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Amended claims in accordance with Rule 137(2)
EPC.

(54) **SYSTEM AND METHOD FOR OPERATING AN ELECTRONIC LOCK**

(57) A method for operating an electronic lock (107) being mounted on one side and configured to control only one key (2) of a lock (3), configured to receive keys (1, 2) in two opposite keyholes, the method being characterized in that it comprises: reading information from a least one sensor (103), configured to detect (201) sliding

out of the key (2) controlled by said electronic lock (107); reading information from said sensor, configured to detect sliding in of the said key to its previous position (203); undertaking one or many actions (209) by the controller (105).

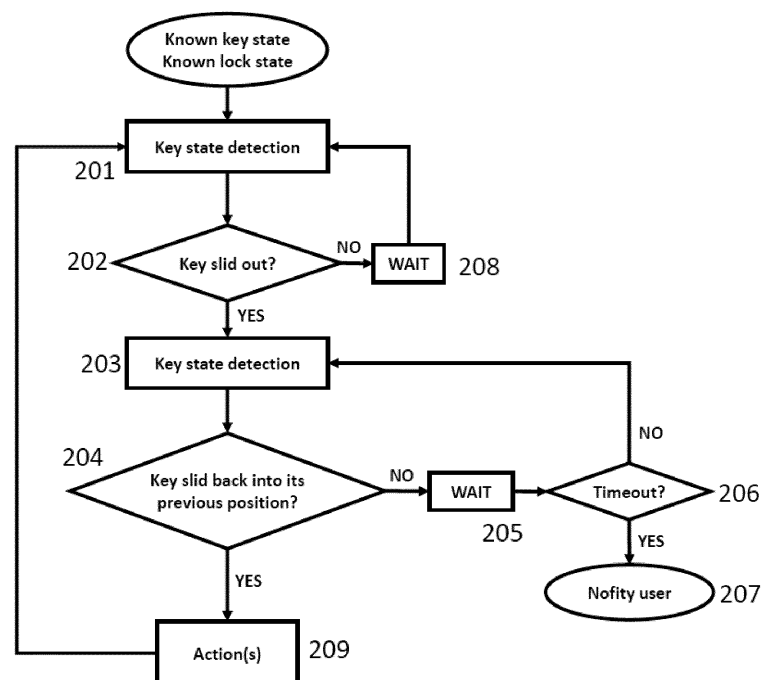


Fig. 2

Description

TECHNICAL FIELD

[0001] The present invention relates to a system and method for operating an electronic lock. In particular, the present invention relates to electronic locks having a capability of supporting two keys such as an inner and outer key operating on a given axis of a lock (for example on opposite sides of a door i.e. the lock is configured to receive keys in two opposite keyholes), wherein an electronic lock is configured to control only one of said keys (typically installed on the inside of a room, apartment or a building).

BACKGROUND OF THE INVENTION

[0002] Prior art defines an electromechanical lock US 20110174029 A1, wherein the electromechanical lock includes a user interface configured to receive input from a user, the user interface activating operating power for the lock; a memory configured to store access tables, the access tables including information on the keys allowed to open the lock; and an electronic circuitry configured to modify the access tables on the basis of the insertions of an associate master key and an end function key into the lock, the insertion of the associated master key initializing a programming mode and the insertion of an end function key causing the lock to exit the programming mode.

[0003] Therefore, the US 20110174029 A1 discloses a sensor able to detect different keys. Further, this lock is not configured to receive two keys on opposite sides of the lock.

[0004] In most cylinder-type locks, utilizing two keys on opposite sides of the lock, information on an action of a key on one side of the lock is not transferred to the opposite side of the lock. In case of electronic locks this causes lack of information on current state of the lock and a possibility of indicating a false state of the lock to other devices and/or users.

[0005] It would be advantageous to prevent such false states and provide a system and method that would appropriately process information related to both keys of said electronic lock.

[0006] The aim of the development of the present invention is an improved and cost effective system and method for operating an electronic lock and preventing false lock states.

SUMMARY AND OBJECTS OF THE PRESENT INVENTION

[0007] An object of the present invention is a method for operating an electronic lock being mounted on one side and configured to control only one key of a lock, configured to receive keys in two opposite keyholes, the method being characterized in that it comprises: reading

information from a least one sensor, configured to detect sliding out of the key controlled by said electronic lock; reading information from said sensor, configured to detect sliding in of the said key to its previous position; undertaking one or many actions by the controller.

[0008] Preferably, said key is slid in to its previous position by a push mechanism.

[0009] Preferably, said actions comprise at least one of: automated verification of state of the said lock; generating notification regarding changing state of the said lock or possible false state of the said lock; transmitting said notification to an external device; returning said lock to its previous state.

[0010] Preferably, the method further comprises generating and transmitting a notification if the key controlled by the electronic lock is not slid in to its previous position within time specified by timeout.

[0011] Another object of the present invention is a computer program comprising program code means for performing all the steps of the computer-implemented method according to the present invention when said program is run on a computer.

[0012] Another object of the present invention is a computer readable medium storing computer-executable instructions performing all the steps of the computer-implemented method according to the present invention when executed on a computer.

