data.

[0074] It is pointed out also that the electronic circuits described, and essential for the device **1**, may be included in the control unit **C** of the coin handling device **G**. However, it is also possible that all the electronics control and calculation circuits essential for the device **1** are displaced inside it. In this case, the device **1** is independent from the coin handling device **G** and it will be compatible with any similar device.

[0075] These independence and compatibility are increased, advantageously, by the independence of the calibration device **1**, mentioned above, from the coin handling device **G**.

[0076] However, it is possible that, during the use of the device **1**, the calculation of the number of coins found in one or more tanks **2** does not return an integer number at least for certain numbers of coins.

[0077] It is therefore expected, during the operative step, a calibration step in which there are:

- a first scaling step of the calculated number of coins, if this calculated number is different from an integer, to the nearest integer number;
- a second scaling step of the measure of the magnetic losses normalized to value such that the calculated number of coins corresponds to the nearest integer number cited above;
- a storage step of the result of the second scaling step to apply it to all subsequent measures of the magnetic losses greater than or equal to the normalized value.

[0078] In other words, the calibration step is performed preferably, but not necessarily, when the calculated number of coins is not an integer. In this case, the programmable logical unit **12** stores the value for scaling the measurement and obtains an integer number and applies it for all the voltage value equal or less thereof, that is for a number of coins equal to or greater than that for which it was necessary the scaling step.

[0079] This calibration step can then be performed for additional calculated numbers of coins. This means that with the increase of the number of coins in each tank **2**, the programmable logical unit **12** may need to take into account additional successive scaling steps.

[0080] Regarding the electrical and data connections between the device **1** and the coin handling device **G**, it is typically wired. The number of cables in the wired connection can be high because many cables must be dedicated to data, to control signals and to the power. However, if the device has the electronic management and control circuits on board, the wired connection could be constituted by only two power supply connections using the same for the transmission of data and control signals. To do so it could be used, for example, the conveyed waves transmitting signals technique.

[0081] According to another aspect of the invention, in order to avoid the presence of connecting cables or electro-mechanical contacts between the device **1** and the coin handling device **G**, that are complex to realize and manage during the maintenance, the above link can be made with the wireless technique. Some possibilities, in this direction, are made by optical or magnetic links.

[0082] The latter, in particular, are really effective. They are made by an unidirectional or bidirectional transmission of signals between a first metal magnetic pole of the coin handling device **G** and a second metal magnetic pole of the device **1** of the invention.

[0083] It is pointed out that in this way not only the separation or the insertion of the device **1** into the coin handling device **G** is simplified, but it is particularly in-

sensitive, on the contrary to the optical links, to the dirt.

[0084] Previously it was said that the coin handling device **G** comprises pipes for transport the coins from the insertion zone **I** of the tanks **2** in correspondence of which there are identification means of the coins inserted, usually but not necessarily of the electromagnetic type.

[0085] These identification means may be used to count coins and store the inserted or dispensed coin number in the coin handling device **G**. This means allow not only to indicate the amount received or supplied, but also to further verify the number of coins stored in the coin handling device **G**.

[0086] However, this additional control allows to determine whether there will be unauthorized withdrawals of coins from the tanks **2**, especially in power off instants of the device **1**. Besides that, a real-time detection of the number of coins presents on the pipes allow to verify whether there are changes in the number of coins presents in the tanks **2** at the power on of the coin handling device **G**.

[0087] In the light of the foregoing, it is understood that the proposed mechanism achieves the objectives set and, in particular, overcomes the disadvantages known art being particularly accurate in time.

[0088] Due to the above, the proposed device fulfil all the intended objects and, particularly, overcome the drawbacks of the prior art being accurate during time.

[0089] Furthermore, the device of the invention also allows to detect and report failures or malfunctions thereof caused by mechanical errors or coin supplying error also due to a coin block in the tanks.

[0090] The device of the invention is susceptible of a number of changes and variants, within the inventive principle disclosed in the appended claims. All the details may be replaced by other technically equivalent elements, and the materials may be different depending on different needs.

[0091] While the device of the invention has been described with particular reference to the accompanying figures, the numerals referred to in the disclosure and claims are only used for the sake of a better intelligibility of the invention and shall not be intended to limit the claimed object in any manner.

