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

(11) EP 2 230 645 B1

# (12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
**10.04.2013 Bulletin 2013/15**

(51) Int Cl.:
***G07D 1/00*** *(2006.01)*

(21) Application number: **10002696.2**

(22) Date of filing: **15.03.2010**

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

Einrichtung und Verfahren zur bestimmung der Münzgeldmenge in einem Münztank.

Système et procédé pour déterminer la quantité de monnaies se trouvant dans un réservoir.

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR**

(30) Priority: **16.03.2009 IT VI20090058**

(43) Date of publication of application:
**22.09.2010 Bulletin 2010/38**

(73) Proprietor: **Coges S.p.A.**
**36015 Schio VI (IT)**

(72) Inventor: **Malaguti, Alberto**
**36010 Carré (VI) (IT)**

(74) Representative: **Trentin, Michele et al**
**Borgo Santa Lucia 31**
**36100 Vicenza (IT)**

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Printed by Jouve, 75001 PARIS (FR)

## 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 devices 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 measuring 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 popwering 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 axsonometric 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 axsonometric 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 impinges 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. Afterwords 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 follow 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 form 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 obtain 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 insensitive, 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 inductor **(5)** 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 generated 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 the power supplying of said inductor (**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.

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

- a first generating step of a magnetic field susceptible to impinge at least said tank **(2)** when empty;
- 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;
- a second measurement step of the magnetic losses of said magnetic field caused by said predetermined number of coins;
- 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.

**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:

- 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;
- 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;
- 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.

**Patentansprüche**

**1.** Einrichtung zum Messen der Anzahl von Münzen in einer Münzhandhabungseinrichtung (G) oder einem ähnlichen Gerät, umfassend:

- wenigstens einen im Wesentlichen rohrförmigen Tank (2) zum Lagern, Laden und Ausgeben von Münzen;
- Emittermittel (4) für ein Magnetfeld, umfassend wenigstens einen Induktor (5), der um den Tank (2) herum verlaufend angeordnet ist und mit Strom versorgt wird, um das Magnetfeld zu erzeugen, mit dem die Münzen, die im Tank (2) enthalten sind, beaufschlagt werden sollen;
- Detektormittel (8) zum Erfassen der magnetischen Verluste des Magnetfeldes aufgrund der Münzen, die im Tank (2) vorhanden sind;
- Rechenmittel (9), die mit den Detektormitteln (8) betriebswirksam verbunden sind, um die Anzahl der Münzen im Tank (2) in Abhängigkeit von den magnetischen Verlusten zu berechnen,

**dadurch gekennzeichnet, dass** die Emittermittel (4) wenigstens eine Trennschaltung umfassen, die aus wenigstens zwei passiven Elementen (5, 7) besteht, wovon eines den Induktor (5) umfasst, wobei die Detektormittel (8) wenigstens eine Messschaltung (10) der elektrischen Potentialdifferenz an den Enden des Induktors (5) umfassen, um den Spannungswert der elektrischen Potentialdifferenz zu messen, wenn der Induktor (5) mit Strom versorgt wird, sodass die magnetischen Verluste erfasst werden.

**2.** Einrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** sie wenigstens einen Wechselstromgenerator (6) umfasst, um den Induktor (5) mit Strom zu versorgen.

**3.** Einrichtung nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** zwischen der Messschaltung (10) und den Rechenmitteln (9) eine Verstärkerschaltung (14) eingefügt ist, wobei der Verstärkungskoeffizient der Verstärkerschaltung (14) von den Rechenmitteln (9) geprüft wird, um den Spannungswert an einen vorausbestimmten Spannungsbereich gemäß den Parametern der Messschaltung (10) anzupassen.

**4.** Einrichtung nach einem oder mehreren der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Rechenmittel (9) wenigstens einen programmierbaren Logikbaustein (12) umfassen.

**5.** Einrichtung nach Anspruch 4, **dadurch gekennzeichnet, dass** der Wechselstromgenerator (6) wenigstens ein Zeitelement umfasst, das zum programmierbaren Logikbaustein (12) gehört, der mit wenigstens einem Tiefpassfilter (16) betriebswirksam verbunden ist, um ein elektrisches Ausgangssignal zu erhalten, das eine Sinuswellenform aufweist.