[0013] A further object of the present invention is a system for operating an electronic lock being mounted on one side and configured to control only one key of a lock, configured to receive keys in two opposite keyholes, the system comprising: a data bus communicatively coupled to a memory and other components of the system; a controller; an electronic lock module, controlled by the controller, configured to execute physical tasks related to control of a key; a wireless communication module configured to allow the controller to communicate events, related to the electronic lock; the system being characterized in that it comprises: at least one sensor, coupled to the controller, configured to detect sliding out, by a predefined distance, of a key controlled by said electronic lock while said key remains partially inserted in the respective keyhole; wherein the controller is configured to execute all steps of the method according to the present invention.

[0014] Preferably, the controller is configured to communicate with a "Key position sensor module" that is responsible for detecting vertical/horizontal position of an associated key.

[0015] Preferably, the sensor is a proximity sensor or a light sensor or contact sensor or a magnetic sensor.

[0016] Preferably, the sensor is coupled to an analog to digital converter reporting data to the controller.

[0017] Preferably, said predefined distance is in a range of 1 to several millimeters whereas said key still remains partially inserted in said lock.

[0018] Preferably, said system further comprises by a push mechanism configured to return the key to a fully

slid-in state.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] These and other objects of the invention presented herein, are accomplished by providing a system and method for operating an electronic lock. Further details and features of the present invention, its nature and various advantages will become more apparent from the following detailed description of the preferred embodiments shown in a drawing, in which:

Fig. 1 presents a diagram of the system according to the present invention;

Fig. 2 presents a diagram of the method according to the present invention;

Fig. 3 presents a system of the present invention with the inner key slid in and the outer key outside of the lock; and

Fig. 4 presents a system of the present invention with the outer key slid in and the inner key slid out.

NOTATION AND NOMENCLATURE

[0020] Some portions of the detailed description which follows are presented in terms of data processing procedures, steps or other symbolic representations of operations on data bits that can be performed on computer memory. Therefore, a computer executes such logical steps thus requiring physical manipulations of physical quantities.

[0021] Usually these quantities take the form of electrical or magnetic signals capable of being stored, transferred, combined, compared, and otherwise manipulated in a computer system. For reasons of common usage, these signals are referred to as bits, packets, messages, values, elements, symbols, characters, terms, numbers, or the like.

[0022] Additionally, all of these and similar terms are to be associated with the appropriate physical quantities and are merely convenient labels applied to these quantities. Terms such as "processing" or "creating" or "transferring" or "executing" or "determining" or "detecting" or "obtaining" or "selecting" or "calculating" or "generating" or the like, refer to the action and processes of a computer system that manipulates and transforms data represented as physical (electronic) quantities within the computer's registers and memories into other data similarly represented as physical quantities within the memories or registers or other such information storage.

[0023] A computer-readable (storage) medium, such as referred to herein, typically may be non-transitory and/or comprise a non-transitory device. In this context, a non-transitory storage medium may include a device that may be tangible, meaning that the device has a con-

crete physical form, although the device may change its physical state. Thus, for example, non-transitory refers to a device remaining tangible despite a change in state.

[0024] As utilized herein, the term "example" means serving as a non-limiting example, instance, or illustration. As utilized herein, the terms "for example" and "e.g." introduce a list of one or more non-limiting examples, instances, or illustrations.

DESCRIPTION OF EMBODIMENTS

[0025] In typical, cylinder locks having a first (typically outer) and a second (typically inner) key insertable in appropriate key holes, an action (a turn) on the first key, on one side of the lock, is not transferred to the other side of the lock meaning that the second key is not affected at all and does not turn when the first key turns.

[0026] This leads to a situation wherein an observer, present on for example on the inside, is not aware of the action executed on the outside.

[0027] An electronic lock mounted on the inside, is configured to monitor its state but is typically not configured to monitor the other side of the lock, where the second key may be used.

[0028] Nevertheless, the inventor has observed that while using the first (typically outside) key, the second, inner key may be pushed back by a small distance (typically fraction of a millimeter to few millimeters) while still remaining partially inserted in the respective lock. In other words, the sliding out of the second, inner key is caused by the insertion of the other, first key in said lock in a keyhole opposite to the keyhole in which the key controlled by said electronic lock is inserted (typically the second, inner key).

[0029] Detection of such displacement of the inner (second) key may be therefore used to avoid reporting false lock states by the electronic lock. Such detection of a sliding out, of the respective second key, by a predefined distance amount (this distance may depend on the lock type (e.g. in a range of 1 to several millimeters such as 0,75-5 mm) and may be a configurable parameter of the system) may then be reported to a user and/or the electronic lock may thereafter attempt to detect the state of the lock, for example by turning its key and detecting whether the lock is in an open or locked state.

[0030] Depending on a cylinder lock type, the electronic lock may be configured to always keep the inner key in a vertical or horizontal position, inserted in the lock on the inside.

[0031] Fig. 1 presents a diagram of the system according to the present invention. The system comprises a data bus 101 communicatively coupled to a memory 104. Additionally, other components of the system are communicatively coupled to the system bus 101 so that they may be managed by a controller 105.

