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(54) Coin dispensing system with coin tubes with capacitative coin level sensors

(57) An in-passage sensing type coin dispenser system includes coin tubes mounted in a machine main unit, a coin dispenser unit for validating inserted coins and dispensing validated coins into the coin tubes, a coin hopper controllable to discharge coins out of the coin tubes, and a. sensor module including multiple sets of electrodes mounted at the outer perimeter of each coin tube for generating a coupling capacitance and a detection circuit for converting the coupling capacitance from each set of electrodes into a respective digital signal indicative of a low-level or full-level coin storage status of the respective coin tube or the related metal coin storage amount.

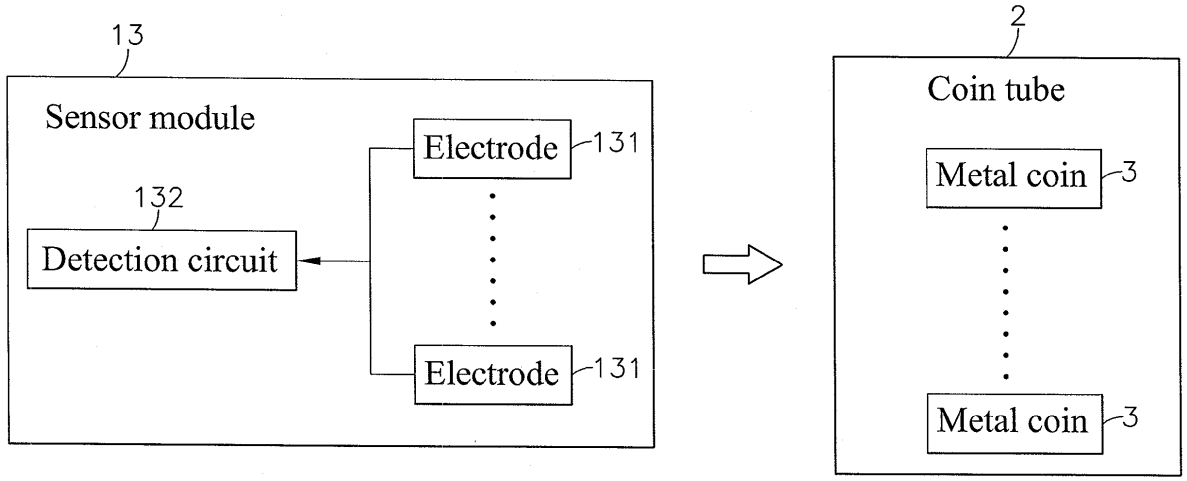


FIG. 3

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Description

1. Field of the Invention:

[0001] The present invention relates to bill acceptor technology and more particularly, to an in-passage sensing type coin dispenser system, which uses electrodes at each coin tube to induce coupling capacitance and a detection circuit to measure the value of each induced coupling capacitance indicative of the coin storage status in each coin tube.

2. Description of the Related Art:

[0002] Following fast development of modern technology, convenience and rapidness are highly demanded in our modern daily life. Nowadays, different automatic vending machines, card dispensers, ticket machines and bill exchange machines are used everywhere to sell different products without serviceman. These machines are highly appreciated for the advantage of saving much labor and bringing convenience to people. With the selling of more and more kinds of goods, advanced vending machines need added functions.

[0003] Further, commercial automatic vending machines and amusement machines commonly provide a coin acceptor for allowing people to insert coins, achieving unmanned operation and self-checkout. Further, a coin-operated automatic vending machine or amusement machine generally uses a coin validator module to validate the authenticity and value of each inserted coin or token. Different coins or tokens have different sizes. After validation of an inserted coin, the coin will be dispensed into one of a number of coin tubes inside the machine. If the number of coins stored in one coin tube reaches a predetermined high level, the coin dispenser cannot dispense any further coin into the respective coin tube. If the coin storage status of one coin tube reaches a predetermined low level, the coin hopper of the machine cannot discharge coins from the respective coin tube, ensuring normal operation of the machine.

[0004] At the present time, non-contact type displacement sensors are commonly used in coin-operated vending machines and amusement machines to detect the storage status of coins in each coin tube. These non-contact type displacement sensors include ultrasonic displacement sensors, magnetic displacement sensors and optical displacement sensors. An ultrasonic displacement sensor transmits an ultrasonic wave onto a coin and to receive reflection of ultrasonic wave from the coin. The energy difference between the transmitted ultrasonic wave and reflected ultrasonic wave, i.e., the attenuation of the ultrasonic energy indicative of the position of the coin is measured by a controller. An ultrasonic displacement sensor has the disadvantages of large size and high cost. Further, the signal strength of an ultrasonic displacement sensor is indirectly proportional to the distance of the coin. For use with an ultrasonic displacement sensor, the length of the coin tubes must be limited. A coin tube having an excessive length may contribute to the problems of scattering attenuation, insufficiency of excited energy and recognition error. A magnetic displacement sensor is adapted to induce an eddy current upon presence of a coin within the effective sensing range. The value of the induced eddy current is measured by a controller to figure out the current position of the coin. A magnetic displacement sensor is simply suitable for a short distance sensing application. When used in a coin tube, the exciting frequency of the sensing coil will be increased, complicating posterior signal processing and relatively increasing the cost.

[0005] Further, an optical displacement sensor is adapted to detect the position of coins in a coin tube by means of light chopping. A light reflector is provided to reflect emitted light onto the coin tube. When a coin passes to chop the light beam, a shadow is produced. A controller calculates the position of the coin subject to change of the shadow. An optical displacement sensor is free from the interference of electronic noises, and has the advantage of low signal attenuation. The size of the coin tube does not significantly affect the sensing accuracy of the optical displacement sensor. When increasing the size of the coin tube, the size of the light reflector must be relatively increased. However, because the light reflector is inexpensive, increasing the size of the light reflector does not increase much the cost of the optical displacement sensor. However, recognition error may occur if the optical displacement sensor is used under a dust or polluted environment.