Claims

1. A device for measuring the number of coins in a coin handling device (**G**) or similar apparatus comprising:

- at least one substantially tubular tank (**2**) for storing, loading and dispensing coins;
- emitter means (**4**) of a magnetic field including at least one inductor (**5**) arranged peripherally to said tank (**2**) and powered to generating said magnetic field susceptible to impinge the coins contained in said tank (**2**);
- detector means (**8**) to detect magnetic losses

of said magnetic field due to the coins present in said tank (**2**);

- calculation means (**9**) operatively connected to said detector means (**8**) to calculate said number of coins in said tank (**2**) as a function of said magnetic losses,

characterized in that said emitter means (**4**) comprise at least one partition circuit composed by at least two passive elements (**5**, **7**) one of which comprises said inductor (**5**), said detector means (**8**) including at least one measurement circuit (**10**) of the electric potential difference at the ends of said inductor (**5**) to measure the voltage value of said electric potential difference when said device (**1**) is powered so detecting said magnetic losses.

2. Device as claimed in claim 1, **characterized by** comprising at least an AC generator (**6**) to power said inductor (**5**).

3. Device as claimed in claim 1 or 2, **characterized in that** between said measurement circuit (**10**) and said calculation means (**9**) is interposed an amplifier circuit (**14**), the coefficient of amplification of said amplifier circuit (**14**) being checked by the calculation means (**9**) to adjust said voltage value detected to a predetermined voltage range according to said measurement circuit (**10**) parameters.

4. Device as claimed in one or more of the preceding claims, **characterized in that** said calculation means (**9**) comprise at least one programmable logical unit (**12**).

5. Device as claimed in claim 4, **characterized in that** said AC generator (**6**) includes at least one timing element, belong to said programmable logical unit (**12**), operatively connected to at least one low pass filter (**16**) to obtain an output electrical signal having a sinusoidal waveform.

6. A method of measuring the number of coins in at least one tank (**2**) of a coin handling device (**G**), or a similar system, involving the following steps:

- generation and emission of a magnetic field through an inductor (**5**) electrically powered and which impinge said at least one tank (**2**) so that the coins stored therein cause magnetic losses in said magnetic field;
- measure of said magnetic losses;
- calculation of the number of coins stored in said tank (**2**) by subtracting the measured value of said magnetic losses the measured value of said magnetic losses in the absence of coins in said tank (**2**) and dividing that difference by a predetermined value of magnetic losses gener-

ated by the presence of a coin in said tank (2),

characterized in that said measured value of said magnetic losses is made measuring the electric potential difference between the ends of said inductor (5) during said generation and emission step of said magnetic field. 5

7. Method as claimed in claim 6, **characterized by** comprising, before said measurement step, a calibration step to determine said predetermined value of magnetic losses. 10

8. Method as claimed in claim 7, **characterized in that** said calibration step includes at least the following steps: 15

- a first generating step of a magnetic field susceptible to impinge at least said tank (2) when empty; 20

- a first measurement step of the magnetic losses of said magnetic field vacuum;

- a loading step, in said tank (2), of a predetermined number of coins;

- a second generating step of a magnetic field susceptible to impinge said tank (2) containing said predetermined number of coins; 25

- a second measurement step of the magnetic losses of said magnetic field caused by said predetermined number of coins; 30