[0032] The memory 104 may store system configuration and/or computer program or programs executed by the controller 105 in order to execute steps of the method

according to the present invention.

[0033] An electronic lock 107 may be controlled by the controller 105 and execute physical tasks related to control of an associated key. Said electronic lock 107, typically comprises an appropriate motor configured to rotate a key under its control.

[0034] Further, a wireless communication module 106 may be implemented in order to allow the controller 105 to communicate events related to the electronic lock 107. For example, the controller 105 may control transmission of messages/notifications related to locking or unlocking of the door lock being controlled by said electronic lock 107. Exemplary wireless communication methods include Zwave, Bluetooth, ZigBee, WiFi, or the like.

[0035] Lastly, the controller 105 is in communication with at least one sensor 103 configured to detect sliding out and sliding in of a key controlled by said electronic lock 107. The sensor 103 may be implemented using different approaches such as a proximity sensor, a light sensor, contact sensor a magnetic sensor or the like. Such sensor 103, depending on needs, may be coupled to an analog to digital converter that will in turn report data to the controller 105.

[0036] The controller 105 may also communicate with a "Key position sensor module" 102 that is responsible for detecting vertical/horizontal position of an associated key. Such sensor may comprise multiple sensors such as accelerometers, magnetic field encoders or optical encoders.

[0037] Fig. 2 presents a diagram of the method according to the present invention. The process starts with known state of the key 2 controlled by the electronic lock 107, wherein said key is fully inserted in said lock (which may be detected appropriately by the sensor 103). The system at this state is also aware of the current lock 3 state, that is whether it is locked or unlocked.

[0038] The method starts at step 201 from detecting, using said sensor 103, the state of the key under control (typically the inner key).

[0039] Next, at step 202, the information, read from the sensor 103, is matched against a predefined condition (which may be said predefined distance amount) in order to determine whether the key has been partially slid out of the lock while still remaining partially inserted in the respective lock. In case the key remains slid in said lock, the system moves to a wait state 208 and back to continue monitoring the information reported by said sensor 103. In said wait state, the system awaits elapsing of a predefined time condition.

[0040] The purpose of the wait state 208 is to allow periodical key monitoring and thus to reduce power consumption of the whole system.

[0041] Otherwise, when the system detects that the key has been partially slid out, the system moves to step 203 where it continues to monitor, using said sensor 103, whether the key is slid back into its previous position.

[0042] If the key remains slid out 204, the system is periodically checking, by means of a wait state 205,

whether a timeout 206 has occurred. The wait state 205 may be in a range of 500ms to 1000ms while the timeout of step 206 is preferably in a range of 2s to 4s.

[0043] If in the step 204 the system detects that the controlled key is slid in back to its position, it is assumed that the other key has been removed and the controller 105 performs an action or actions of step 209 according to its configuration.

[0044] A purpose of the wait state 205 is similar to 208, that is, it enables periodical key monitoring and helps reducing power consumption of the whole system.

[0045] A purpose of the timeout 206 is twofold. This timeout allows a person, using the other key (typically outer key), to open/lock and remove the respective key. If after such timeout the monitored key (typically the inner key) is still slid out it may be assumed that the user has forgotten to take the other key.

[0046] Such situation is critical for safety as it also prevents the electronic lock 107 from locking the lock from the inside (using the key which is under its control). Thus, a user and/or other device are preferably notified.

[0047] It is clear that the respective time values may be configuration parameters of the present system and may be stored in the memory 104.

[0048] Actions of step 209 undertaken by controller 105 may comprise several steps like verifying the lock state and/or generating notification to user and/or sending notification message(s) to an external device and/or returning the lock to its previous position and others. These actions may be preprogrammed or configured by a user. Otherwise, the system returns to step 201.

[0049] In case the other key has been removed, the controlled key is returned to a fully slid-in state by a suitable push mechanism such as a spring.

[0050] An action of lock state verification from step 209 may be executed by suitably rotating of the key similarly as a human operator would do (i.e. the system is aware whether the lock is a right/left lock and whether key rotation left or right sets the lock to its locked state).

[0051] In case verification action of step 209 results in that the lock's state has changed, a user (or other devices such as a smart home gateway) may be notified of the new lock state or the controller 105 may set back the lock to its previous state. To this end, the controller (105) may generate appropriate notification message(s). Clearly, the state of the lock (3) is updated in the electronic lock so that the controller (105) is aware of the current state.

[0052] Fig. 3 presents an example of a system of the present invention with the inner key 2 slid in and the outer key outside of the lock. A system according to the present invention 6 having a sensor 7 of the inner key 2 wherein information reported by the sensor is provided to the controller 105.

[0053] Insertion of the outer key 1 to the lock cylinder 3 will result in sliding out of the inner key 2 and a change of distance A to distance B (smaller than A) shown in Fig. 4.

[0054] When the outer key 1 has been removed, the

inner key 2 may be inserted into the cylinder lock 3 with a use of a pusher 4 and a spring 5. This allows to execute actions from step 209 of the method according to the present invention.