[0006] In view of the above statement, there is still room for improvement in coin detection

SUMMARY OF THE INVENTION

[0007] The present invention has been accomplished under the circumstances in view. It is therefore one object of the present invention to provide an in-passage sensing type coin dispenser system, which detects the coin storage status in each coin tube of the coin dispenser system by means of capacitive coupling technology, having the advantages of simple structure, rapid response, workability under high temperature, dust and/or polluted environment, ease of installation and low cost.

[0008] To achieve this and other objects of the present invention, an in-passage sensing type coin dispenser system comprises a housing, a coin tubes mounted in the housing for storing predetermined metal coins having a predetermined value and size, a coin dispensing unit mounted in the housing at a top side for validating the authenticity and value of metal coins and dispensing validated metal coins into the coin tubes, a coin hopper mounted in the housing at a bottom side for discharging metal coins out of the coin tubes, and a sensor module, which comprises an upper set of electrodes mounted at the outer perimeter of each coin tube near the top end thereof for sensing the presence of metal coins in the

respective coin tube and generating a corresponding first induced current of analog signal, a lower set of electrodes mounted at the outer perimeter of each coin tube near the bottom end thereof for sensing the presence of said metal coins in the respective coin tube and generating a corresponding second induced current of analog signal, and a detection circuit electrically coupled with the upper and lower sets of electrodes and adapted to receive the first induced current of analog signal and second induced current of analog signal. If the detection circuit receives a first induced current of analog signal from the upper set of electrodes at one coin tube, the detection circuit immediately stops the coin dispenser unit from dispensing metal coins into the respective coin tube. If the detection circuit receives a second induced current of analog signal from the lower set of electrodes at one coin tube, the detection circuit immediately stops the coin hopper from discharging metal coins out of the respective coin tube.

[0009] In an alternate form of the present invention, the in-passage sensing type coin dispenser system comprises a housing, a coin tubes mounted in the housing for storing predetermined metal coins having a predetermined value and size, a coin dispensing unit mounted in the housing at a top side for validating the authenticity and value of metal coins and dispensing validated metal coins into the coin tubes, a coin hopper mounted in the housing at a bottom side for discharging metal coins out of the coin tubes, and a sensor module, which comprises multiple sets of electrodes bilaterally and longitudinally mounted at the outer perimeter of each coin tube along the length thereof for generating a coupling capacitance, and a detection circuit electrically coupled with the multiple sets of electrodes and adapted to receive the coupling capacitance and to convert the coupling capacitance received from the set of electrodes at each coin tube into a corresponding digital signal indicative of the number of metal coins being stored in the respective coin tube.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

FIG. 1 is an elevational view of an in-passage sensing type coin dispenser system in accordance with the present invention.

FIG. 2 is an exploded view of the in-passage sensing type coin dispenser system in accordance with the present invention.

FIG. 3 is a block diagram of the sensor module of the in-passage sensing type coin dispenser system in accordance with the present invention.

FIG. 4 is a schematic sectional view illustrating electrodes mounted at the outer perimeters of coin tubes near top and bottom ends thereof in accordance with the present invention.

FIG. 5 is similar to FIG. 4, illustrating the storage of metal coins in one coin tube at a low-level status and the storage of metal coins in the other coin tube at a full-level status.

FIG. 6 is a schematic sectional view illustrating electrodes mounted at the outer perimeters of coin tubes in a parallel manner and extended along the length of the coin tubes in accordance with the present invention.

FIG. 7 corresponds to FIG. 6, illustrating the storage amount of metal coins in one coin tube changed.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0011] Referring to FIGS. 1-5, an in-passage sensing type coin dispenser system in accordance with the present invention is shown. The coin dispenser system comprises a machine main unit **1,** and a set of coin tubes **2.**

[0012] The machine main unit **1** comprises a housing **11** defining therein an accommodation space **10,** a coin dispensing unit **12** mounted in a top side in the accommodation space **10** inside the housing **11,** a sensor module **13** mounted in a bottom side of the coin dispensing unit **12,** and a coin hopper **14** mounted in a bottom side in the accommodation space **10** inside the housing **11.** The set of coin tubes **2** is mounted in the coin hopper **14** at the bottom side of the coin dispensing unit **12.** The coin dispensing unit **12** comprises a coin inlet **120** disposed at a top side thereof for receiving metal coins **3,** a coin validator module **121** for validating the authenticity and values of metal coins **3** being put into the coin inlet **120,** and a coin dispensing module **122** for dispensing validated metal coins **3** into the coin tubes **2** in a proper order.

[0013] The sensor module **13** comprises multiple sets of electrodes **131** respectively mounted on the outer perimeters of the coin tubes **2** at different elevations, a detection circuit **132** electrically coupled with the multiple sets of electrodes **131** by electric wires and arranged at the bottom side of the coin dispenser unit **12.** In actual application, the detection circuit **132** can be mounted inside the coin dispenser unit **12,** or at any suitable location inside the housing **11** to detect change of capacitance of storage metal coins **3** in each of the coin tubes **2.** Further, the coin hopper **14** is mounted at the bottom side in the accommodation space **10** inside the housing **11** to accommodate the coin tubes **2** and to propel storage metal coins **3** out of the coin tubes **2** for coin exchange or giving change.

[0014] The coin tubes **2** are cylindrical coin storage devices for receiving sorted metal coins **3,** each defining a cylindrical passage **20** that has a specific inner diameter for accommodating a predetermined number of metal coins **3** having a specific value.

