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

(11) **EP 3 732 340 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
20.04.2022 Bulletin 2022/16

(21) Application number: **18839537.0**

(22) Date of filing: **07.12.2018**

(51) International Patent Classification (IPC):
E05B 19/22 *(2006.01)* ***G07C 9/00*** *(2020.01)*

(52) Cooperative Patent Classification (CPC):
E05B 19/22; G07C 9/00944; G07C 2209/62

(86) International application number:
PCT/IB2018/059744

(87) International publication number:
WO 2019/130136 (04.07.2019 Gazette 2019/27)

(54) DEVICE FOR DETECTING AND INDICATING A DOOR LOCK STATUS

VORRICHTUNG ZUM ERKENNEN UND ANZEIGEN EINES TÜRSCHLOSSSTATUS

DISPOSITIF DE DÉTECTION ET D'INDICATION DE L'ÉTAT D'UNE SERRURE DE PORTE

(84) Designated Contracting States:
AL 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 RS SE SI SK SM TR

(30) Priority: **27.12.2017 SI 201700342**

(43) Date of publication of application:
04.11.2020 Bulletin 2020/45

(73) Proprietor: **Euro Start D.O.O.**
1312 Videm - Dobrepolje (SI)

(72) Inventors:
- **OSEK, Mitja**
  3250 Rogaska Slatina (SI)
- **BLATNIK, Gregor**
  2381 Podgorje (SI)

(74) Representative: **Sveticic, Andrej**
Patentna pisarna d.o.o.
Copova 14
1000 Ljubljana (SI)

(56) References cited:
EP-A1- 3 070 683
DE-U1-202005 012 218
US-A1- 2009 293 567
US-A1- 2013 335 194
US-B1- 6 255 957

EP 3 732 340 B1

Description

Field of Invention

[0001] The invention refers to a device for detecting and indicating a door lock status, a kit of parts comprising a key, a door lock and a device for detecting and indicating a door lock status, and a method of operating a device for detecting and indicating a door lock status.

Prior Art

[0002] Locking a door is a routine operation that people carry out subconsciously. However, when we get away from the door, we often start wondering whether we have locked the door or not. This is a stressful situation and we sometimes go check whether the door is really locked. This is why devices have been developed, which detect and record a door lock status; we can be reassured to have locked the door thanks to an indicator in the device indicating the door lock status.

[0003] A device of this type is disclosed in document US 2009/0293567 A1. The device electronically tracks the use of a key to lock and unlock a door and retains information of the status. The user is able to query about the recorded door lock status. The device includes an actuating arrangement to allow tracking of the key position during a locking or unlocking motion of the key. These tracked signals are evaluated relative to at least two known signals indicative of a locking movement or an unlocking movement. The user is able to query the door lock status at a later point.

[0004] In locks that lock from both sides, rotation of a key to the right on one side of a door lock represents locking, while rotation of the key to the right on the other side represents unlocking of the lock and vice versa. Known devices do not allow detecting of a door look status depending on the side of the lock, from which the door was locked.

[0005] Document US 2013/335194 A1 discloses a key managed by a key management device, which has an operation detecting unit configured to detect an operating state thereof, and a transmitter configured to transmit information of the operating state detected by the operation detecting unit to receiving devices through wireless communication. The operation detecting unit includes an acceleration sensor, and detects information of acceleration measured by the acceleration sensor as the operating state thereof.

[0006] Document US 6 255 957 B1 discloses a process which reliably detects the change of the locking state of at least one lock with a logic with a memory and a display attached to a key. The process includes determining a rotation of the key associated with the lock within the lock, detecting a single or multiple rotations in unlocking or locking direction of the lock and simultaneously determining whether the detected rotation occurs in unlocking or locking direction of the lock. A signal is generated that indicates the unlocking or locking of the lock. This signal is stored in the memory of the logic, and the signal is displayed. It also discloses a device for implementing the process which includes one or several markers mounted near the lock, one or several sensors non-rotatablye connected with the key for detecting these markers, a logic attachable to the key with a memory in which data can be stored whereby the logic can process the signals received from the sensors, and a display for displaying the locking state.

[0007] Document EP 3 070 683 A1 discloses a method for monitoring the locking state of a rotary lock which can be operated with a mechanical key. The key is provided with a sensor device, the sensor device is a rotary motion sensor with which a rotary motion of the key is detected, and has an orientation sensor with which the orientation of the key is detected during the rotary movement, based on the rotary movement of the key detected by the rotary movement sensor, the locking state of the rotary lock is determined and on the basis of the orientation detected by the orientation sensor during the turning movement of the key it is determined on which side of the rotary lock the key has been operated.

