(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
27 September 2007 (27.09.2007)

PCT

(10) International Publication Number
WO 2007/106964 A1

(51) International Patent Classification:
G01F 23/62 (2006.01)

(21) International Application Number:
PCT/BR2007/000068

(22) International Filing Date: 20 March 2007 (20.03.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
MU 8600392-5 20 March 2006 (20.03.2006) BR

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(81) **Designated States** *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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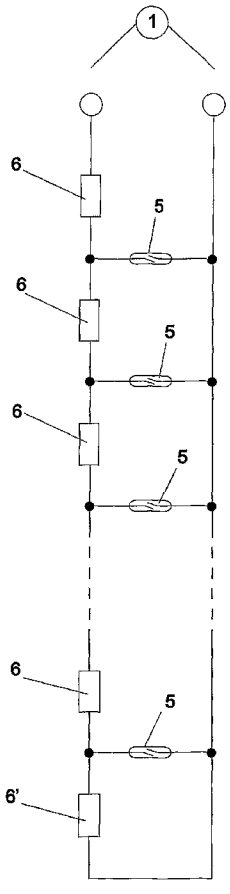
(54) **Title:** MAGNETIC RESISTIVE FUEL LEVEL SENSOR FOR AUTOMOTIVE VEHICLES AND SIMILAR



(57) **Abstract:** Magnetic resistive fuel level sensor for automotive vehicles and similar, applicable to fuel tanks of vehicles and similar, outstanding for having magnetic-resistive actuation by means of a float (1) with an inserted magnet (2), displace along appropriate guides (3) that, in case of volume variation inside the tank, is displaced vertically in parallel to an electronic board (4) containing magnetic sensors (5) and resistors (6), all conducted without invasion since the sensor has no rod, in order to avoid wear of the resistive element.

WO 2007/106964 A1

Published:
— *with international search report*

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"MAGNETIC RESISTIVE FUEL LEVEL SENSOR FOR AUTOMOTIVE VEHICLES AND SIMILAR"

BRIEF INTRODUCTION

This Utility Model Patent application is about a **"MAGNETIC RESISTIVE FUEL LEVEL SENSOR FOR AUTOMOTIVE VEHICLES AND SIMILAR"**, particularly a fuel level sensor for measuring the fuel level in the tank of automotive vehicles and similar, this sensor having no rod, thus it is not invasive in order to avoid the wear of the resistive element, including also a float provided with a magnet inside it, with vertical movement along the sensor track, by means of guides, such track consisting of an electronic board basically consisting of magnetic sensors and resistors.

BRIEF HISTORY

Various particulars are desirable and indispensable for fuel level sensors to be used in automotive vehicles. The main particulars are:

- Durability
- Reliability
- Technical feasibility, for manufacture and economic.

A) Durability – since it is partially submerged in fuel, all the area exposed to the fuel in question shall be designed and manufactured with materials that withstand the oxidizing and/or corrosive agents characteristic of the fuels such as gasoline and alcohol, for example. This fact assures the non deterioration of the sensor during the time of use, considering the unhealthy means where it is installed. Another factor that determines the durability of the level sensor is its capacity to withstand temperature

variations. During practical application, a vehicle may be submitted to different types of climate, i.e., variable temperatures. Depending on the region, the temperature may vary from some negative Celsius degrees up to various tenths of positive Celsius degrees inside the fuel tank. Besides chemical strength and resistance to temperature gradients, it is necessary to consider the mechanical strength of the assembly. During normal use, the vehicle is exposed to various movements that generate vibrations and mechanical impacts, transmitted to the level sensor. For this reason, the concern with the mechanical strength of the assembly is indispensable to assure the durability of the same. Another aspect of vital importance, not only for the correct operation of the sensor, but the user safety as well, is the sealing of the assembly. If the level sensor has a deficient sealing on the mechanical components, the fuel may infiltrate inside the sensor and reach the electronic circuit and may cause early deterioration and, due to the presence of electrical current, even when reduced, a combustion hazard.

