

(19)



(11)

EP 1 786 998 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
10.03.2010 Bulletin 2010/10

(21) Application number: **05756278.7**

(22) Date of filing: **21.06.2005**

(51) Int Cl.:
E05B 47/00 (2006.01)

(86) International application number:
PCT/FI2005/050225

(87) International publication number:
WO 2006/008340 (26.01.2006 Gazette 2006/04)

(54) **ELECTROMECHANICAL PROGRAMMABLE LOCK AND ITS OPERATING SYSTEM**

ELEKTROMECHANISCHES PROGRAMMIERBARES SCHLOSS UND BETRIEBSSYSTEM DAFÜR
SERRURE PROGRAMMABLE ELECTROMECHANIQUE ET SYSTEME DE FONCTIONNEMENT
ASSOCIE

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IS IT LI LT LU MC NL PL PT RO SE SI SK TR**

(30) Priority: **19.07.2004 FI 20041002**

(43) Date of publication of application:
23.05.2007 Bulletin 2007/21

(73) Proprietor: **iLoq Oy
90570 Oulu (FI)**

(72) Inventors:
• **PUKARI, Mika
FI-90570 Oulu (FI)**
• **KRUUSING, Arvi
FI-90570 Oulu (FI)**

(74) Representative: **Brax, Matti Juhani et al
Berggren Oy Ab
Kirkkokatu 9
90100 Oulu (FI)**

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

EP 1 786 998 B1

Description

[0001] The invention relates to an electromechanical programmable lock and its operating system.

[0002] A locking system based on a programmable, electronic key can be implemented either as centralized or decentralized or as a combination thereof.

[0003] A centralized system consists of an electricity supply and telecommunications network, electrically operated lock bodies, electronic key reading devices, electronic keys, generally containing only a code, programmable control units and backup batteries. A centralized system provides good properties, but is expensive to implement especially in an old building, in which no provision has been made for the cabling required by the system.

[0004] A decentralized system generally makes an independent opening decision in the lock control unit on the basis of information programmed in the key. The power supply of the system has typically been implemented by a power source feeding the lock control unit and/or a backup battery. The power supply of a decentralized system can also be implemented by a battery in the key. The maintenance of the batteries of the locks and keys is problematic, because the draining of the batteries prevents opening the lock or they leave the lock in the open position.

[0005] There are also known locks in which the identification of the key and the opening/closing of the lock is carried out either partly or entirely electrically. In such locking systems, the key includes a memory element, which can be read and identified by the reading circuit in the lock. If the lock recognizes the electric identifier of the key, the lock opens either by turning the key set in the lock or by the operation of an electric opening mechanism. One such solution has been presented in the patent US 6 331 812, in which a locking code has been saved in the key. The key also includes a small battery, by which the key code can be sent to the lock. Another exemplary solution of the use of an electric key identifier is known from the application WO 00/68536. However, both systems require an external energy source for carrying out the electric recognition and electric opening of the lock.

[0006] An electric locking arrangement, which is entirely independent of an external source of electric energy, is known from the following publications, for example. The publication WO 81/02603 discloses a solution in which a door knob belonging to the lock is connected to an electric generator. Turning the knob creates electricity, which is utilized in the operation of the lock. The arrangement is complicated and always requires a separate door knob for functioning.

[0007] Publication DE 19918817 discloses a procedure, in which the key has been provided with an arrangement creating electricity. The electricity is produced by means of a mass moving in the key, which operates an electric generator. The mass in the key moves when the

person is moving, thereby creating a small electric current. The electricity produced is loaded to a battery in the key. The energy of the battery is used in sending the code of the key to the lock.

[0008] A lock, which is independent of an external energy source and at least partly electrically operated, can also be implemented by using the piezoelectric phenomenon. An arrangement, in which piezoelectric elements have been installed in the body of the lock, is known from the patent US 6 437 684. Inserting the key in the lock and turning it in the lock creates a deformation in the piezoelements, which creates an electric current. This current is utilized in the management of the locking.