Technical Problem

[0008] The technical problem is how to configure a device for detecting and indicating a door lock status that would detect a correct status regardless of the side, from which a door lock was locked.

Solution to the Technical Problem

[0009] The technical problem is solved by a device for detecting and indicating a door lock status, comprising:

a housing that can be fastened to a key head by means of a first fastening means, and
an electronic unit arranged within the housing and further comprising:

- a printed circuit board,
- at least one LED,
- a motion sensor,
- a magnetic field density sensor,
- a microcontroller,
- a battery, and
- a push button,

wherein the device further comprises two permanent magnets, which, when in the working position, are arranged on two opposite sides of the door by means of a third fastening means such that they face each other with their opposite poles.

[0010] When the device is in use, the housing is fastened to the key head. The motion sensor detects key orientation and a direction of key rotation within the lock.

The magnetic field density sensor detects the magnetic field density and determines, from which side of the lock the door was locked in dependence on the detected magnetic field density. The magnetic field density sensor can detect the direction of key rotation within the lock instead of the motion sensor. A source of the magnetic field is two permanent magnets. Prior to the first use, the device must be calibrated by keeping the push button depressed for several seconds in order to determine a threshold value of the magnetic field density. The detected direction of key rotation within the lock is recorded in a memory of the microcontroller. The lock status can be checked by pushing the push button and verifying the LED's light signal.

[0011] The invention further refers to a kit comprising a key, a door lock and a device for detecting and indicating a door lock status.

[0012] An advantage of the device of the invention over known devices lies in the fact that it correctly detects a change in the door lock status regardless of the side, from which the lock was locked/unlocked and also regardless of the number of keys used for locking and unlocking one lock. A further advantage is a simple, low-cost construction of the device and its reliable operation.

Figure 1: Electronic unit housing fastened on a key
Figure 2: Key with the electronic unit, exploded view
Figure 3: Printed circuit board of the electronic unit from one side
Figure 4: Printed circuit board of the electronic unit from the other side
Figure 5: Lock and key with the device for detecting and indicating a door lock status

[0013] The invention is described by way of several embodiments in more detail hereinbelow.

[0014] A device for detecting and indicating a door lock status comprises:

a housing 2 that can be fastened to a key 3 head by means of a first fastening means, and
an electronic unit arranged within the housing and further comprising:

a printed circuit board 5,
at least one LED 6,
a motion sensor 7,
a magnetic field density sensor 8,
a microcontroller 9,
a battery 10, and
a push button 11,

wherein the device further comprises two permanent magnets, which, when in the working position, are arranged on two opposite sides of the door by means of a third fastening means such that they face each other with their opposite poles.

[0015] In a preferred embodiment, the housing 2 is disc-shaped. It comprises two plastic parts. A first portion 2a of the housing is intended to be fastened to a head of the key 3 by means of the first fastening means, such as a double-sided adhesive tape or a first screw 2d and a first nut 2e. The first nut can be integrated in the first portion of the housing. A hole on the key head can be used for the first screw to pass through. A second portion 2b of the housing functions as a detachable cover protecting the electronic unit and can be removed if needed (e. g. for replacing the battery). The first portion 2a of the housing and the second portion 2b of the housing can be coupled to each other by means of a second fastening means formed as a snap-in connection or of at least one second screw 2f and at least one nut 2h. The housing can further comprise an annular portion 2g, with which the housing can be connected to a keychain.

[0016] The permanent magnet 4 is intended for fastening to a lock or door by means of the third fastening means such as a double-sided adhesive tape or a third screw and is intended to designate the side of the lock/door.

[0017] All other components of the electronic unit are connected by means of a printed circuit board 5.

[0018] The motion sensor 7 is configured to detect orientation of the key. The motion sensor can be selected among an accelerometer, a combination of a gyroscope and an accelerometer, a gyroscope. A direction of key rotation within a lock can be detected by a motion sensor or a magnetic field density sensor.

[0019] A push button 11 is configured for calibrating the device prior to first use. The device is calibrated as follows: the key is inserted into a lock, the push button is kept depressed for a predetermined period of time (e. g. 5 seconds), and the key is rotated within the lock by 360° in direction of door lock locking, wherein at least one LED signalizes calibration start/stop (e. g. by a blink). The push button 11 is further configured to check the door lock status which is signalized by means of at least one LED 6.

[0020] The battery 10 (e. g. CR1632) supplies all components of the electronic unit. By means of its standard function of the controller (e. g. LVD - low voltage detection), the device can perform a function of detecting whether the battery will soon be empty and signalizes it by blinking the LED 6 when the door lock status is checked.