B) Reliability – for a correct measurement of the fuel level inside the tank, the level sensor shall be accurate; with an appropriate resolution for the application as well as repeatability assurance. In order to assure the accuracy or precision of the measurement, the sensor shall be calibrated in compliance with a calibration curve corresponding to the respective tank where it will be used. This curve, directly related to the tank format and the particulars of the fuel level indicator, varies according to each vehicle model / manufacturer. The resolution of the level sensor determines how many reading points the sensor shall have. Thus, a better resolution will have more reading points available in the panel and will have better processing for the signal corresponding to the fuel level in the tank, conducted by the electronic control unit of the vehicle. The repeatability is a determinant factor to be considered to assure that the measurements,

corresponding to a certain level, will not change with time, due to any of the already commented inconveniences.

C) Feasibility – in order to be economically feasible, a fuel level sensor, besides complying with the quality and reliability requirements, shall have low production cost; shall allow the automation of the manufacture process, due to the large demand; shall allow facilitated logistics, for raw material and finished product, and, above all, shall be compatible with the fuel tanks of the manufactures vehicles.

STATE OF THE ART

Fuel sensors shall convert the fuel level of the tank into a corresponding electrical resistance in order to allow the interpretation of the signal by the indicator and the electronic control unit of the vehicle.

In the current STATE OF THE ART the used method includes a float coupled to the end of a rod, the other end shall be coupled to conductive brush system running along a resistive track on an electronic circuit board. The fuel levels changes in the tank move the float causing an angular movement of the rod, which on its turn, changes the position of the conductive brush on the resistive track, due to the change in the electrical resistance.

Even though the conventional reading method is functional, it presents some inconveniences related to the loss of calibration due to the deformation of the rod; susceptibility for fuel infiltration due to the fact that the rod invades the sensor body, mechanical wear due to the friction of the conductive brush on the resistive track.

The operation of the conventional measuring method needs a power supply source (battery) coupled to the assembly, which changes the original characteristics of the vehicle. A third disadvantage is relative to the float containing the magnet, which moves along the

electronic circuit shaft, besides the longitudinal movement (up or down) it is also subject to radial movement, i.e., around the housing of the mentioned circuit, needing a double magnet to actuate the circuit in any radial position.

OBJECTIVE OF THE INNOVATION

To crate a fuel level meter for tanks of vehicles and similar, outstanding due to conduction the measuring by means of resistive - magnetic reading characterizing a non invasive measuring means, i.e., without the rod there is no wear of the resistive element, in order to extend the operation life of the level meter assembly, showing to be accurate, efficient and durable.

These factors open a market option, particularly, as commented above, in the automobile industry that requires quality, accuracy, sturdiness and reliability.

ABOUT THE INNOVATION

The main aspect of the innovation is the fact that this is a fuel level sensor with no rod, including a float with a magnet inside it that moves vertically along the sensor track by means of guides, provided with an electronic circuit board inside the sensor.

The float position relative to the sensor track corresponds to the fuel level inside the tank. The change in the electrical resistance is due to the interaction of the magnetic field of the float magnet and magnetic sensors positioned horizontally along all the vertical length of the electronic board of the level sensor. Each magnetic sensor has one of its terminals connected to the node point of a series connected resistor set, its other terminal is connected to the other magnetic sensors. Thus, the drive of the magnetic sensor on a certain position, caused by the magnetic field of the magnet, changes the electric resistance to the corresponding value.

DESCRIPTION OF THE DRAWINGS

As follows, the figures show the new concept facilitating the understanding of the requested coupling, showing:

Figure 1: Schematic electric drawing of the magnetic-resistive fuel level sensor for automotive vehicles and similar;

Figure 2: Side view showing the main components of the magnetic-resistive fuel level sensor for automotive vehicles and similar, with base details;

Figure 3: Front view showing the main components of the magnetic-resistive fuel level sensor for automotive vehicles and similar;

Figure 4: Lower view of the magnetic-resistive fuel level sensor for automotive vehicles and similar;

Figure 5: Upper view of the magnetic-resistive fuel level sensor for automotive vehicles and similar;

Figure 6: Detail of the float of the magnetic-resistive fuel level sensor for automotive vehicles and similar.