[0009] Two different piezoelectric lock solutions are known from the published application FR 276 4625. Electricity is used both for the identification of the key and the movement of the lock elements. In the first solution presented, electricity is created by the difference of temperature on different sides of the lock in the door. The difference of temperature bends the piezo strips, which at the same time create an electric current for the operation of the lock. For a situation in which there is no temperature difference, the lock body includes a capacitor, which is continuously loaded in normal operation. In another embodiment of the published application, piezoelectricity is created in a key, which includes piezo strips. Inserting the key in the lock and turning it creates an electric current, which is utilized in identifying the key and opening the lock. The problem with piezoelectric elements is a low production of electricity in a static or slow oscillating motion. Therefore, using a piezo element in an application in which higher electric power is required, requires making the piezo element to oscillate at a high frequency in one way or another. Achieving high-frequency oscillation complicates such lock structures, in which piezoelectric elements are utilized. See as well US 5 265 452 A.

[0010] The objective of the invention is to provide a new lock and locking method, by which an electromechanic, programmable lock system can be implemented without a separate, electric power source.

[0011] The objectives of the invention are achieved by a lock arrangement, in which mechanical power transmission has been arranged from a turnable lock cylinder to an electric generator turnably fastened to the lock body, the turning angle of which depends on the torque transmitted by it. When the key is turned, electric current is first produced by an electric generator to the electric key identification system of the lock. Then the electrical load of the generator does not produce a high torque. If the key is identified and accepted to be used for opening the lock, the output arrangement of the generator is changed so that the torque transmitted by the generator increases strongly. Turning the key then also causes the turning of the body of the electric generator, as a result of which the mechanical detent is removed from the opening path of the lock. After this, the lock opens fully mechanically by turning the key further.

[0012] The invention has the advantage that an electric

lock system can be implemented without a separate electric actuator and the storage of electric energy required by it.

[0013] In addition, the invention has the advantage that electric identification can be used in the lock, which enables the use of more versatile protection arrangements than a conventional mechanical locking system.

[0014] A further advantage of the invention is the fact that electric energy is required only for the identification and acceptance of the key and the coupling arrangements of the terminals of the generator.

[0015] Yet another advantage of the invention is easy electric programmability of the lock and the key, which enables changing the locking system easily.

[0016] An additional advantage of the invention is the fact that the key bit can be smooth, or only one projection or groove is required in it to enable drawing the door open by the key.

[0017] Another additional advantage of the invention is the fact that the lock can be opened mechanically by turning the key, and no electric energy is required for opening it.

[0018] The electromechanical lock according to the invention is characterized in that the electric energy required by the electric identification has been produced from the movement of the key by an electromagnetic generator, and that the difference between the torque transmitted by the loaded and unloaded electromagnetic generator has been arranged either to open the lock or to bring it to the blocking state.

[0019] The electromechanical locking method according to the invention is characterized in that the electric energy required by the electric identification of the key is produced by the movement of the key by means of an electromagnetic generator, and that the difference between the torque of the loaded and unloaded electromagnetic generator is used either to open the lock or to bring it to the blocking state.

[0020] Some preferred embodiments of the invention are presented in the dependent claims.

[0021] The basic idea of the invention is the following: Electrical identification and acceptance of the key and mechanical opening motion of the lock bolt are both utilized in the lock. The key is identified and accepted electrically, but the motion of the bolt is achieved mechanically by turning the key. The key turns sufficiently for moving the bolt only if the key has been identified. Alternatively, an unaccepted key turns freely around in the lock body without a mechanical connection to the lock bolt. The electric energy required for the identification and acceptance is produced in the lock by an electromagnetic generator, the rotor of which is turned by turning the key. The motion of the key to the rotor of the generator is transmitted from the lock cylinder by a gear system. The body of a direct-current generator has been installed in the lock body so that the direct-current generator can be turned around its longitudinal axis. If the control unit of the lock finds that the key turned in the lock is not allowed

to open the lock, the control unit changes the coupling of the output of the direct-current generator in a way that the torque of the rotor is minimized. For example, the terminals of the generator can be disconnected. In this case, the body of the generator does not turn from its rest position, and the detent bar of the lock cylinder collides with the detent in the lock body. Alternatively, the key turns round in the lock without a mechanical connection to the bolt.