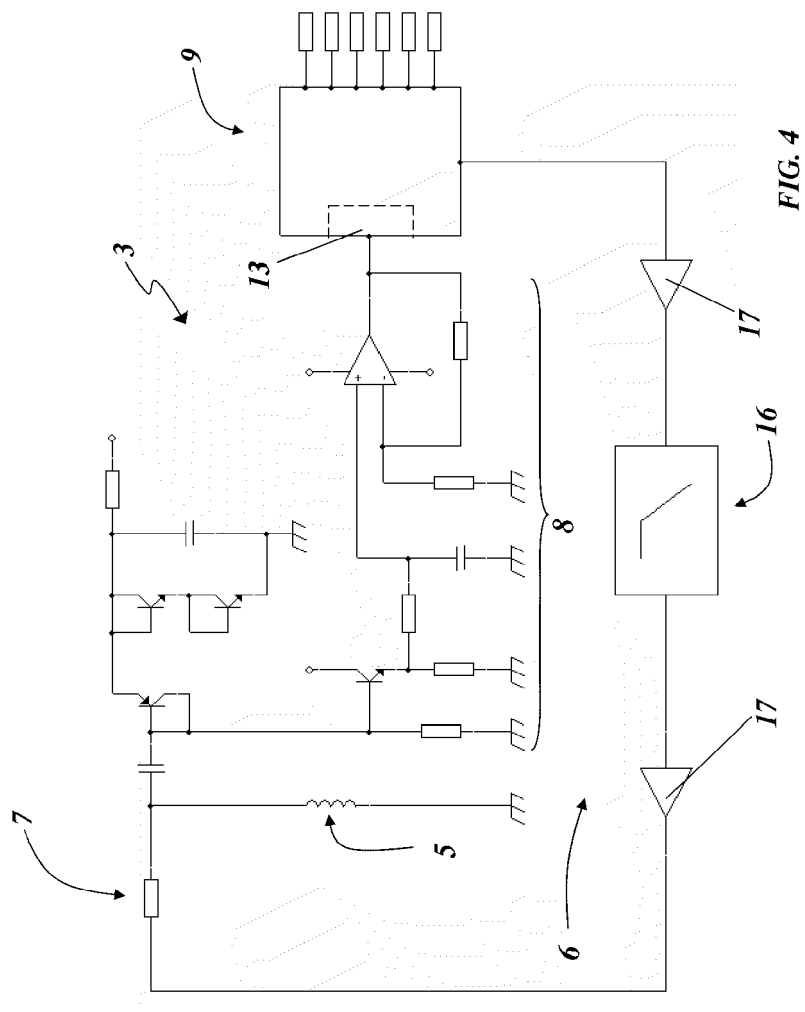
- a calculation step of said magnetic losses caused by said predetermined number of coins, executed by subtracting the value of said magnetic losses detected with said second measurement step to the value of said losses detected with said first measurement step and dividing said difference by said predetermined number of coins. 35

9. Method as claimed in one or more of the claims from 6 to 8, **characterized by** comprising an additional calibration step in which they can be identified: 40

- a first scaling step of the calculated number of said coins, if the calculated number is different from an integer, to the nearest integer number; 45

- a second scaling step of said measures of magnetic losses to a normalized value such that said calculated number of said coins will match the nearest integer number; 50

- a storage step of the magnitude of said second scaling step to apply said second scaling step to all the subsequent measurements of magnetic losses greater than or equal to said normalized value. 55