ADDITIONAL EMBODIMENTS

[0055] A method for operating an electronic lock (107) being mounted on one side and configured to control only one key (2) of a lock (3), configured to receive keys (1, 2) in two opposite keyholes, the method being characterized in that it comprises:

- detecting (201) a state of the electronic lock (107) wherein the key (2), controlled by the electronic lock (107), is fully inserted in said lock (3);
- reading information from a least one sensor (103), configured to detect (202) sliding out, by a predefined distance, of the key (2) controlled by said electronic lock (107) while said key (2) remains partially inserted in the respective keyhole;
- in case it has been detected that the key (2) is slid out while remaining partially inserted in the respective keyhole, generating a notification regarding a possibility of a false electronic lock (107) state and transmitting said notification to at least one external device.

[0056] The aforementioned method wherein said sliding out distance is within a range of from a fraction of a millimeter to few millimeters and is caused by the insertion of the other key in said lock (3) in a keyhole opposite to the keyhole in which the key (2) controlled by said electronic lock (107) is inserted.

[0057] The aforementioned method wherein prior to generating and transmitting said notification a timeout is introduced (208) allowing a person, using the other key (1), to open or lock said lock (3) and remove the respective key (1).

[0058] The aforementioned method wherein the method further comprises the steps of:

- returning the key (2) to a fully slid-in state, by a push mechanism (4, 5);
- verifying the lock (3) state;
- in case the lock's (3) state has changed (203), notifying the new lock (3) state to at least one external device.

FURTHER REMARKS

[0059] The present invention prevents reporting false states by locks coupled to electronic systems and thus makes operation of electronic locks more reliable and

error-free. Therefore, the invention provides a useful, concrete and tangible result.

[0060] The invention uses a sensor to detect physical elements as well as processes responses from such sensor in order to improve reliability of electronic locks. Hence, the machine or transformation test is fulfilled and that the idea is not abstract.

[0061] At least parts of the methods according to the invention may be computer implemented. Accordingly, the present invention may take the form of an entirely hardware embodiment, or an embodiment combining software and hardware aspects that may all generally be referred to herein as a "circuit", "module" or "system".

[0062] Furthermore, the present invention may take the form of a computer program product embodied in any tangible medium of expression having computer usable program code embodied in the medium.

[0063] It can be easily recognized, by one skilled in the art, that at least parts of the aforementioned method for operating an electronic lock may be performed and/or controlled by one or more computer programs. Such computer programs are typically executed by utilizing the computing resources in a computing device. Applications are stored on a non-transitory medium. An example of a non-transitory medium is a non-volatile memory, for example a flash memory while an example of a volatile memory is RAM. The computer instructions are executed by a processor. These memories are exemplary recording media for storing computer programs comprising computer-executable instructions performing all the steps of the computer-implemented method according to the technical concept presented herein.

[0064] While the invention presented herein has been depicted, described, and has been defined with reference to particular preferred embodiments, such references and examples of implementation in the foregoing specification do not imply any limitation on the invention. It will, however, be evident that various modifications and changes may be made thereto without departing from the broader scope of the technical concept. The presented preferred embodiments are exemplary only, and are not exhaustive of the scope of the technical concept presented herein.

[0065] Accordingly, the scope of protection is not limited to the preferred embodiments described in the specification, but is only limited by the claims that follow.

Claims

1. A method for operating an electronic lock (107) being mounted on one side and configured to control only one key (2) of a lock (3), configured to receive keys (1, 2) in two opposite keyholes, the method being characterized in that it comprises:

- reading information from a least one sensor (103), configured to detect (201) sliding out of

- the key (2) controlled by said electronic lock (107);
- reading information from said sensor, configured to detect sliding in of the said key to its previous position (203);
 - undertaking one or many actions (209) by the controller (105).
2. The method according to claim 1 wherein said key (2) is slid in to its previous position by a push mechanism (4,5).
3. The method according to claim 1 wherein the said actions (209) comprise at least one of:
- automated verification of state of the said lock;
 - generating notification regarding changing state of the said lock or possible false state of the said lock;
 - transmitting said notification to an external device;
 - returning said lock to its previous state.
4. The method according to claim 1 wherein the method further comprises generating and transmitting (207) a notification if the key controlled by the electronic lock is not slid in to its previous position within time specified by timeout (206).
5. A computer program comprising program code means for performing all the steps of the computer-implemented method according to claim 1 when said program is run on a computer.
6. A computer readable medium storing computer-executable instructions performing all the steps of the computer-implemented method according to claim 1 when executed on a computer.
7. A system for operating an electronic lock being mounted on one side and configured to control only one key (2) of a lock (3), configured to receive keys (1, 2) in two opposite keyholes, the system comprising:
- a data bus (101) communicatively coupled to a memory (104) and other components of the system;
 - a controller (105);
 - an electronic lock module (107), controlled by the controller (105), configured to execute physical tasks related to control of a key;
 - a wireless communication module (106) configured to allow the controller (105) to communicate events, related to the electronic lock (107);
- the system being **characterized in that** it comprises:
- at least one sensor (103), coupled to the controller (106), configured to detect sliding out, by a predefined distance, of a key controlled by said electronic lock (107) while said key (2) remains partially inserted in the respective keyhole;
 - wherein the controller (105) is configured to execute all steps of the method according to claim 1.
8. The system according to claim 7 wherein the controller (105) is configured to communicate with a "Key position sensor module" (102) that is responsible for detecting vertical/horizontal position of an associated key.
9. The system according to claim 7 wherein the sensor (103) is a proximity sensor or a light sensor or contact sensor or a magnetic sensor.
10. The system according to claim 9 wherein the sensor (103) is coupled to an analog to digital converter reporting data to the controller (105).
11. The system according to claim 7 wherein said predefined distance is in a range of 1 to several millimeters whereas said key still remains partially inserted in said lock.
12. The system according to claim 7 wherein said system further comprises by a push mechanism configured to return the key (2) to a fully slid-in state.