[0022] The situation changes if the control unit of the lock finds that the key turned in the lock is such that the lock may be opened by it. In this case, the control unit of the lock changes the coupling of the output of the direct-current generator in a way that the torque of the rotor increases strongly. The output of the generator can be shorted, for example. In this case, the torque produced by the key and directed to the generator grows so high that it exceeds the moment caused by the fastening of the body of the direct-current generator, which resists the turning of the body of the direct-current generator. When the key is turned further, the body of the direct-current generator then turns so that it moves the detent bar in the lock to a position in which it does not prevent turning the lock cylinder by the key to a position in which the bolt is drawn into the lock. Alternatively in the arrangement according to the invention, the key is connected to a freely turning lock cylinder, which is further connected to the bolt.

[0023] In the following, the invention will be described in more detail. Reference will be made to the accompanying figures, in which

- Figure 1 shows a longitudinal section of a lock according to the invention as an example;
- Figure 2a shows a cross-section of the lock of Fig. 1 in the starting position as an example;
- Figure 2b shows, as an example, the lock of Fig. 1 when electric energy is produced by the key for identification and acceptance;
- Figure 2c shows, as an example, the lock of Fig. 1 in the closing position, in which the key has not been identified;
- Figure 2d shows, as an example, the lock of Fig. 1 in the opening position, in which the key has been identified; and
- Figure 3 which shows the main steps of the locking method according to the invention as an exemplary flow chart.

[0024] Fig. 1 shows an exemplary lock arrangement 100, in which the invention can be applied. The key 180 belonging to the lock comprises an electrical identification unit 181. The key 180 and the electrical identification

unit 181 belonging to it can be programmed by some prior art system. The operation of the invention only requires that the information comprised by the identification unit 181 in the key 180 can be read from the key by some electrical system. The information of the identification unit 181 preferably comprises the identification code of the key 180, an encryption key and user group information. For safety of use, the information has been encrypted by some prior art encryption technique.

[0025] The control unit 121 belonging to the lock 100 can read the information contained by the identification unit 181. The reading can be carried out either wirelessly or via a wired contact, like in the example of Fig. 1 by signal conductors 124 and 182 and slide contacts 125. Wireless reading is possible e.g. by the RFID (Radio Frequency Identification) technology, in which the device 121 of the identifier unit 181 carrying out the reading wirelessly transmits to the circuit being read a sufficient amount of electric energy for reading the identifier wirelessly. The control unit 121 may also comprise an external connection 123, through which the information or the state of the control unit can be read or changed. The external connection 123 is preferably located on the side of the door in the object to be protected to which access is only by an accepted key.

[0026] In Fig. 1, number 110 denotes a lock body, which is preferably cylindrical. The lock body 110 has been provided with a cylindrical inner cavity, in which the lock cylinder 120 can turn around its longitudinal axis 101 by the force of the key 180. The rest cavity 192 of the detent bar 190 has also been made in the lock body 110. When the lock is in the basic position, the detent bar 190 is pressed to the rest cavity 192 by the force of the springs 191 a and 192b. Then the lock can be said to be in the basic position.

[0027] Cavities for the electric generator according to the invention and the locking actuators 150a and 150b have also been made in the lock body 110. A mechanical gear system 140 has also been permanently connected to the electric generator 130, which is preferably a permanent magnet generator. They have preferably been placed concentrically on the same shaft 102. The electric generator 130 can be implemented by a Faulhaber generator 0816006F, for example, and the gear system 140 by a gear system 08/1 of the same manufacturer, which has a transformation ratio of the order of 1:60. This arrangement can produce approx. 1 mJ of energy, which is sufficient for carrying out the identification and acceptance. The lock cylinder 120 and the gear system 140 have preferably been connected to each other by toothed gear wheels 171 and 172. The rotatory motion of the lock cylinder 120 is thus transmitted to the shaft 102 of the generator 130 in the opposite direction. This rotatory motion, which has an opposite direction in relation to the lock cylinder, is utilized in the opening method of the locking according to the invention.