[0021] The microcontroller 9 manages the signals. It receives signals from the motion sensor 7, the magnetic field density sensor 8 and the push button 11, processes them and sends them to at least one LED 6. The microcontroller can comprise a non-volatile memory to preserve data in case of power failure (e. g. EEPROM). In this case, the calibration data are preserved even in case of power failure (e. g. upon battery replacement) and recalibration is not necessary. The microcontroller is adapted to store the door lock status data for a predetermined period of time (e. g. 4 hours), the data is then deleted. The purpose of this function is to prevent storage of ob-

solete data in the event of a plurality of keys for the same lock and used by various users.

[0022] The microcontroller 9 can function in three operating modes: normal mode, low-power mode, sleep mode. The normal operating mode is active in locking, unlocking and calibration when signals from the sensors are obtained. It functions in the low-power mode, in which the internal clock of the microcontroller functions when the user wants to retrieve the data on a door lock status. The microcontroller passes from the low-power mode to the normal operating mode at a certain condition, e. g. when an interruption signal is received from the motion sensor, which indicates that the key is oriented in a direction identical to the direction of the key when inserted in the lock. The microcontroller can pass to a low-power mode when the key is oriented for a certain period of time (e. g. 3 seconds) in a direction indicating that the key cannot be in the lock or when the key is still for a certain period of time (e. g. 10 seconds); it returns to the operating mode when it receives an interruption signal from the motion sensor signalizing vibrations. The microcontroller can pass to a sleep mode when the device for detecting and indicating the door lock status on the key is still for a certain period of time and leaves this mode when the key is lifted/moved from a standstill.

[0023] The LED 6 is intended to indicate the door lock status. There may be only one (e. g. a white LED) which emits light when the user pushes the push button and the lock is locked. There are preferably two LEDs (e. g. green and red). When the user pushes the push button and the lock is locked, the green diode goes on, otherwise the red one goes on if the lock is unlocked. If the diode blinks twice, it indicates that a predetermined time has elapsed, in which the microcontroller memorizes the door lock status. The diodes also signalize other statuses, such as battery status (almost empty), calibration start/end, etc.

[0024] The magnetic field density sensor, e. g. a Hall sensor or a MEMS magnetic field density sensor, is used to detect, from which side of the lock the key is inserted.

[0025] The magnetic field density sensor 8 measures the magnetic field of the two permanent magnets, of which, when in use, one is arranged on the external side of the lock or door and the other on the internal side of the lock or door such that they face each other with their opposite poles.

[0026] In one of the embodiments, the magnetic field density sensor assumes the role of a motion sensor. In this case, the magnetic field density sensor is a triaxial magnetic field density sensor. The microcontroller computes the direction of key rotation based on the magnetic field density measurements in individual axes.

[0027] The motion sensor is configured to detect whether the key orientation conforms to the key orientation when the key is in the lock, or to detect a direction of rotation.

[0028] When the motion sensor is selected as a combination of a gyroscope and an accelerometer, the first one detects a direction of rotation, while the latter detects orientation (if the key is in the lock).

[0029] When an accelerometer is selected as the motion sensor, it detects a direction of the key rotation and the orientation of the key when the key is in the lock.

[0030] When the magnetic field density sensor assumes the role of a motion sensor, the latter is a triaxial magnetic field density sensor 8 detecting both the key orientation and the direction of rotation. It also detects, from which side of the lock the key is inserted.

[0031] When a combination of an accelerator and a triaxial magnetic field density sensor is selected as the motion sensor, the first one detects key orientation, while the latter detects the direction of rotation and also detects, on which side of the lock the key is inserted.

[0032] When a combination of a gyroscope and a magnetic field density sensor is selected as the motion sensor, the magnetic field density sensor detects key orientation and also the side of the lock, from which the key is inserted. The gyroscope detects the direction of key rotation within the lock.

[0033] The method for calibrating the device for detecting and indicating a door lock status comprises the steps:

- insertion of the key 3 into a lock of an unlocked door,
- holding the push button 11 for indicating the door lock status until the LED 6 starts blinking,
- detection of a direction of rotation by means of the motion sensor 7, when the key is rotated in the lock,
- detection of a value of the magnetic field density by means of the magnetic field density sensor 8,
- input of the value of the magnetic field density and the direction of rotation into the memory of the microcontroller 9.