[0015] As stated above, the coin dispenser unit **12** is mounted in the housing **11** of the machine main unit **1** at the top side; the hopper **14** is mounted in the housing **11**

at the bottom side of the coin tubes **2;** the multiple sets of electrodes **131** of the sensor module **13** are respectively mounted around the outer perimeters of the coin tubes **2** near the opposing top and bottom ends thereof and respectively electrically connected to the positive and negative terminals of the detection circuit **132;** each coin tube **2** defines therein a cylindrical passage **20** having a specific inner diameter for accommodating a predetermined number of metal coins **3.** Further, the electrodes **131** of the sensor module **13** can be configured having a thickness equal to, or, greater or smaller than the thickness of the metal coins **3** to be dispensed into the coin tubes **2.**

[0016] When metal coins **3** are guided into the coin tubes **2** by the coin dispenser unit **12,** the metal coins **3** are kept in the cylindrical passages **20** of the respective coin tubes **2** between the respective upper and lower sets of electrodes **131.** At this time, a change of capacitance occurs in the capacitive coupling between the electrodes **131** and the storage metal coins **3** in each coin tube **2,** causing the upper or lower set of electrodes **131** at each coin tube **2** to provide a respective induced current of analog signal to the detection circuit **132** for conversion into a respective digital signal indicative of the capacitance value between the upper or lower set of electrodes **131** at the respective coin tube **2.** If the detection circuit **132** detects a change in the capacitance value between the lower set of electrode **131** at one coin tube **2,** it means that the respective coin tube **2** has metal coin(s) **3** stored therein. At this time, this coin tube **2** is at a low-level status, and the coin hopper **14** is prohibited from discharging metal coins. If the detection circuit **132** detects a change in the capacitance value between the upper set of electrode **131** at one coin tube **2,** it means that the respective coin tube **2** has metal coin(s) **3** stored therein. At this time, this coin tube **2** is at a full-level status, and the coin dispenser unit **12** is stopped from dispensing metal coins into the coin tubes **2.** Subject to the arrangement described above, the invention effectively detects the coin storage status of each coin tube **2** to be at a low level or full level status. Further, the electrodes **131** have the advantages of simple structure, rapid response, workability under high temperature, dust and/or polluted environment, ease of installation and low cost.

[0017] Referring to FIGS. 6 and 7, in an alternate form of the present invention, two electrodes **131** are bilaterally and longitudinally mounted at the outer perimeter of each coin tube **2** along the length of the respective coin tube **2,** and electrically connected to the detection circuit **132.** During operation, a capacitance is induced between the two electrodes **131** indicative of the amount of metal coins **3** stored in the cylindrical passage **20.** Further, the surface area of the electrodes **131** can be increased to relatively increase the sensitivity, assuring a high level of sensing reliability.

[0018] When metal coins **3** are put into the cylindrical passage **20** in each coin tube **2,** the capacitance between the two electrodes **131** at the outer perimeter of the respective coin tube **2** is changed, generating an induced current that is measured by the detection circuit **132** and converted into a corresponding digital signal indicative of the amount of metal coins **3** in the cylindrical passage **20** of the respective coin tube **2.**

[0019] Referring to FIGS. 2, 3, 5 and 7 again, the invention is characterized by arranging the electrodes **131** of the sensor module **13** at the outer perimeter of each coin tube **2** in the coin hopper **14** at the bottom side of the coin dispenser unit **12** inside the housing **11** of the machine main unit **1** and electrically connecting the electrodes **131** to the detection circuit **132** such that when metal coins **3** are dispensed into the cylindrical passage **20** in each coin tube **2,** a change of capacitance between the electrodes **131** at the respective coin tube **2** occurs, and the detection circuit **132** measures the capacitance value and converts it into a digital signal indicative of the low-level or high-level coin storage status of the respective coin tube **2** or the amount of metal coins **3** being stored in the respective coin tube **2.** This coin sensing method is simple, highly reliable, and cost effective.

[0020] Although a particular embodiment of the invention has been described in detail for purposes of illustration, various modifications and enhancements may be made without departing from the spirit and scope of the invention. Accordingly, the invention is not to be limited except as by the appended claims.

Claims

1. An in-passage sensing type coin dispenser system, comprising:

a machine main unit comprising a housing;
a coin tubes mounted in said housing, each said coin tube defining therein a cylindrical passage for storing predetermined metal coins having a predetermined value and size;
a coin dispensing unit mounted in a top side in said housing, said coin dispensing unit comprising a coin inlet disposed at a top side thereof for receiving said metal coins, a coin validator module for validating the authenticity and values of the metal coins being put into said coin inlet, and a coin dispensing module for dispensing validated said metal coins into said coin tubes;
a coin hopper mounted in said housing for discharging said metal coins out of said coin tubes; and
a sensor module comprising an upper set of electrodes mounted at the outer perimeter of each said coin tube near a top end thereof for sensing the presence of said metal coins in the respective said coin tube and generating a corresponding first induced current of analog signal, a lower set of electrodes mounted at the outer perimeter of each said coin tube near a

bottom end thereof for sensing the presence of said metal coins in the respective said coin tube and generating a corresponding second induced current of analog signal, and a detection circuit electrically coupled with each said upper set of electrodes and each said lower set of electrodes adapted to receive said first induced current of analog signal and said second induced current of analog signal, detection circuit stopping said coin dispenser unit from dispensing said metal coins into each said coin tube when received said first induced current of analog signal from the associating upper set of electrodes, said detection circuit stopping said coin hopper from discharging said metal coins out of each said coin tube when received said second induced current of analog signal from the associating lower set of electrodes.

2. The in-passage sensing type coin dispenser system as claimed in claim 1, wherein said detection circuit converts said first induced current of analog signal into a first digital signal indicative of a full-level metal coin storage status of the respective said coin tube and said second induced current of analog signal into a second digital signal indicative of a low-level metal coin storage status of the respective said coin tube.

3. The in-passage sensing type in dispenser system as claimed in claim 1, wherein each said electrode of said sensor module is configured having a thickness equal to the thickness of one individual said metal coin.

4. The in-passage sensing type in dispenser system as claimed in claim 1, wherein each said electrode of said sensor module is configured having a thickness greater than the thickness of one individual said metal coin.