Amended claims in accordance with Rule 137(2) EPC.

1. A method for operating an electronic lock (107) operating a lock (3), configured to receive keys (1, 2) in two opposite keyholes, wherein said electronic lock (107) is configured to operate said lock using a key (2) only in one of said opposite keyholes, the method being **characterized in that** it comprises:
- reading information from a least one sensor (103), configured to detect (201) sliding out of the key (2) controlled by said electronic lock (107) while said key (2) remains partially inserted in the respective keyhole of said lock (3);
 - detecting said sliding out of the key (2);
 - whereas said sliding out of the key (2) is caused by an insertion of the other key (1) in said lock (3) in a keyhole opposite to the keyhole in which the key (2) controlled by said electronic lock (107) is inserted;
 - reading information from said sensor, configured to detect sliding in of said key to its previous position (203);
 - undertaking one or many actions (209) by a

controller (105) in response to sliding in said key to its previous position (203) of being slid in.

2. The method according to claim 1 wherein said key (2) is slid in to its previous position by a push mechanism (4,5). 5
3. The method according to claim 1 wherein the said actions (209) comprise at least one of: 10
 - automated verification of state of the said lock;
 - generating notification regarding changing state of the said lock or possible false state of the said lock;
 - transmitting said notification to an external device; 15
 - returning said lock to its previous state.
4. The method according to claim 1 wherein the method further comprises generating and transmitting (207) a notification if the key controlled by the electronic lock is not slid in to its previous position within time specified by timeout (206). 20
5. A computer program comprising program code means for performing all the steps of the computer-implemented method according to claim 1 when said program is run on a computer. 25
6. A computer readable medium storing computer-executable instructions performing all the steps of the computer-implemented method according to claim 1 when executed on a computer. 30
7. A system for operating an electronic lock (107) configured to control only one key (2) of a lock (3), configured to receive keys (1, 2) in two opposite keyholes, wherein said electronic lock (107) is configured to operate said lock (3) using a key only in one of said opposite keyholes, the system comprising: 35 40
 - a data bus (101) communicatively coupled to a memory (104) and other components of the system;
 - a controller (105); 45
 - an electronic lock module (107), controlled by the controller (105), configured to execute physical tasks related to control of a key;
 - a wireless communication module (106) configured to allow the controller (105) to communicate events, related to the electronic lock (107); 50

the system being **characterized in that** it comprises: 55

- at least one sensor (103), coupled to the controller (106), configured to detect sliding out, by a predefined distance, of a key controlled by said

electronic lock (107) while said key (2) remains partially inserted in the respective keyhole;

- whereas said sliding out of the key (2) is caused by an insertion of the other key (1) in said lock (3) in a keyhole opposite to the keyhole in which the key (2) controlled by said electronic lock (107) is inserted;
 - wherein the controller (105) is configured to execute all steps of the method according to claim 1.
8. The system according to claim 7 wherein the controller (105) is configured to communicate with a "Key position sensor module" (102) that is responsible for detecting vertical/horizontal position of an associated key.
 9. The system according to claim 7 wherein the sensor (103) is a proximity sensor or a light sensor or contact sensor or a magnetic sensor.
 10. The system according to claim 9 wherein the sensor (103) is coupled to an analog to digital converter reporting data to the controller (105).
 11. The system according to claim 7 wherein said predefined distance is in a range of 1 to several millimeters whereas said key still remains partially inserted in said lock.
 12. The system according to claim 7 wherein said system further comprises by a push mechanism configured to return the key (2) to a fully slid-in state.