**6.** Verfahren zum Messen der Anzahl von Münzen in wenigstens einem Tank (2) einer Münzhandhabungseinrichtung (G) oder eines ähnlichen Systems, umfassend folgende Schritte:

- Erzeugen und Emittieren eines Magnetfeldes mittels eines elektrisch versorgten Induktors (5), mit dem der wenigstens eine Tank (2) beaufschlagt werden soll, so dass die darin gelagerten Münzen magnetische Verluste im Magnetfeld verursachen;
- Messen der magnetischen Verluste;
- Berechnen der Anzahl von Münzen, die im Tank (2) gelagert sind, durch Subtrahieren des gemessenen Wertes der magnetischen Verluste vom Wert magnetischer Verluste in Abwesenheit von Münzen im Tank (2) und Dividieren jener Differenz durch einen vorausbestimmten Wert magnetischer Verluste, die durch Vorhandensein einer Münze im Tank (2) erzeugt werden,

**dadurch gekennzeichnet, dass** der gemessene Wert der magnetischen Verluste durch Messen der elektrischen Potentialdifferenz zwischen den Enden des Induktors (5) während der Stromversorgung des Induktors (5) erhalten wird.

7. Verfahren nach Anspruch 6, **dadurch gekennzeichnet, dass** es vor dem Schritt des Messens einen Schritt des Kalibrierens umfasst, um den vorausbestimmten Wert magnetischer Verluste zu bestimmen.

8. Verfahren nach Anspruch 7, **dadurch gekennzeichnet, dass** der Schritt des Kalibrierens wenigstens folgende Schritte umfasst:

- einen ersten Schritt des Erzeugens eines Magnetfeldes, mit dem wenigstens der Tank (2) beaufschlagt werden soll, wenn er leer ist;
- einen ersten Schritt des Messens der magnetischen Verluste des Magnetfeldvakuums;
- einen Schritt des Ladens einer vorausbestimmten Anzahl von Münzen in den Tank (2);
- einen zweiten Schritt des Erzeugens eines Magnetfeldes, mit dem der Tank (2) beaufschlagt werden soll, wenn er die vorausbestimmte Anzahl von Münzen enthält;
- einen zweiten Schritt des Messens der magnetischen Verluste des Magnetfeldes, die durch die vorausbestimmte Anzahl von Münzen verursacht werden;
- einen Schritt des Berechnens der magnetischen Verluste, die durch die vorausbestimmte Anzahl von Münzen verursacht werden, ausgeführt durch Subtrahieren des Wertes der magnetischen Verluste, die im zweiten Schritt des Messens erfasst wurden, vom Wert der Verluste, die im ersten Schritt des Messens erfasst wurden, und Dividieren jener Differenz durch die vorausbestimmte Anzahl von Münzen.

9. Verfahren nach einem oder mehreren der Ansprüche 6 bis 8, **dadurch gekennzeichnet, dass** es einen zusätzlichen Schritt des Kalibrierens umfasst, wobei folgende Schritte identifiziert werden können:

- ein erster Schritt des Skalierens der berechneten Anzahl von Münzen, wenn sich die berechnete Anzahl von einer ganzen Zahl unterscheidet, auf die nächste ganze Zahl;
- ein zweiter Schritt des Skalierens der Messungen magnetischer Verluste auf einen normierten Wert, so dass die berechnete Anzahl von Münzen mit der nächsten ganzen Zahl übereinstimmt;
- ein Schritt des Speicherns der Größe des zweiten Schritts des Skalierens, um den zweiten Schritt des Skalierens auf alle nachfolgenden Messungen magnetischer Verluste anzuwenden, die größer oder gleich dem normierten Wert sind.

## Revendications

1. Dispositif pour mesurer le nombre de pièces de monnaie dans un dispositif de manipulation de pièces de monnaie (G) ou un appareil similaire comprenant :

- au moins un réservoir sensiblement tubulaire (2) pour stocker, charger et distribuer des pièces de monnaie ;
- des moyens émetteurs (4) d'un champ magnétique, comprenant au moins une bobine inductrice (5) agencée de façon périphérique par rapport audit réservoir (2), et alimentés pour générer ledit champ magnétique susceptible d'avoir une incidence sur les pièces de monnaie contenues dans ledit réservoir (2) ;
- des moyens détecteurs (8) pour détecter des pertes magnétiques dudit champ magnétique dues aux pièces de monnaie présentes dans ledit réservoir (2) ;
- des moyens de calcul (9) connectés fonctionnellement auxdits moyens détecteurs (8) pour calculer ledit nombre de pièces de monnaie dans ledit réservoir (2) en fonction desdites pertes magnétiques,