The "MAGNETIC RESISTIVE FUEL LEVEL SENSOR FOR AUTOMOTIVE VEHICLES AND SIMILAR", object of this Patent application, is applicable to fuel tanks of vehicles and similar, with the particular features of having magnetic-resistive actuation by means of a float (1) with an inserted magnet (2), which is displaced along appropriate guides (3) that, in case of variation in the fuel volume inside the tank, is displaced vertically in parallel to an electronic board (4) containing magnetic sensors (5) and resistors (6), all this is not invasive since the sensor does not have a rod, in order to avoid the wear of the resistive element.

More particularly, the fuel level sensor (S) for general vehicles has magnetic-resistive actuation; consisting of an electronic circuit board (4) containing magnetic sensors (5) located horizontally along all the extension of the electronic board (4), each magnetic sensor (5) has one of its terminals connected to the node point of a series connected resistor set (6), with the other terminal connected to the other magnetic sensors (5). The connection terminals (T) of the magnetic sensors (5), since it is resistive, have no polarity for connection. The electronic board (4) has a housing (7) in an appropriate material to withstand the adverse conditions of the fuel means, provided with a standard fitting system ideal for the pump where it will be installed, besides guides (3) located in front of the electronic board (4), where the float (1) will move. The mentioned float (1), with semi-cylindrical format, is manufactured in low density material, including a magnet (2) inside it, able to activate the magnetic sensors (5) of the electronic board (4). This float (1) format does not allow its rotation relative to the guide (3), assuring the correct positioning of the magnet (2) relative to the magnetic sensors (5). Also in the lower part there is an inlet filter 98) to prevent solid impurities inside the guides (3) that may cause jamming of the float (1).

Thus, the actuation of the magnetic sensor (5) at a certain position is caused by the magnetic field of the magnet (2) that changes the output electrical resistance by the action of the magnetic sensors (5), to a corresponding value.

Due to the fact that there is a distance between each magnetic sensor (5), due care should be taken so that the intensity of the magnetic field, when positioned between two magnetic sensors (5), is sufficient to drive both of them. If the intensity of the magnetic field of the magnet (2) is lower than necessary, it may happen that no magnetic sensor (5) is activated, causing an erroneous reading of empty tank. For this resource of double drive at the transitions

between two magnetic sensors (5), the upper resistor (6) value has priority over the value of the lower resistor (6).

The number of magnetic sensors (5) placed along the electronic circuit board (4) is determined by the desired resolution, this being specified together with the manufacturer of the vehicle. The accuracy of the level sensor is assured by the calibration of each resistor (6) of the electronic board (4). The minimum number of resistors (6) of the level sensor is determined by the equation n + 1, where "n" is the number of magnetic sensors (5) provided in the electronic board (4) in accordance with the resolution. However, even though 1 is the minimum, more than one resistor (6) may be interconnected between each magnetic sensor (5) in order to assure the correct power dissipation.

One the total height of the level sensor is known, as well as the resolution, the magnetic sensors (5) are positioned horizontally along all the vertical length of electronic circuit board (4). Even though the ideal is to use equal distances between each magnetic sensor (5), this distance may be changed if it is necessary to increase or reduce the resolution of specific ranges of the level sensor.

The correct intensity of the magnetic field shall be assured by magnetization and calibration methods. The only position where there shall be no activation of magnetic sensors is the one equivalent to an empty tank, the electrical resistance being equivalent to the sum of the values of all resistor of the series connected circuit. On the lower part of the level sensor (S) there is also a termination sensor (6') that determines the resistance equivalent to the empty tank, which is the sum of all the resistors (6), in this situation there is no activation of any magnetic sensor (5).