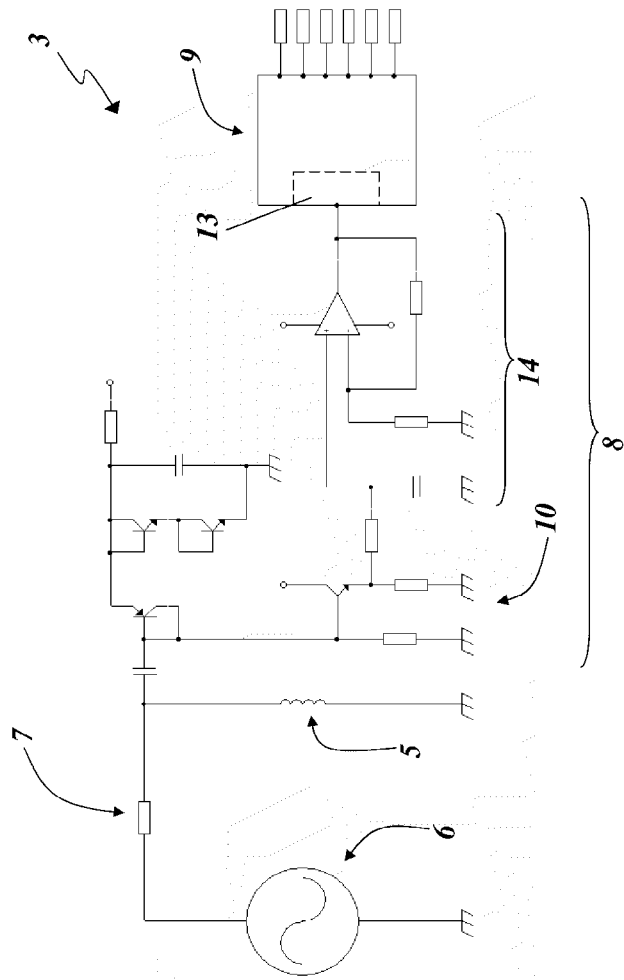


FIG. 2

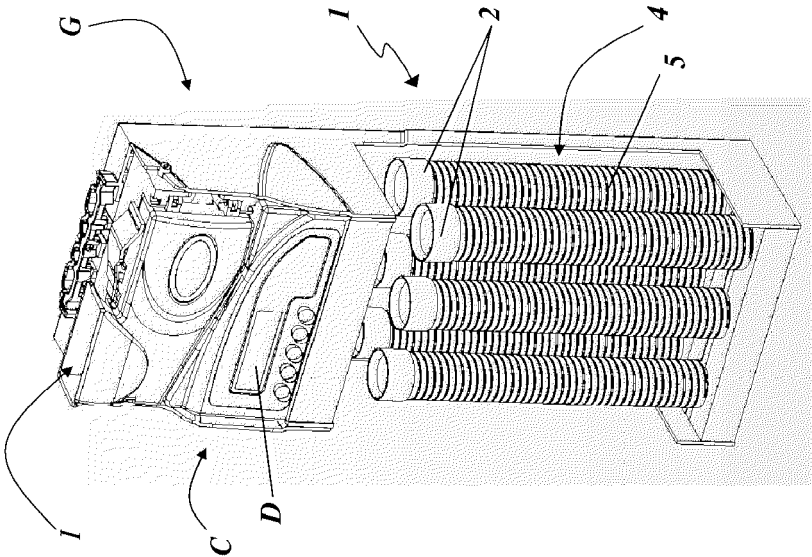


FIG. 1

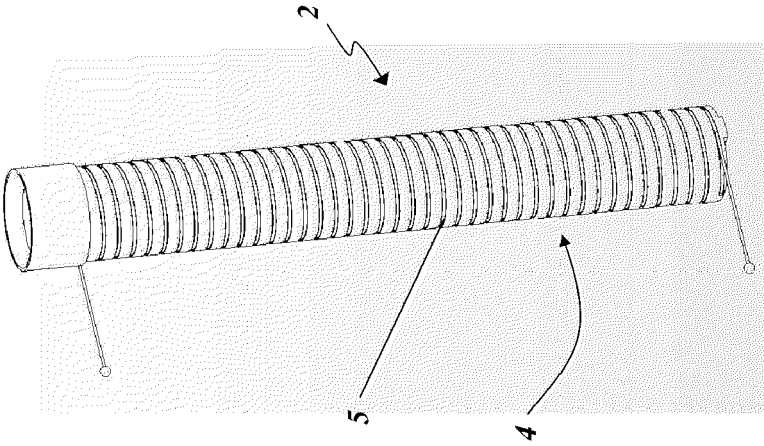


FIG. 3



EUROPEAN SEARCH REPORT

Application Number
EP 10 00 2696

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 38 02 121 A1 (NSM APPARATEBAU GMBH KG [DE] NSM AG [DE]) 3 August 1989 (1989-08-03) * column 1, line 29 - column 2, line 55 * * column 3, lines 1-38 * * column 4, lines 12-29 * * figures 1-4 *	1-9	INV. G07D1/00
X	DE 42 26 611 A1 (NSM AG [DE]) 14 October 1993 (1993-10-14) * column 1, line 18 - column 2, line 19 * * column 2, lines 39-67 * * column 4, lines 3-17 * * figures 1,3,4 *	1-9	
X	US 6 267 662 B1 (JARD PHILIPPE S [US] ET AL) 31 July 2001 (2001-07-31) * column 2, lines 17-59 * * column 3, line 25 - column 4, line 59 * * column 5, line 18 - column 6, line 22 * * figures 1-8 *	1-9	
			TECHNICAL FIELDS SEARCHED (IPC)
			G01D
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 3 May 2010	Examiner Espuela, Vicente
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03-05-2010

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DE 4226611	A1	14-10-1993	NONE	
US 6267662	B1	31-07-2001	NONE	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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