5. The in-passage sensing type in dispenser system as claimed in claim 1, wherein each said electrode of said sensor module is configured having a thickness smaller than the thickness of one individual said metal coin.

6. An in-passage sensing type coin dispenser system, comprising:

a machine main unit comprising a housing;
a coin tubes mounted in said housing, each said coin tube defining therein a cylindrical passage for storing predetermined metal coins having a predetermined size and value;
a coin dispensing unit mounted in a top side in said housing, said coin dispensing unit comprising a coin inlet disposed at a top side thereof for receiving said metal coins, a coin validator module for validating the authenticity and values of metal coins being put into said coin inlet, and a coin dispensing module for dispensing validated said metal coins into said coin tubes;
a coin hopper mounted in said housing for discharging said metal coins out of said coin tubes; and
a sensor module comprising multiple sets of electrodes respectively and bilaterally mounted at the outer perimeter of each
said coin tube and longitudinally extending along the length of each said coin tube for generating a coupling capacitance, and a detection circuit electrically coupled with said multiple sets of electrodes and adapted to receive said coupling capacitance and to measure the value of said coupling capacitance that is indicative of the number of said metal coins being stored in the respective said coin tube.

7. The in-passage sensing type in dispenser system as claimed in claim 6, wherein said detection circuit converts the coupling capacitance received from the set of electrodes at each said coin tube into a corresponding digital signal indicative of the number of said metal coins being stored in the respective said coin tube.

8. The in-passage sensing type in dispenser system as claimed in claim 6, wherein each set of electrodes at each said coin tube has a vertical height extending along the length of the respective said coin tube over the combined thickness of a stack of a predetermined number of said metal coins.