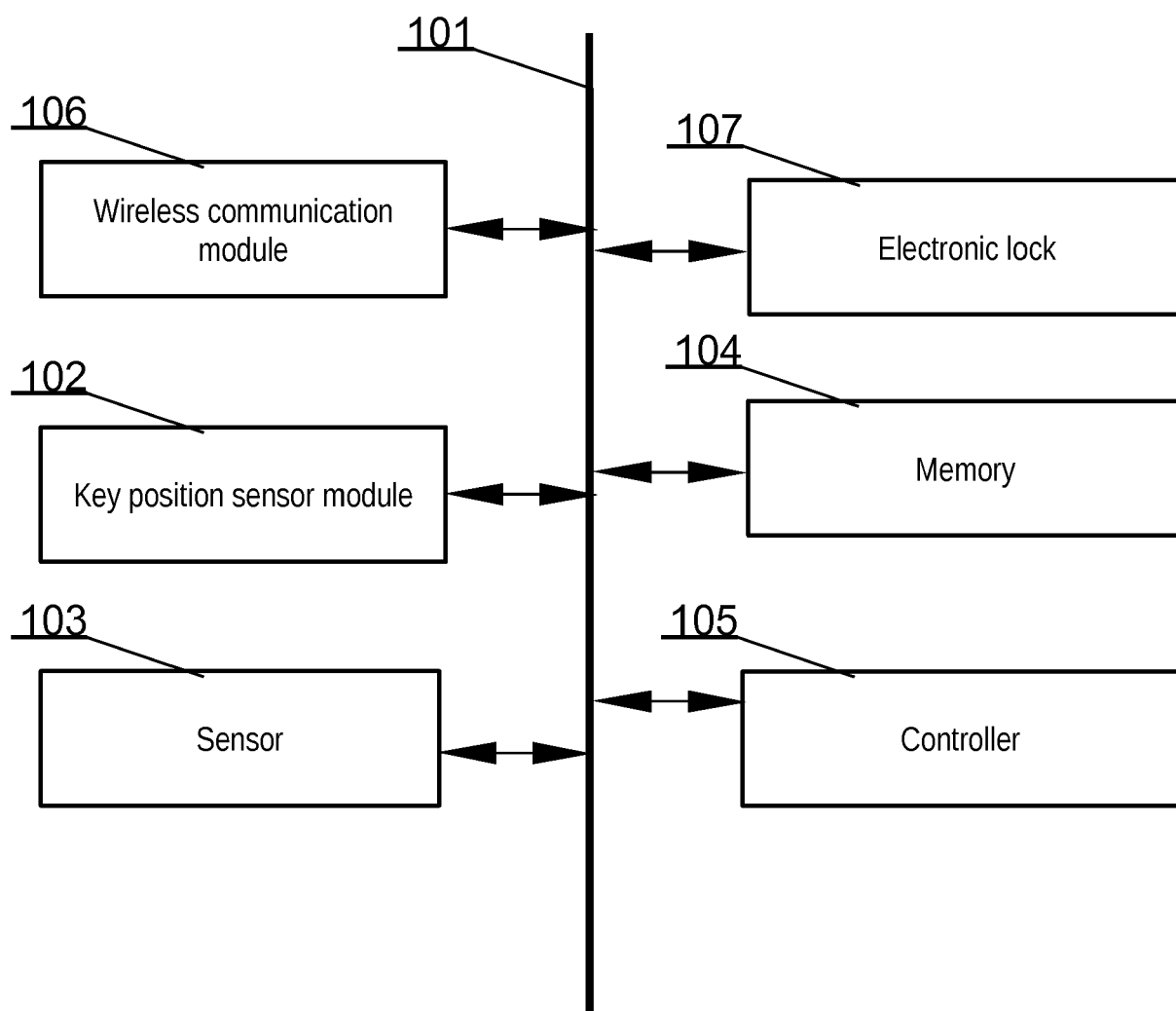


Fig. 1

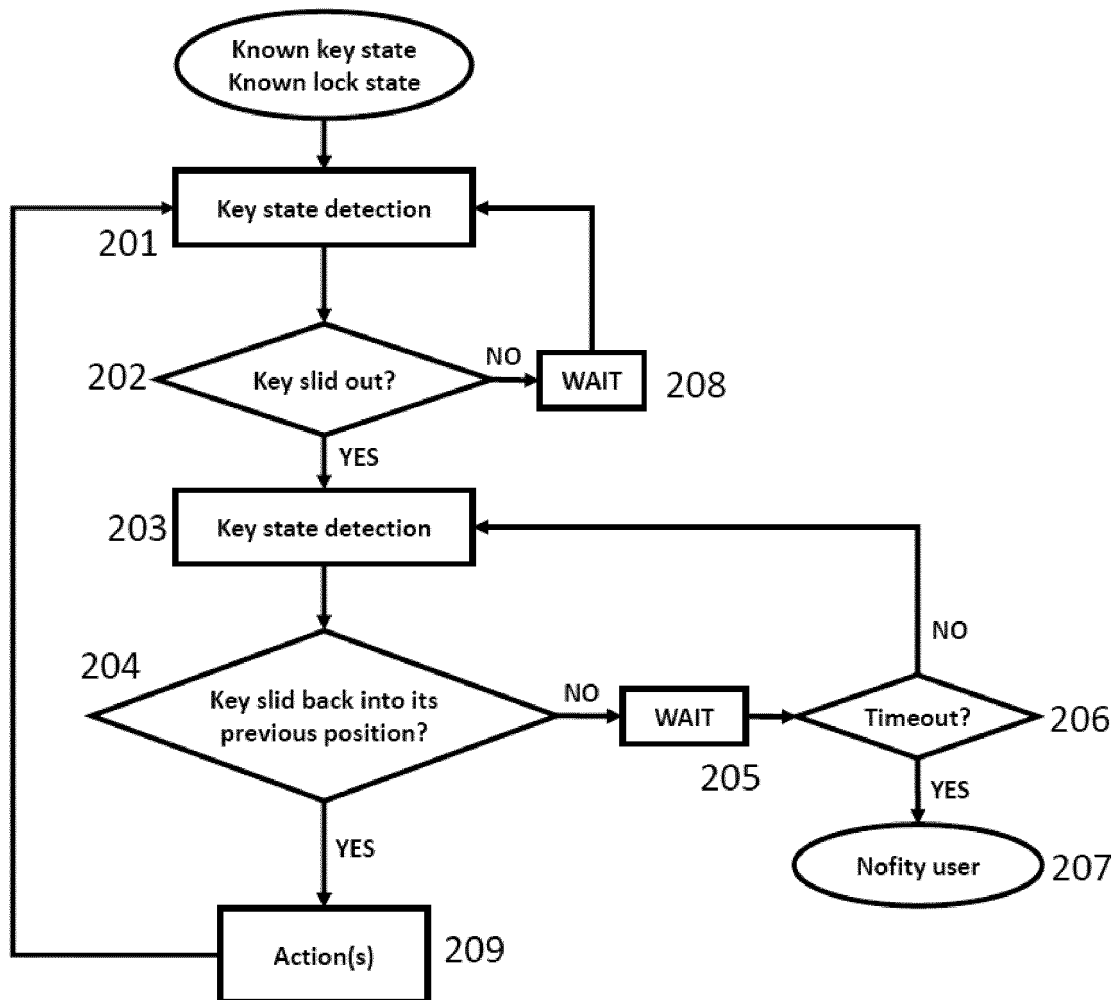


Fig. 2

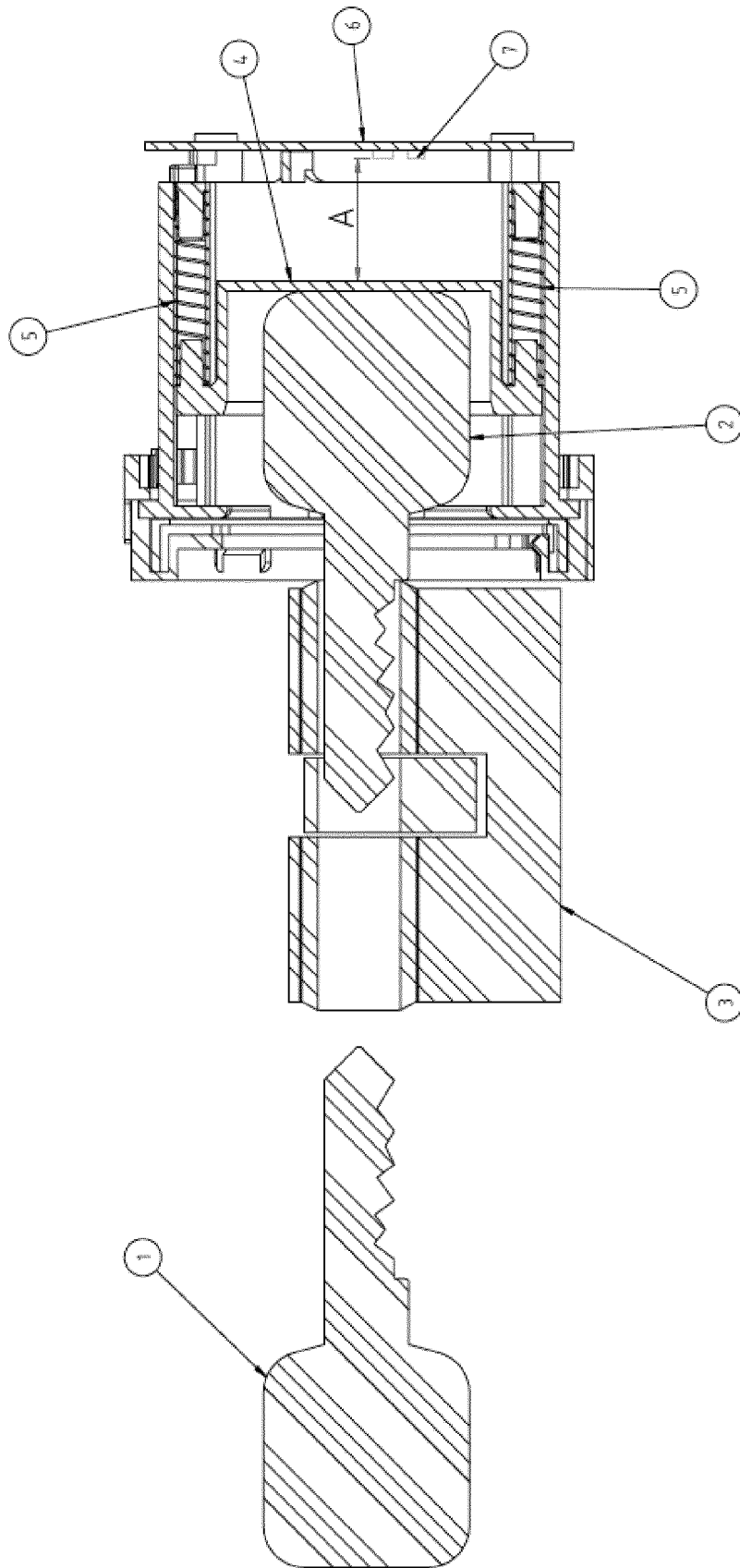


Fig. 3

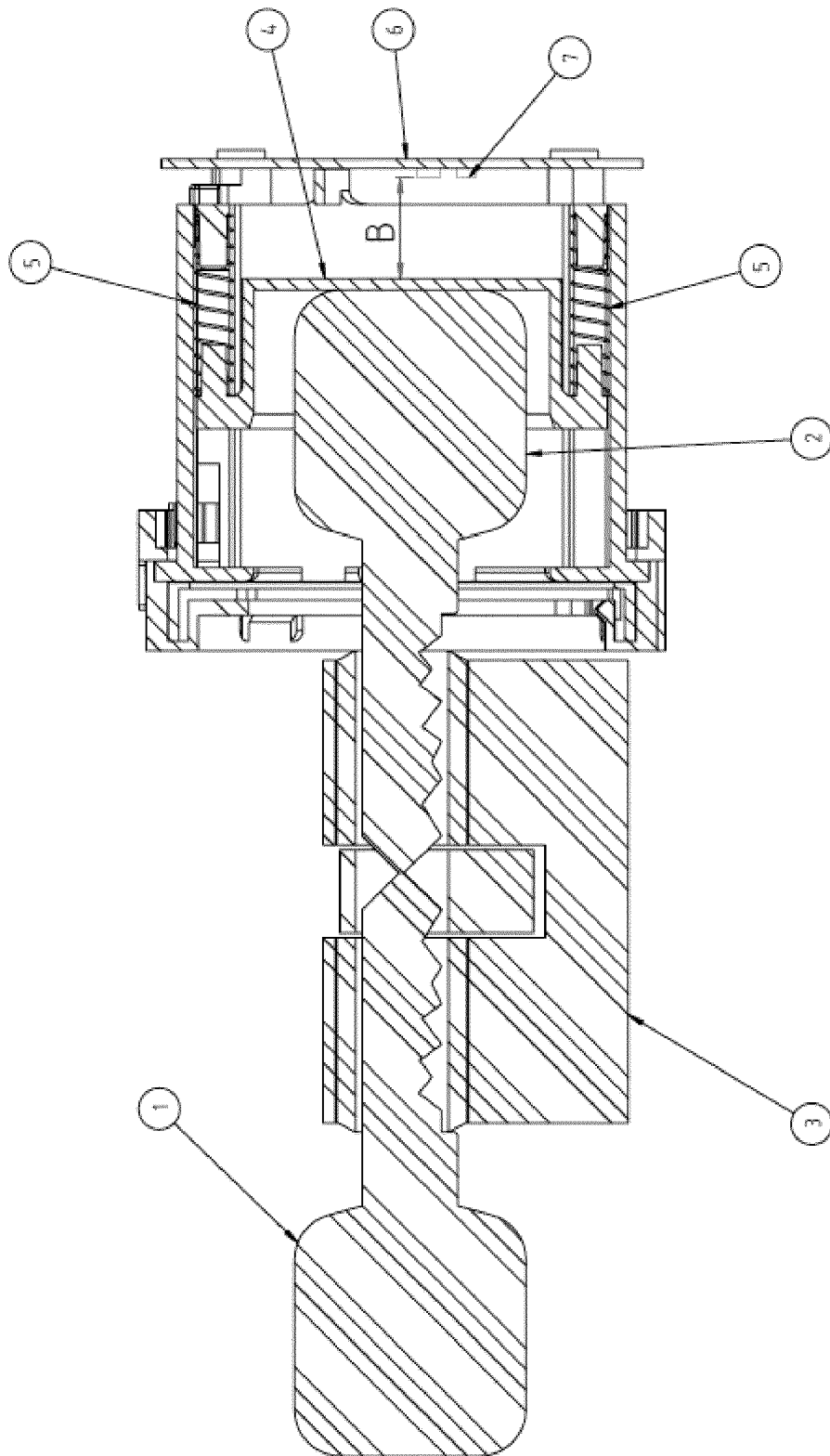


Fig. 4



EUROPEAN SEARCH REPORT

Application Number
EP 18 46 1605

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	WO 99/14457 A1 (CHEN Z00R YOSI [IL]) 25 March 1999 (1999-03-25) * abstract * * figure 7 * * page 3, line 7 - line 28 * * page 6, line 25 - line 32 * * page 9, line 28 - line 33 * * page 14, line 17 - line 28 *	1-12	
			TECHNICAL FIELDS SEARCHED (IPC)
			G07C E05C E05B
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 27 February 2019	Examiner Saraceni, Alessandro
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 18 46 1605

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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