**caractérisé en ce que** lesdits moyens émetteurs (4) comprennent au moins un circuit de séparation composé d'au moins deux éléments passifs (5, 7) dont un comprend ladite bobine inductrice (5), lesdits moyens détecteurs (8) comprenant au moins un circuit de mesure (10) de la différence de potentiel électrique aux extrémités de ladite bobine inductrice (5) pour mesurer la valeur de tension de ladite différence de potentiel électrique lorsque ladite bobine inductrice (5) est alimentée, détectant ainsi lesdites pertes magnétiques.

**2.** Dispositif selon la revendication 1, **caractérisé en ce qu'**il comprend au moins un générateur CA (6) pour alimenter ladite bobine inductrice (5).

**3.** Dispositif selon la revendication 1 ou 2, **caractérisé en ce que**, entre ledit circuit de mesure (10) et lesdits moyens de calcul (9), est interposé un circuit amplificateur (14), le coefficient d'amplification dudit circuit amplificateur (14) étant contrôlé par les moyens de calcul (9) pour régler ladite valeur de tension détectée à une plage de tension prédéterminée selon les paramètres dudit circuit de mesure (10).

**4.** Dispositif selon une ou plusieurs des revendications précédentes, **caractérisé en ce que** lesdits moyens de calcul (9) comprennent au moins une unité logique programmable (12).

**5.** Dispositif selon la revendication 4, **caractérisé en ce que** ledit générateur CA (6) comprend au moins un relais de temporisation, appartenant à ladite unité logique programmable (12), connecté fonctionnellement à au moins un filtre passe-bas (16) pour obtenir un signal électrique de sortie présentant une forme d'onde sinusoïdale.

**6.** Procédé de mesure du nombre de pièces de monnaie dans au moins un réservoir (2) d'un dispositif de manipulation de pièces de monnaie (G), ou un système similaire, comprenant les étapes suivantes :

- la génération et l'émission d'un champ magnétique par l'intermédiaire d'une bobine inductrice (5) alimentée électriquement et qui a une incidence sur ledit au moins un réservoir (2) pour que les pièces de monnaie stockées dans celui-ci entraînent des pertes magnétiques dans ledit champ magnétique ;
- la mesure desdites pertes magnétiques ;
- le calcul du nombre de pièces de monnaie stockées dans ledit réservoir (2) en soustrayant la valeur mesurée desdites pertes magnétiques de la valeur mesurée desdites pertes magnétiques en l'absence de pièces de monnaie dans ledit réservoir (2) et en divisant cette différence par une valeur prédéterminée de pertes magnétiques générée par la présence d'une pièce dans ledit réservoir (2),

**caractérisé en ce que** ladite valeur mesurée desdites pertes magnétiques est réalisée en mesurant la différence de potentiel électrique entre les extrémités de ladite bobine inductrice (5) durant l'alimentation électrique de ladite bobine inductrice (5).

**7.** Procédé selon la revendication 6, **caractérisé en ce qu'**il comprend, avant ladite étape de mesure, une étape d'étalonnage pour déterminer ladite valeur prédéterminée de pertes magnétiques.

**8.** Procédé selon la revendication 7, **caractérisé en ce que** ladite étape d'étalonnage comprend au moins les étapes suivantes :

- une première étape de génération d'un champ magnétique susceptible d'avoir une incidence sur au moins ledit réservoir (2) lorsqu'il est vide ;
- une première étape de mesure des pertes magnétiques dudit vide de champ magnétique ;
- une étape de chargement, dans ledit réservoir (2), d'un nombre prédéterminé de pièces de monnaie ;
- une seconde étape de génération d'un champ magnétique susceptible d'avoir une incidence sur ledit réservoir (2) contenant ledit nombre prédéterminé de pièces de monnaie ;
- une seconde étape de mesure des pertes magnétiques dudit champ magnétique entraîné par ledit nombre prédéterminé de pièces de monnaie ;
- une étape de calcul desdites pertes magnétiques entraînées par ledit nombre prédéterminé de pièces de monnaie, exécutée en soustrayant la valeur desdites pertes magnétiques détectées avec ladite seconde étape de mesure de la valeur desdites pertes détectées avec ladite première étape de mesure et en divisant ladite différence par ledit nombre prédéterminé de pièces de monnaie.