[0034] The method for operation of the device for detecting and indicating a door lock status comprises the steps:

- switching the microcontroller 9 to the operating mode when the motion sensor 7 detects a horizontal orientation of the key 3, i. e. when the axis X_k of the lock and the axis X are parallel, as a consequence of the key being inserted into the lock,
- detecting a value of the magnetic field density by means of the magnetic field density sensor 8,
- comparing the detected value of the magnetic field density with a predetermined threshold value of the magnetic field density by means of the microcontroller,
- interpreting the measured magnetic field density value; wherein interpretation is carried out as follows: if the measured value of the magnetic field density is higher or identical to the threshold value, this controller interprets it as if the key is inserted into the lock, wherein the sign of the measured value of the geomagnetic field density determines the side of the door, from which the key is inserted in the lock,

- detecting motion by means of the motion sensor 7 while the key 3 in the lock is turned, wherein the microcontroller 9 changes the recorded door lock/unlock status provided that the motion sensor 7 has detected the key being rotated by 360° and depending on the side of the lock detected in the preceding step,
- switching the microcontroller 9 from the normal operating mode to a sleep mode when the motion sensor 7, after the key has been removed from the lock, detects that the axis X_k of the lock and the axis X are no longer parallel, i. e. the key is no longer in a horizontal position.

[0035] The predetermined threshold value is determined as 10% to 90%, preferably 40% to 60%, most preferably around 50% of the value of the magnetic field density measured at calibration.

[0036] The device for detecting and indicating a door lock status can further comprise Bluetooth for establishing connection with a smart phone via suitable application. The Bluetooth enables:

- transfer of data on the door lock status to a smart phone,
- searching for the key in the vicinity by means of the smart phone and a dedicated software/application uploaded on the phone (the key location can be determined within a radius of 20 to 30 m),
- notification on the changed door lock status in case of several users (e. g. notification to a parent that the child has locked the door), etc., and
- wireless (e. g. Qi or AirFuel technologies) or contact charging of the device.

Claims

1. A device for detecting and indicating a door lock status, comprising:

- a housing (2) that can be fastened to a key (3) head by means of a first fastening means, and
- an electronic unit arranged within the housing and further comprising:

  - a printed circuit board (5),
  - at least one LED (6),
  - a motion sensor (7),
  - a microcontroller (9),
  - a battery (10), and
  - a push button (11),
  - a magnetic field density sensor (8),

characterized in that the device further comprises two permanent magnets, which, when in the working position, are arranged on the opposite sides of the door by means of a third fastening means such that they face each other with their opposite poles.

2. Device according to claim 1, **characterized in that** the motion sensor (7) is selected among a gyroscope, an accelerometer, a combination of a gyroscope and an accelerometer, and a magnetic field density sensor.

3. Device according to any of preceding claims, **characterized in that** the LED (6) is white.

4. Device according to claim 1 or 2, **characterized in that** there are two LEDs (6), wherein one is green and the other one is red.

5. Device according to any of preceding claims, **characterized in that** magnetic field density sensor (8) is a Hall sensor or a MEMS magnetic field density sensor.

6. Device according to any of preceding claims, **characterized in that** the third fastening means are selected among a double-sided adhesive tape or a screw.

7. Device according to any of preceding claims, **characterized in that** the housing (2) is formed of two portions, wherein the first portion (2a) of the housing and the second portion (2b) of the housing can be coupled to each other by means of a snap-in connection or at least one second screw (2f).

8. Device according to any of preceding claims, **characterized in that** the housing (2) is disc-shaped.

9. Device according to any of preceding claims, **characterized in that** the housing (2) further comprises an annular portion (2g), with which the housing can be connected to a keychain.

10. Device according to any of preceding claims, **characterized by** further comprising Bluetooth for establishing connection with a smart phone via suitable application.

11. A kit comprising a key (3), a door lock (13) and a device for detecting and indicating a door lock status according to any of preceding claims.

12. Method for calibrating the device according to any of claims 1 to 10, comprising the steps:

- insertion of the key (3) into a lock of an unlocked door,
- holding the push button (11) for indicating the door lock status until the LED (6) starts blinking,
- detection of a direction of rotation by means of the motion sensor (7) when the key is rotated in

the lock,
- detection of a value of the magnetic field density by means of the magnetic field density sensor (8),
- input of the value of the magnetic field density and the direction of rotation into the memory of the microcontroller (9).