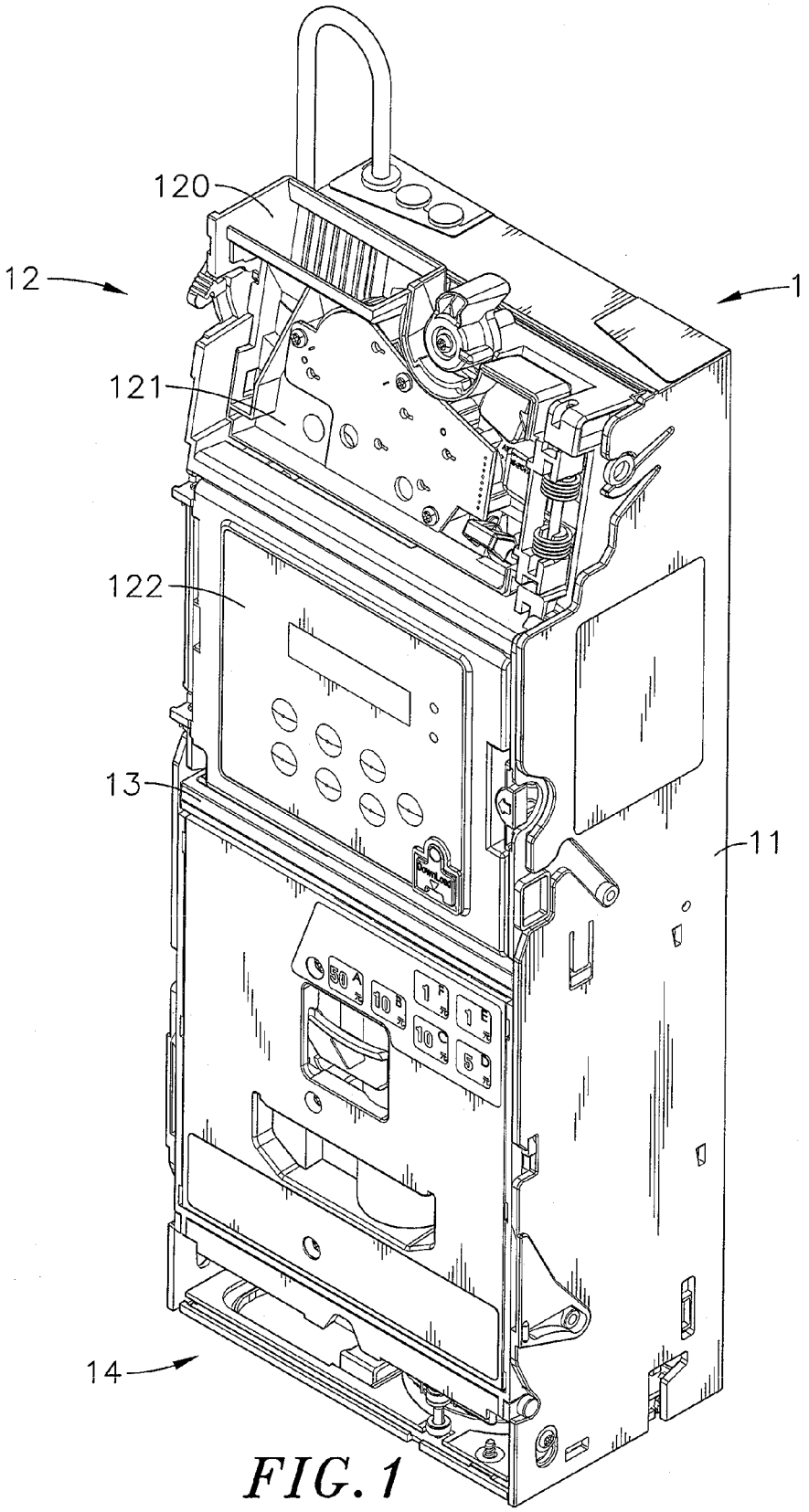


FIG. 1

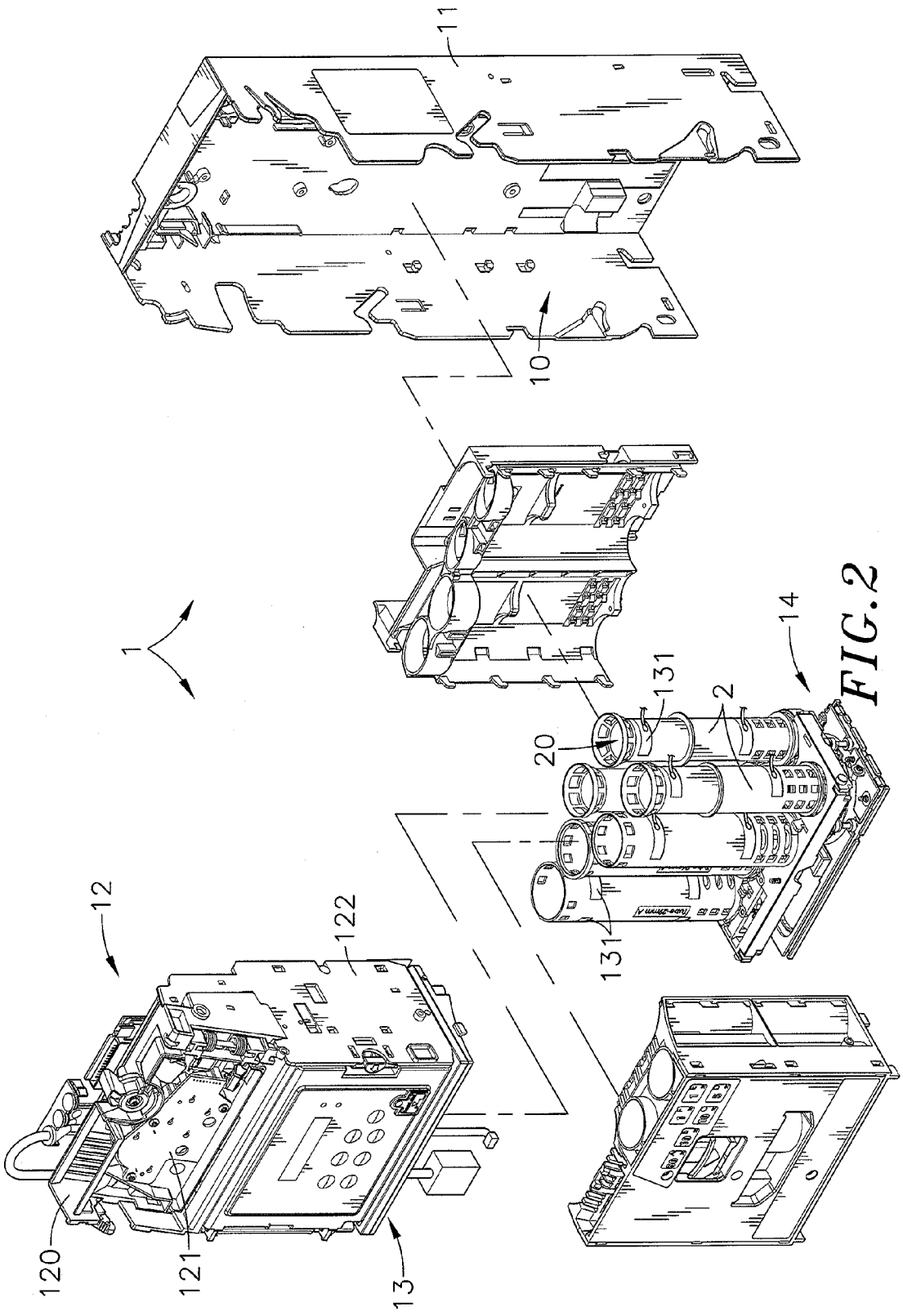


FIG. 2

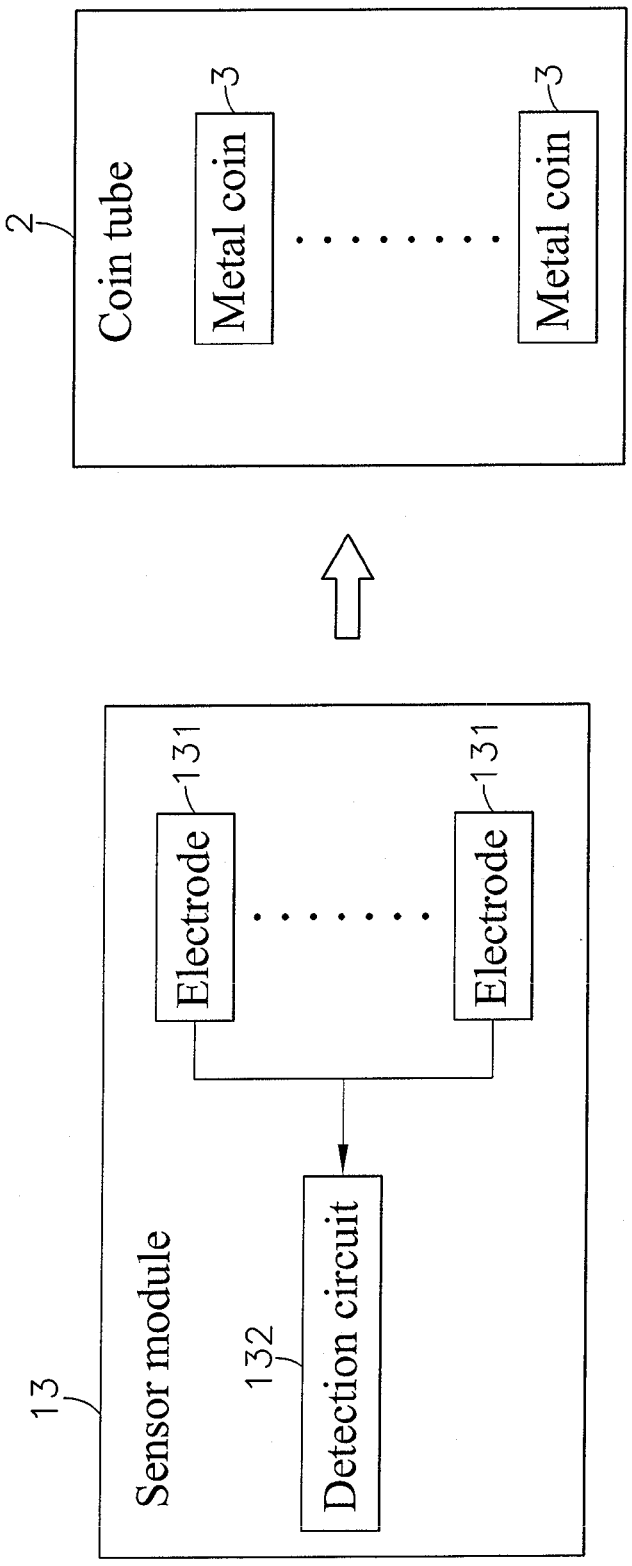

2
Coin tube
3
Metal coin
3
Metal coin
13
Sensor module
131
Electrode
131
Electrode
132
Detection circuit

FIG. 3

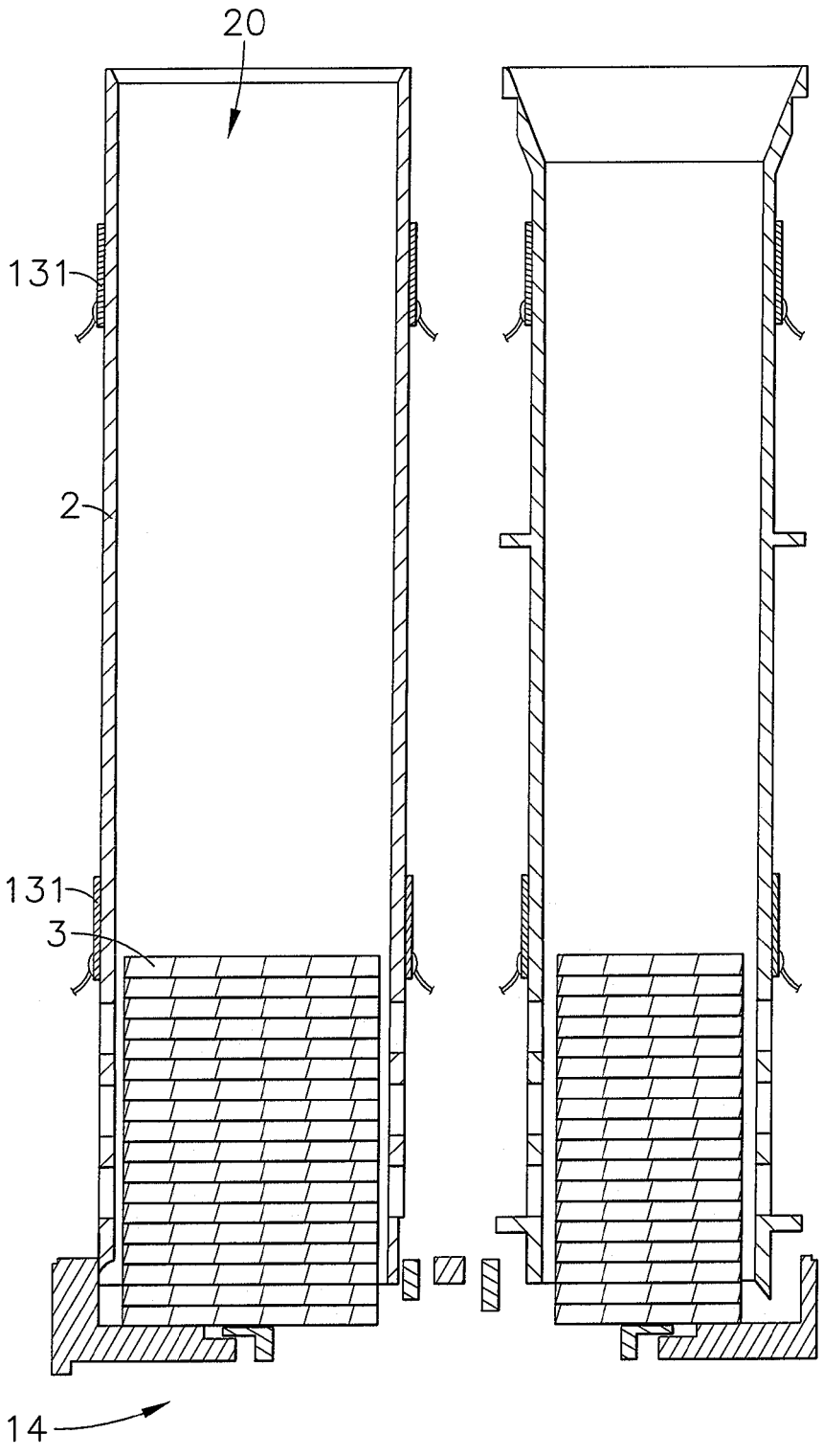


FIG. 4

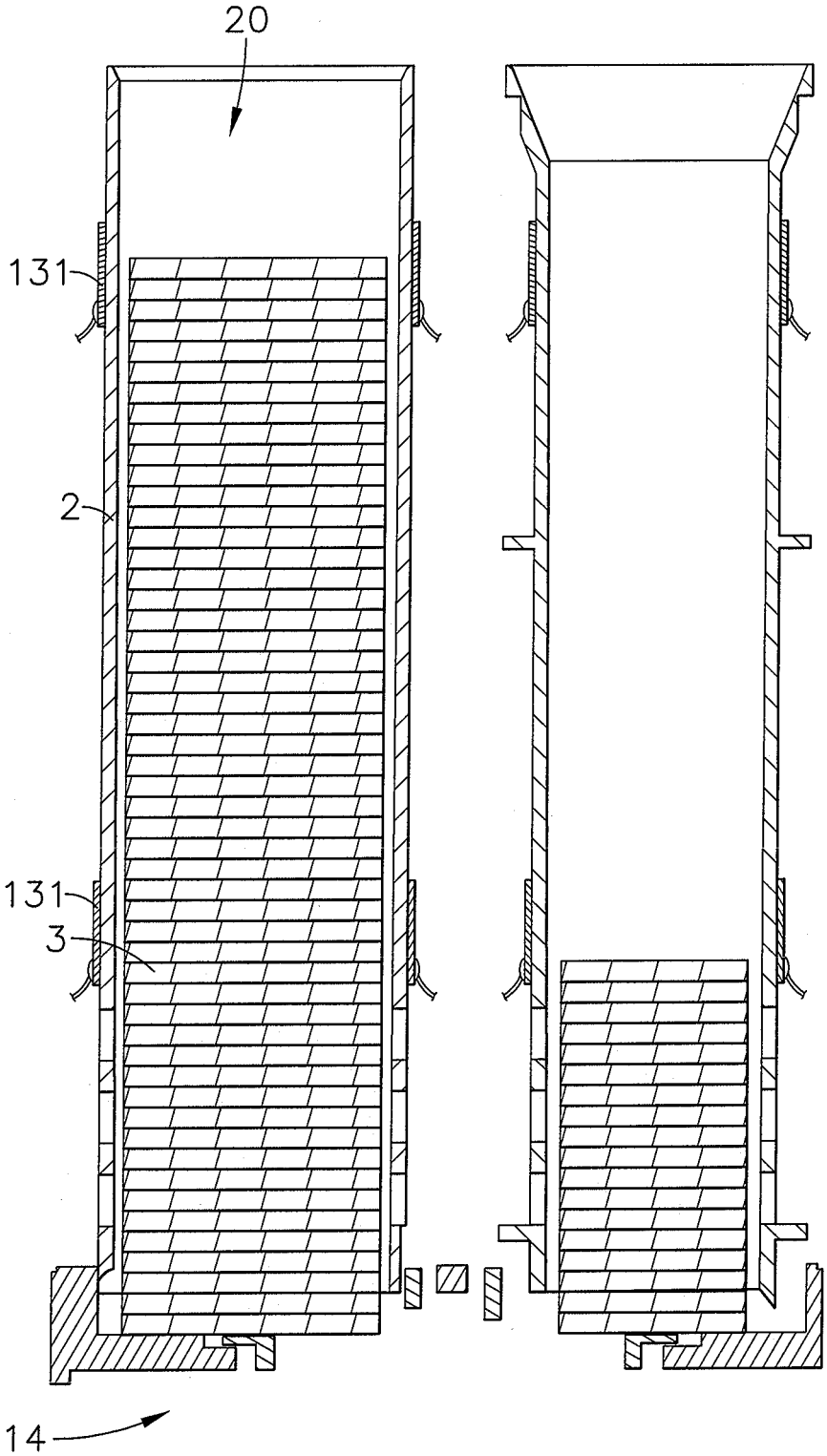


FIG.5