CLAIM

1) **"MAGNETIC RESISTIVE FUEL LEVEL SENSOR FOR AUTOMOTIVE VEHICLES AND SIMILAR"**, applicable to fuel tanks of vehicles and similar, characterized for being of magnetic-resistive actuation, consisting of an electronic circuit board (4) containing magnetic sensors (5) positioned horizontally along all the extension of the electronic board (4), each magnetic sensor (5) having one terminal connected to the node point of a series connected resistor set (6), having the other terminal connected to the other magnetic sensors (5); the electronic board (4) having a housing (7) in appropriate material to withstand the adverse conditions of the fuel means, provided with a standard fitting system ideal for the pump where it will be installed, besides guides (3) located in front of an electronic board (4), where will be displaced the float (1) with semi-cylindrical format containing a magnet (2) inside it able to activate the magnetic sensors (5) of the electronic board (4); also on the lower part is a filter (8); the drive of the magnetic sensor (5) at a certain position is caused by the magnetic field of the magnet (2) that changes the output electrical resistance by the drive of the magnetic sensors (5), to a corresponding value; double drive shall be provided on the transitions between two magnetic sensors (5), the value of the upper resistor (6) having priority over the value of the lower resistor (6), avoiding erroneous reading of empty tank; the amount of magnetic sensors (5) positioned along the electronic circuit board (4) is determined by the desired resolution.