13. Method for operation of the device according to any of claims 1 to 10, comprising the steps:

- switching the microcontroller (9) to the operating mode when the motion sensor (7) detects a horizontal orientation of the key (3), i. e. when the axis X_k of the lock and the axis X are parallel, as a consequence of the key being inserted into the lock,
- detecting a value of the magnetic field density by means of the magnetic field density sensor (8),
- comparing the detected value of the magnetic field density with a predetermined threshold value of the magnetic field density by means of the microcontroller,
- interpreting the measured magnetic field density value; wherein interpretation is carried out as follows: if the measured value of the magnetic field density is higher or identical to the threshold value, this controller interprets it as if the key is inserted into the lock, wherein the sign of the measured value of the geomagnetic field density determines the side of the door, from which the key is inserted in the lock,
- detecting motion by means of the motion sensor (7) while the key (3) in the lock is turned, wherein the microcontroller (9) changes the recorded door lock/unlock status provided that the motion sensor (7) has detected the key being rotated by 360° and depending on the side of the lock detected in the preceding step,
- switching the microcontroller (9) from the normal operating mode to a sleep mode when the motion sensor (7), after the key has been removed from the lock, detects that the axis X_k of the lock and the axis X are no longer parallel, i.e. the key is no longer in a horizontal position.

Patentansprüche

1. Vorrichtung zum Detektieren und Anzeigen eines Türverriegelungsstatus, die Folgendes umfasst:

- ein Gehäuse (2), das mittels eines ersten Befestigungsmittels an einem Schlüssel(3)-Kopf befestigt werden kann, und
- eine elektronische Einheit, die im Gehäuse angeordnet ist und ferner Folgendes umfasst:
- eine Leiterplatte (5),
- mindestens eine LED (6),
- einen Bewegungssensor (7),
- eine Mikrosteuerung (9),
- eine Batterie (10) und
- einen Druckknopf (11),
- einen Magnetfelddichtesensor (8),

dadurch gekennzeichnet, dass die Vorrichtung ferner zwei Dauermagnete umfasst, die, wenn sie sich in der Arbeitsposition befinden, auf den gegenüberliegenden Seiten der Tür mittels eines dritten Befestigungsmittels angeordnet sind, derart, dass sie mit ihren entgegengesetzten Polen einander zugewandt sind.

2. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** der Bewegungssensor (7) aus einem Gyroskop, einem Beschleunigungsmesser, einer Kombination aus einem Gyroskop und einem Beschleunigungsmesser und einem Magnetfelddichtesensor ausgewählt ist.

3. Vorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die LED (6) weiß ist.

4. Vorrichtung nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** es zwei LEDs (6) gibt, wobei eine grün und die andere rot ist.

5. Vorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der Magnetfelddichtesensor (8) ein Hallsensor oder ein MEMS-Magnetfelddichtesensor ist.

6. Vorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** das dritte Befestigungsmittel aus einem beidseitigen Klebeband oder einer Schraube ausgewählt ist.

7. Vorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** das Gehäuse (2) aus zwei Abschnitten gebildet ist, wobei der erste Abschnitt (2a) des Gehäuses und der zweite Abschnitt (2b) des Gehäuses mittels einer Rastverbindung oder mindestens einer zweiten Schraube (2f) aneinandergekoppelt werden können.

8. Vorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** das Gehäuse (2) scheibenförmig ist.

9. Vorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** das Gehäuse (2) ferner einen Ringabschnitt (2g) umfasst, mit dem das Gehäuse mit einer Schlüsselkette verbunden werden kann.

10. Vorrichtung nach einem der vorhergehenden Ansprüche, **gekennzeichnet durch** weiteres Umfassen von Bluetooth zum Herstellen einer Verbindung via eine geeignete Anwendung mit einem Smartphone.

11. Kit, das einen Schlüssel (3), ein Türschloss (13) und eine Vorrichtung zum Detektieren und Anzeigen eines Türverriegelungsstatus nach einem der vorhergehenden Ansprüche umfasst.

12. Verfahren zum Kalibrieren der Vorrichtung nach einem der Ansprüche 1 bis 10, das die folgenden Schritte umfasst:

- Einstecken des Schlüssels (3) in ein Schloss einer unverriegelten Tür,
- Halten des Druckknopfes (11) zum Anzeigen des Türverriegelungsstatus, bis eine LED (6) zu blinken beginnt,
- Detektion einer Drehrichtung mittels des Bewegungssensors (7), wenn der Schlüssel im Schloss gedreht wird,
- Detektion eines Wertes der Magnetfelddichte mittels des Magnetfelddichtesensors (8),
- Eingabe des Wertes der Magnetfelddichte und der Drehrichtung in den Speicher der Mikrosteuerung (9).