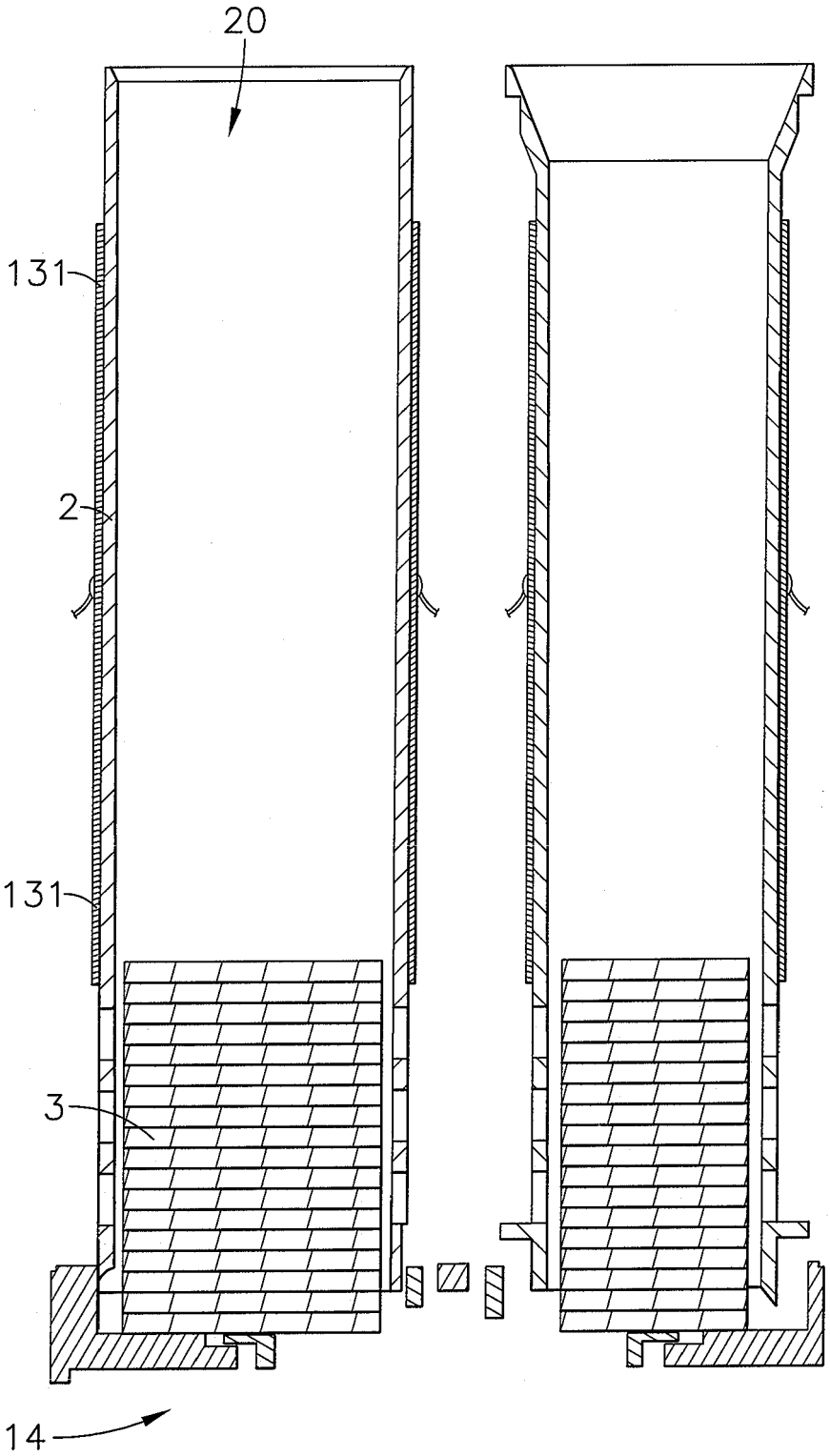


FIG. 6

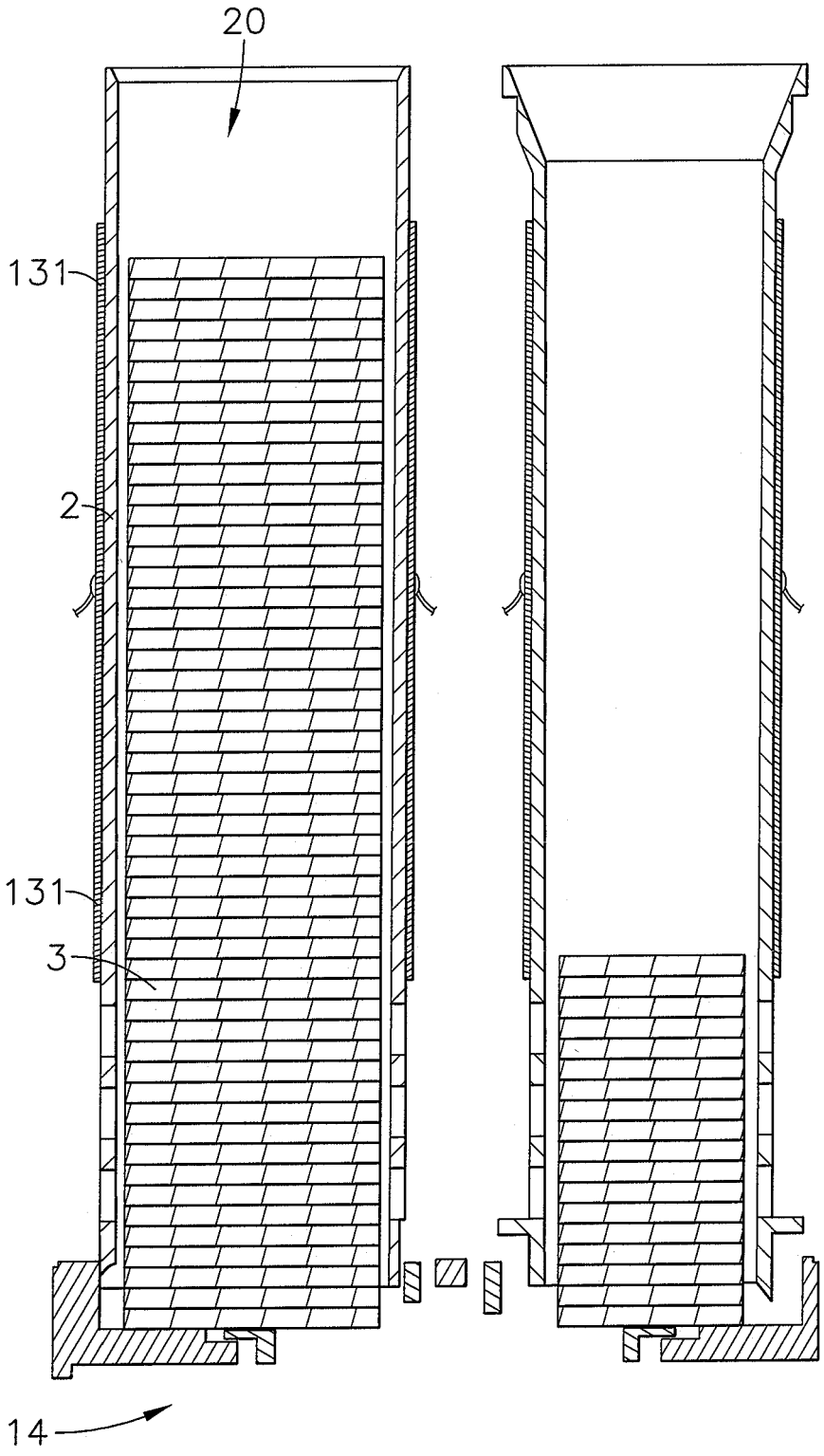


FIG. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 13 15 0051

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	US 6 267 662 B1 (JARD PHILIPPE S [US] ET AL) 31 July 2001 (2001-07-31) * column 3, line 25 - column 4, line 27 * * column 5, line 18 - line 67 * * column 6, line 6 - line 9 * * column 6, line 12 - line 20; figures 1-5, 7b * -----	1-8	INV. G07D1/00
A	EP 0 680 021 A1 (NAT REJECTORS GMBH [DE]) 2 November 1995 (1995-11-02) * column 2, line 23 - line 24 * * column 2, line 44 - line 45 * * column 3, line 1 - line 13 * * column 4, line 28 - line 35 * * column 5, line 1 - line 4; figure 1 * -----	1,2,6	
A	DE 101 05 332 A1 (HESS SB AUTOMATENBAU GMBH & CO [DE]) 29 August 2002 (2002-08-29) * claims 1, 6, 7; figures * -----	1,2,6	
			TECHNICAL FIELDS SEARCHED (IPC) G07D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	7 May 2013	Neville, David

CATEGORY OF CITED DOCUMENTS

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07-05-2013

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