FIG. 1

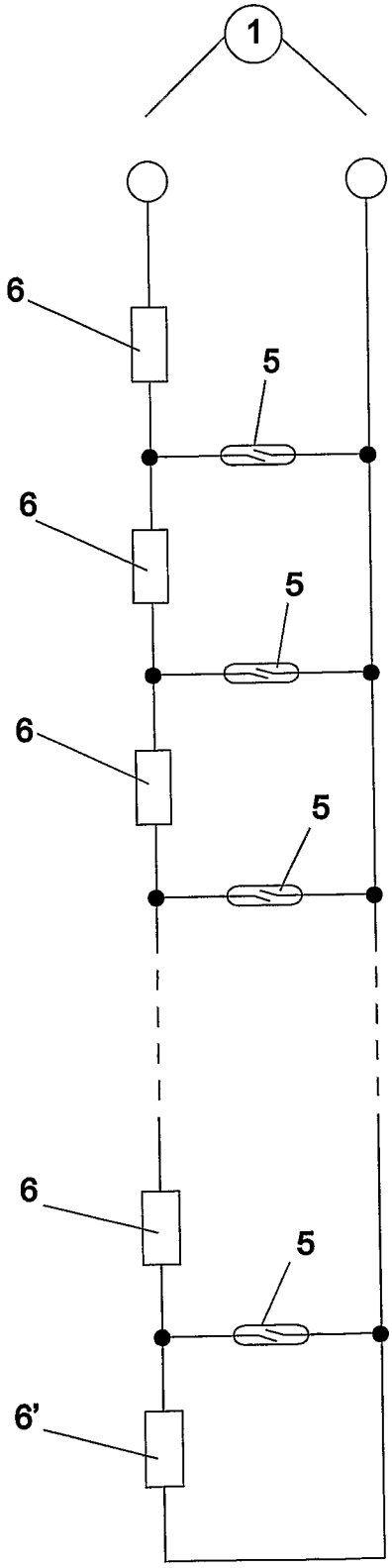


FIG. 2

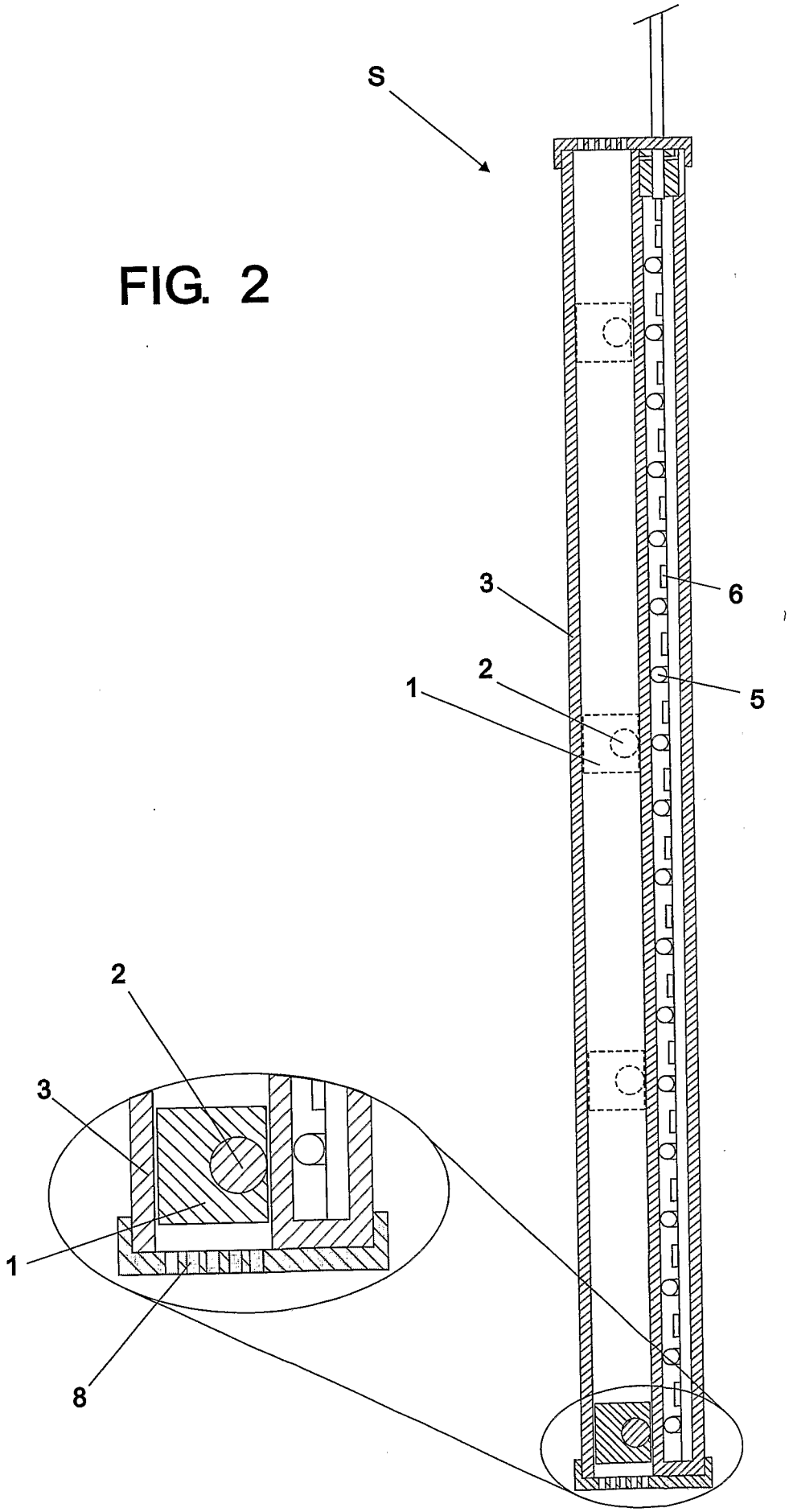


FIG. 3

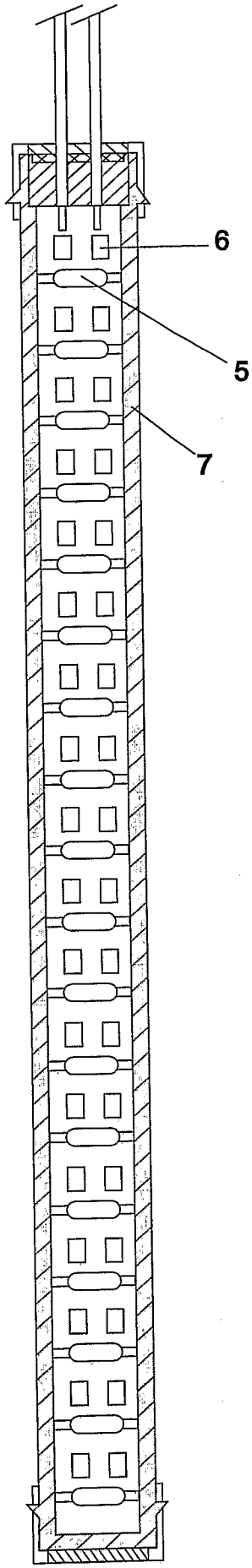


FIG. 4

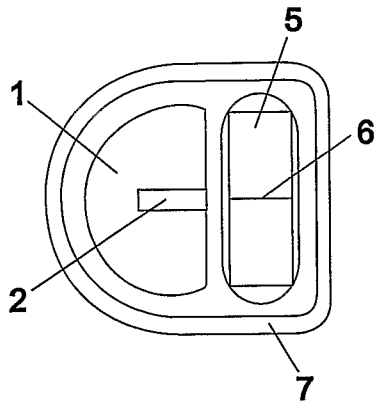


FIG. 5

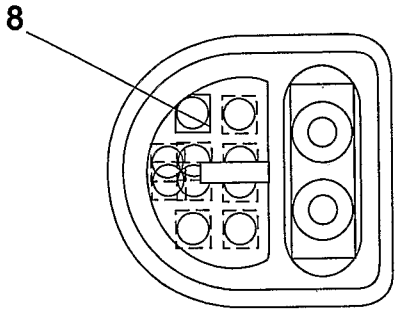
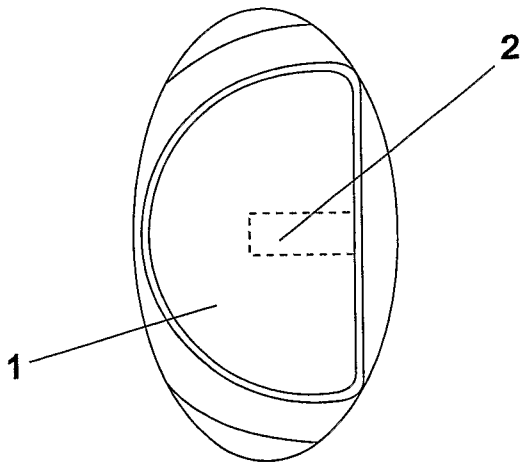


FIG. 6



INTERNATIONAL SEARCH REPORT

International application No.
PCT/BR 2007/000068

A. CLASSIFICATION OF SUBJECT MATTER
IPC[8]: ***G01F 23/62*** (2006.01)
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC[8]: G01F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Epodoc, WPI, cl txte, cl txtg

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	RU2178873 C2 (UCHNO TEKHN KOMPLEKS IM A N TU ET AL) 27 January 2002 (27.01.2002) *Abstract, Figs. 2, 4*	1
X	JP11326016 A (KANSEI CORP) 26 November 1999 (26.11.1999) *Abstract, Figs. 1-4*	1
X	JP59040212 A (TOKYO KEISO KK) 5 March 1984 (05.03.1984) *Abstract, Figs. 1-2*	1

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
8 May 2007 (08.05.2007)	15 June 2007 (15.06.2007)
Name and mailing address of the ISA/ AT **Austrian Patent Office** Dresdner Straße 87, A-1200 Vienna Facsimile No. +43 / 1 / 534 24 / 535	Authorized officer BABUREK G. Telephone No. +43 / 1 / 534 24 / 352

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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PCT/BR 2007/000068

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