13. Verfahren zum Betätigen der Vorrichtung nach einem der Ansprüche 1 bis 10, das die folgenden Schritte umfasst:

- Schalten der Mikrosteuerung (9) in den Betriebsmodus, wenn der Bewegungssensor (7) eine horizontale Ausrichtung des Schlüssels (3), d. h. wenn die Achse X_k des Schlosses und die Achse X parallel verlaufen, als eine Konsequenz davon, dass der Schlüssel in das Schloss eingesteckt wurde, detektiert,
- Detektieren eines Wertes der Magnetfelddichte mittels des Magnetfelddichtesensors (8),
- Vergleichen des detektierten Wertes der Magnetfelddichte mittels der Mikrosteuerung mit einem vorbestimmten Schwellwert der Magnetfelddichte,
- Interpretieren des gemessenen Magnetfelddichtewertes; wobei die Interpretation wie folgt durchgeführt wird: wenn der Messwert der Magnetfelddichte höher als der Schwellwert oder mit demselben identisch ist, interpretiert diese Steuerung ihn so, als wenn der Schlüssel in das Schloss eingesteckt ist, wobei das Vorzeichen des Messwertes der geomagnetischen Felddichte die Seite der Tür, von der der Schlüssel in das Schloss eingesteckt ist, bestimmt,
- Detektieren einer Bewegung mittels des Bewegungssensors (7), während der Schlüssel (3) im Schloss gedreht wird, wobei die Mikrosteuerung (9), vorausgesetzt, dass der Bewegungssensor (7) detektiert hat, dass der Schlüssel um 360° gedreht wurde, und in Abhängigkeit von der Seite des Schlosses, die im vorhergehenden Schritt detektiert wurde, den aufgezeichneten Türverriegelungs-/-entriegelungsstatus ändert,
- Schalten der Mikrosteuerung (9) aus dem normalen Betriebsmodus in einen Ruhemodus, wenn der Bewegungssensor (7), nachdem der Schlüssel aus dem Schloss entfernt wurde, detektiert, dass die Achse X_k des Schlosses und die Achse X nicht mehr parallel verlaufen, d. h. der Schlüssel sich nicht mehr in einer horizontalen Position befindet.

Revendications

1. Dispositif de détection et d'indication de l'état d'une serrure de porte, comportant :

- un boîtier (2) qui peut être fixé à une tête de clé (3) à l'aide d'un premier moyen de fixation, et
- une unité électronique disposé à l'intérieur du boîtier et comportant en outre :
  - une carte (5) à circuit imprimé,
  - au moins une DEL (6),
  - un capteur (7) de mouvement,
  - un microcontrôleur (9),
  - une batterie (10), et
  - un bouton-poussoir (11),
  - un capteur (8) de densité de champ magnétique,

caractérisé en ce que le dispositif comporte en outre deux aimants permanents qui, lorsqu'ils se trouvent dans la position de fonctionnement, sont disposés sur les côtés opposés de la porte à l'aide d'un troisième moyen de fixation de façon à se faire face avec leurs pôles opposés.

2. Dispositif selon la revendication 1, **caractérisé en ce que** le capteur (7) de mouvement est choisi parmi un gyroscope, un accéléromètre, une combinaison d'un gyroscope et d'un accéléromètre, et un capteur de densité de champ magnétique.

3. Dispositif selon l'une quelconque des revendications précédentes, **caractérisé en ce que** la DEL (6) est blanche.

4. Dispositif selon la revendication 1 ou 2, **caractérisé en ce qu'**il existe deux DEL (6), l'une étant verte et l'autre étant rouge.

5. Dispositif selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le capteur (8) de densité de champ magnétique est un capteur à effet Hall ou un capteur MEMS de densité de champ magnétique.

6. Dispositif selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le troisième moyen de fixation est choisi parmi un ruban adhésif double face et une vis.

7. Dispositif selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le boîtier (2) est formé de deux parties, la première partie (2a) du boîtier et la deuxième partie (2b) du boîtier pouvant être couplées l'une à l'autre au moyen d'une liaison par encliquetage ou d'au moins une deuxième vis (2f).

8. Dispositif selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le boîtier (2) est en forme de disque.

9. Dispositif selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le boîtier (2) comporte en outre une partie annulaire (2g), à l'aide de laquelle le boîtier peut être relié à un porte-clés.

10. Dispositif selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**il comporte en outre un Bluetooth servant à établir une liaison avec un ordiphone par l'intermédiaire d'une application appropriée.

11. Kit comportant une clé (3), une serrure (13) de porte et un dispositif de détection et d'indication de l'état d'une serrure de porte selon l'une quelconque des revendications précédentes.

12. Procédé d'étalonnage du dispositif selon l'une quelconque des revendications 1 à 10, comportant les étapes :

- d'insertion de la clé (3) dans une serrure d'une porte déverrouillée,
- de maintien du bouton-poussoir (11) pour indiquer l'état de la serrure de porte jusqu' à ce que la DEL (6) commence à clignoter,
- de détection d'un sens de rotation au moyen du capteur (7) de mouvement lorsque la clé est tournée dans la serrure,
- de détection d'une valeur de la densité de champ magnétique au moyen du capteur (8) de densité de champ magnétique,
- d'entrée de la valeur de la densité de champ magnétique et du sens de rotation dans la mémoire du microcontrôleur (9).