**9.** Procédé selon une ou plusieurs des revendications 6 à 8, **caractérisé en ce qu'**il comprend une étape d'étalonnage supplémentaire dans laquelle peuvent être identifiées :

- une première étape de réduction du nombre calculé desdites pièces de monnaie, si le nombre calculé est différent d'un entier relatif, au nombre entier relatif le plus proche ;
- une seconde étape de réduction desdites mesures de pertes magnétiques à une valeur normalisée de sorte que ledit nombre calculé desdites pièces de monnaie correspondra au nombre entier relatif le plus proche ;
- une étape de stockage de l'amplitude de ladite seconde étape de réduction pour appliquer ladite seconde étape de réduction à toutes les mesures suivantes de pertes magnétiques supérieure ou égales à ladite valeur normalisée.

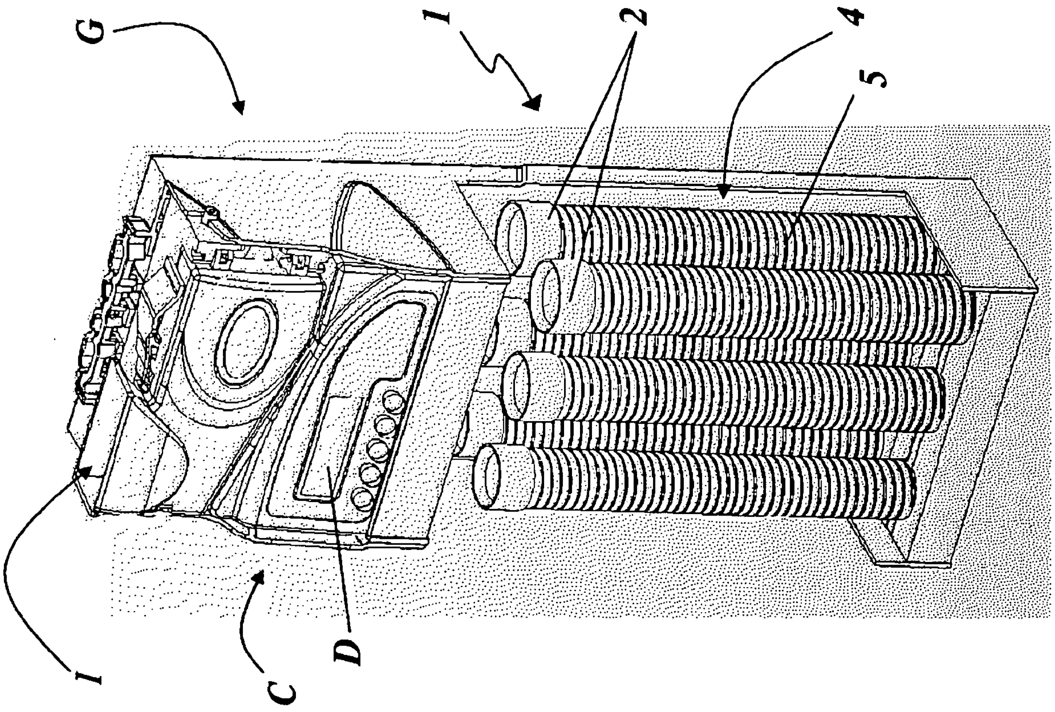


FIG. 1

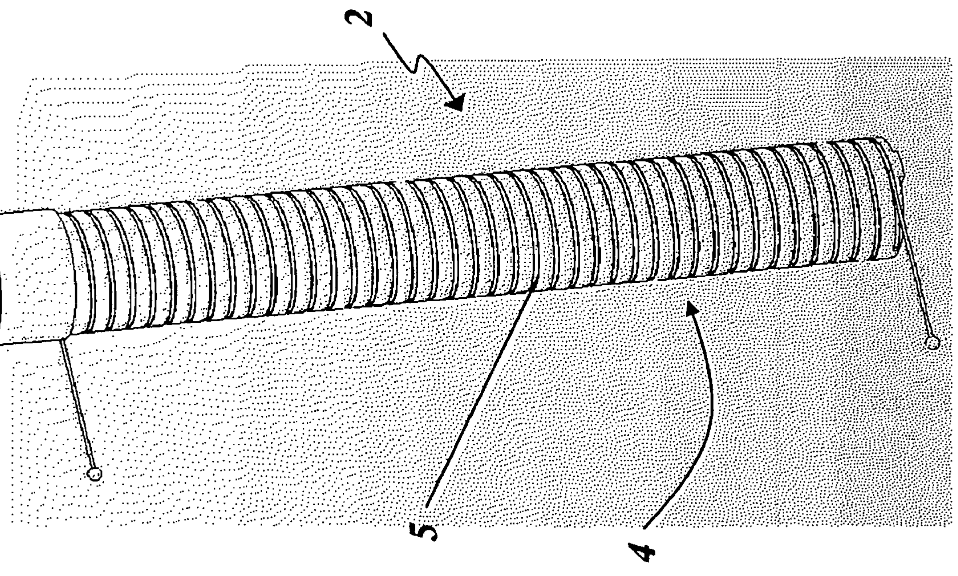


FIG. 3

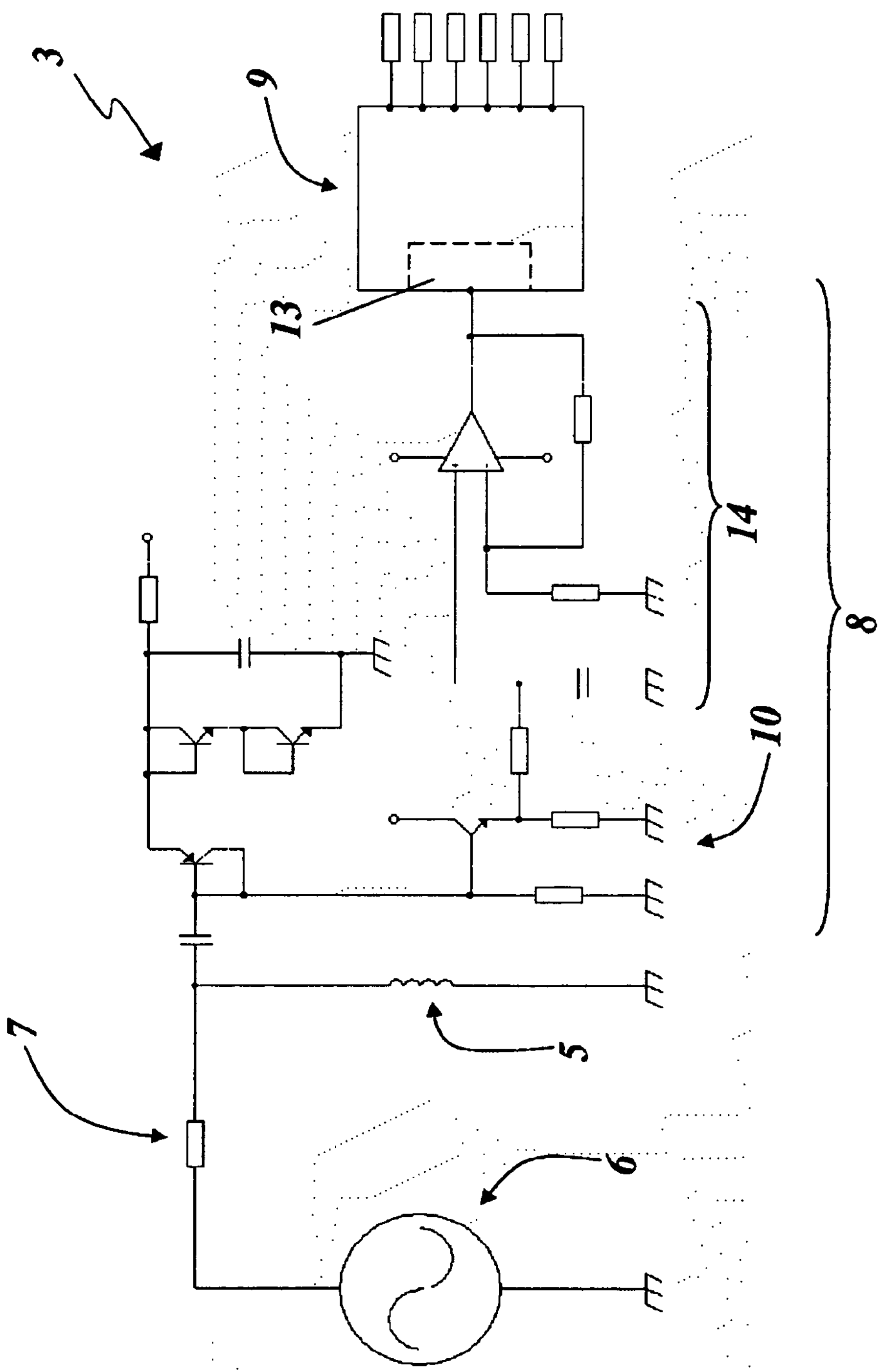


FIG. 2

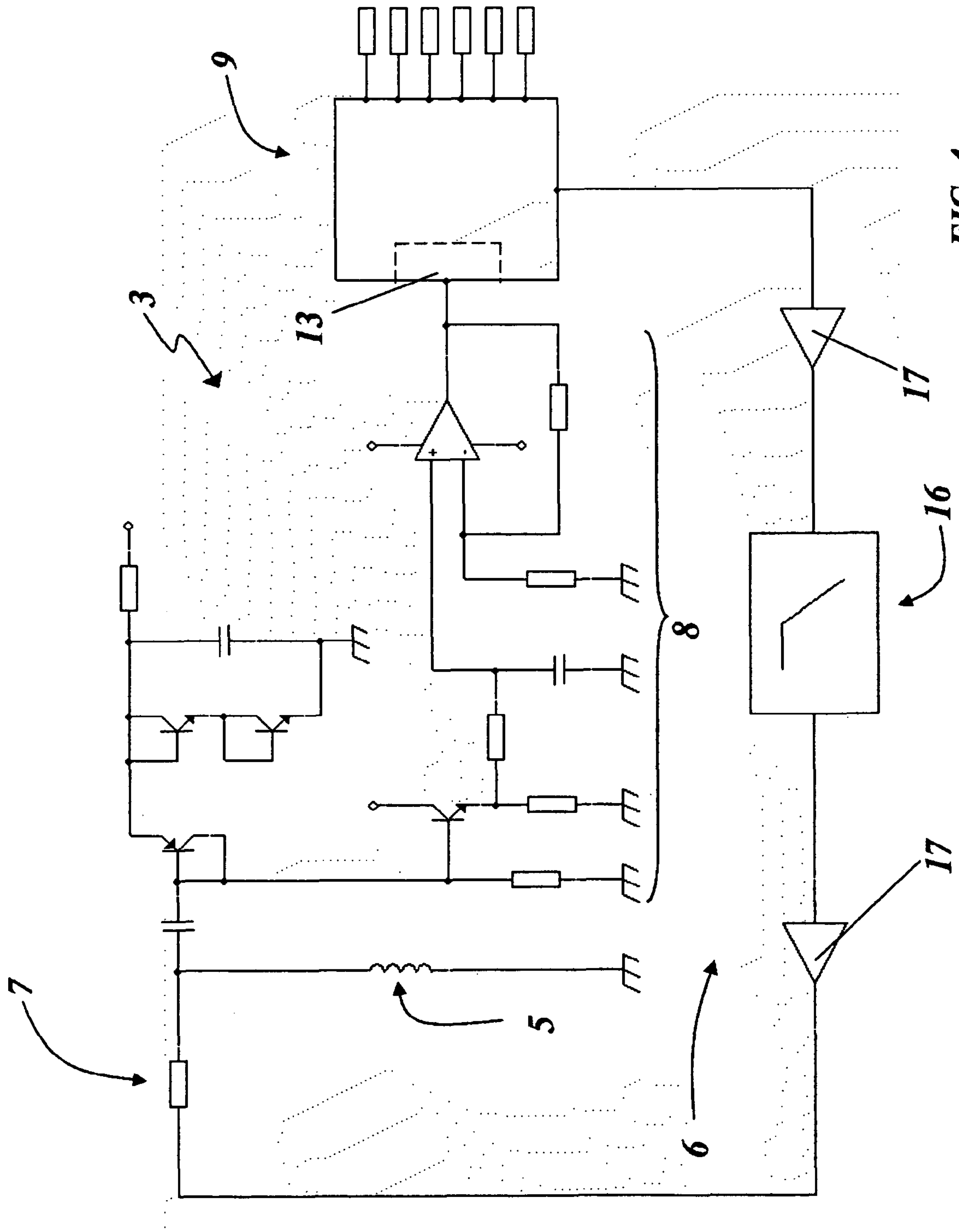


FIG. 4

## REFERENCES CITED IN THE DESCRIPTION

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