13. Procédé d'utilisation du dispositif selon l'une quelconque des revendications 1 à 10, comportant les étapes consistant à :

- faire passer le microcontrôleur (9) dans le mode de fonctionnement lorsque le capteur (7) de mouvement détecte une orientation horizontale de la clé (3), c.à.d. lorsque l'axe X_k de la serrure et l'axe X sont parallèles, en conséquence de l'insertion de la clé dans la serrure,
- détecter une valeur de la densité de champ magnétique au moyen du capteur (8) de densité de champ magnétique,
- comparer la valeur détectée de la densité de champ magnétique avec une valeur seuil prédéterminée de la densité de champ magnétique au moyen du microcontrôleur,
- interpréter la valeur mesurée de densité de champ magnétique ; l'interprétation étant réalisée comme suit : si la valeur mesurée de la densité de champ magnétique est supérieure ou identique à la valeur seuil, ledit contrôleur l'interprète comme si la clé était insérée dans la serrure, le signe de la valeur mesurée de la densité de champ géomagnétique déterminant le côté de la porte à partir duquel la clé est insérée dans la serrure,
- détecter un mouvement au moyen du capteur (7) de mouvement tandis que la clé (3) dans la serrure est tournée, le microcontrôleur (9) changeant l'état enregistré de verrouillage/déverrouillage de la porte à condition que le capteur (7) de mouvement ait détecté le fait que la clé soit tournée de 360° et en fonction du côté de la serrure détecté à l'étape précédente,
- faire passer le microcontrôleur (9) du mode de fonctionnement normal à un mode de sommeil lorsque le capteur (7) de mouvement, après que la clé a été retirée de la serrure, détecte que l'axe X_k de la serrure et l'axe X ne sont plus parallèles, c.à.d. que la clé n'est plus dans une position horizontale.

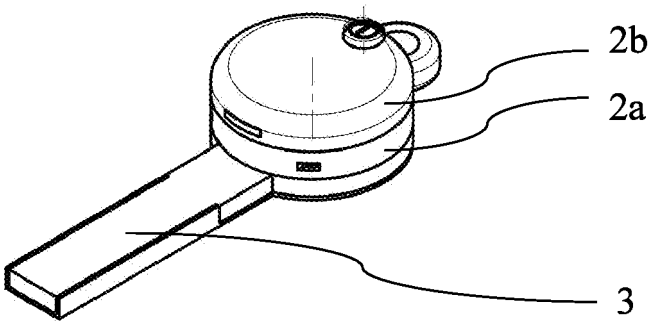

Figure 1

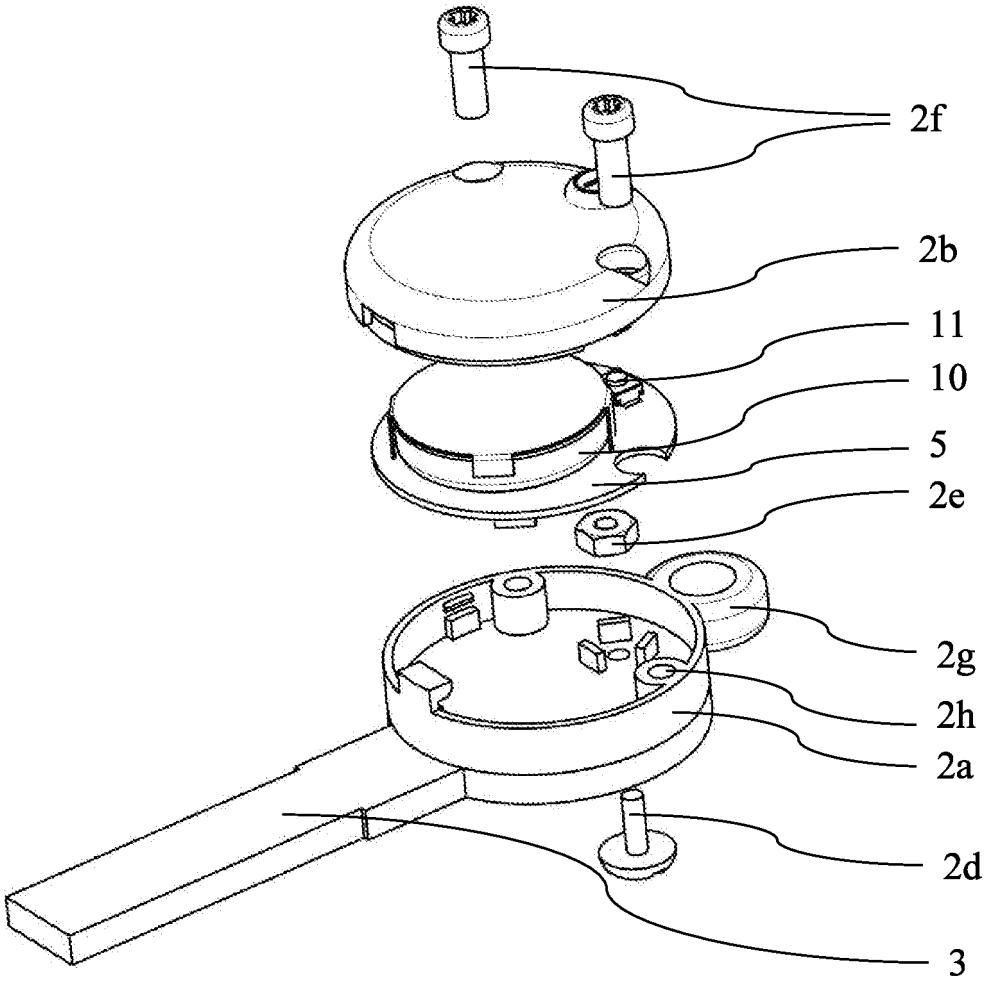

Figure 2

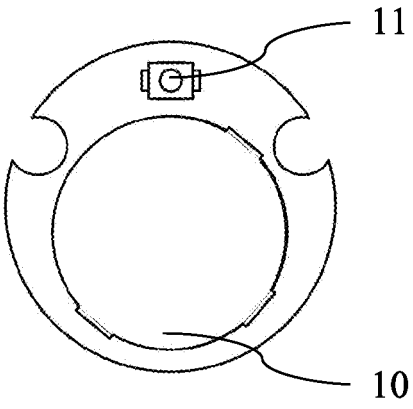

Figure 3

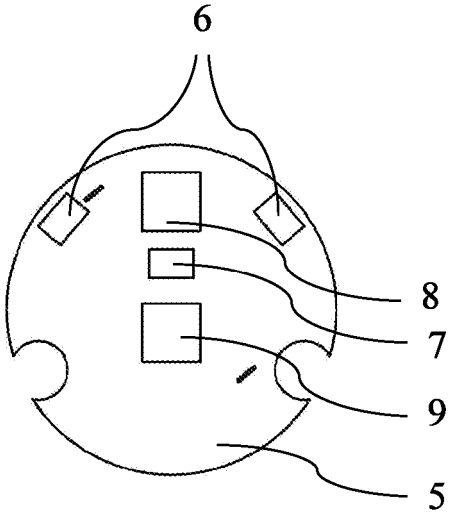

Figure 4

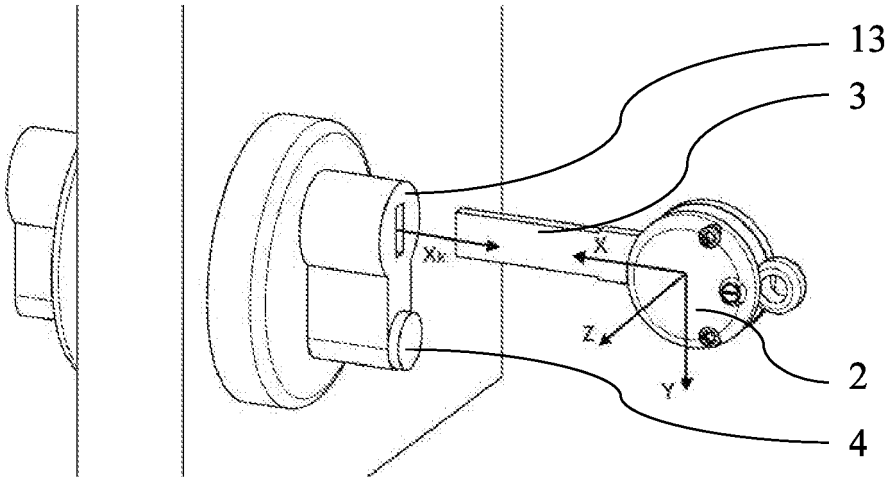

Figure 5

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 20090293567 A1 **[0003]**
- US 2013335194 A1 **[0005]**
- US 6255957 B1 **[0006]**
- EP 3070683 A1 **[0007]**