[0028] In the example of Fig. 1, actuators 150a and 150b according to the invention, which are flexibly sup-

ported on both sides of the casing of the generator, have also been permanently connected to the combination of a generator and a gear system 130, 140. In the case of an identified and accepted key, the detent bar 190 can be directed past the detent 111 on the lower part of the lock body 110 by the actuators 150a and 150b. The detent 111 has advantageously been made by shaping in the cavity of the lock cylinder in the lock body 110 at least one lock groove, to which the detent bar 190 can get stuck. Turnable connection of actuators 150a and 150b can be implemented by springs 151 a and 151b, for example. It is obvious to a person skilled in the art that within the scope of the inventive idea, the springs 151 a and 151 b that resist the turning of the electric generator can also be replaced by other actuators exerting a force that changes according to the position.

[0029] The lock 100 also includes a control unit 121. In the example of Fig. 1, it has been placed in the lock body 110, but it can naturally also be located in the lock cylinder 120. However, this alternative embodiment is more complicated than the solution mentioned above, because in this solution it is also necessary to arrange the transfer of energy from the lock body 110 to the rotating lock cylinder 120. In the example of Fig. 1, the electric energy is fed from the generator 130 as follows. The first feed lines 131, which are permanently connected to the control unit 121 of the lock, start from the generator 130. When the key 180 is turned, advantageously about 90 degrees from the starting position, the electric energy created is thus transferred from the generator 130 to the inputs of the control unit 121. In the first step of opening the lock, electricity is used for reading the information comprised by the identifier unit 181 of the key 180. When the key has been turned about 120 degrees, the signal of the sensor 122 in the body 110 of the lock is directed along the connection 127 to the control unit 121. Then the control unit 121 must make the decision on allowing or preventing the opening of the lock. In an advantageous embodiment of the invention, the current of the electromagnetic generator can also be used to load a capacitor (not shown in Fig. 1), the coupling of which to the feed lines 131 coming from the electromagnetic generator can be changed. The loading transmitted by the electromagnetic generator can be regulated by the coupling of the capacitor.

[0030] If the identification of the key is accepted, the control unit 121 changes the coupling connected to the feed lines 131 in such a way that the change of the coupling considerably increases the torque measurable from the shaft 102 of the electric generator. This can be done, for example, by shorting the feed lines 131 coming to the control unit 121. It is also possible to feed a current in the opposite direction from the control unit 121 back to the generator 130 from a capacitor connected in the reverse direction, for example, in order to increase the torque.

[0031] When the torque transmitted by the generator 130 increases, it causes the body of the whole generator

130 to turn in spite of the resisting force of the springs 151 a and 151b. Then the actuators 150a and 150b turn to a position in which they can direct the detent bar 190 past the detent 111, and the lock can be opened by turning the key 180 further.

[0032] If the key 180 is not identified or accepted before the turning angle of the key exceeds about 120 degrees, the control unit 121 advantageously disconnects the feed lines 131 coming from the electric generator 130. Then the torque transmitted by the electric generator 130 is minimized and remains so small that the body of the electric generator does not turn sufficiently to enable the actuators 150a and 150b according to the invention to direct the detent bar 190 past the detent 111. Then the lock cannot be opened mechanically by the key. If the control unit 121 also comprises a capacitor, it can be connected to the feed lines 131 in the forward direction in order to reduce the torque transmitted by the electromagnetic generator.

[0033] The operation of the lock according to the invention when turning the key 180 is seen in figures 2a-2d. In Fig. 2a, the lock is in the basic state. The cylindrical cavity made in the lock body 110, in which the lock cylinder 120 has been centrally placed, is also seen in Fig. 2a. The rest cavity 192 of the detent bar 190, into which the spring 191 presses the detent bar 190 in the rest position of the lock, is seen in the upper part of the lock body. The rest cavity 192 has been formed such that by turning the lock cylinder 120 by the key 180 lightly, the detent bar 192 is removed from the rest cavity 192. In the middle of the lock cylinder 120 there is seen the key 180, which can be entirely smooth without mechanical coding in the solution according to the invention.

[0034] In Fig. 2a, a mechanical projection, detent 111, is seen on the lower part of the cylindrical cavity made in the lock body. In the example of Fig. 2a, the detent has been made by two grooves in the direction of the lock cylinder. If the key 180 is not accepted, this detent 111 prevents the movement of the detent bar 190 past it. Fig. 2a also shows schematically how one actuator 150 and generator 130 according to the invention have been connected in relation to the lock body 110 and the detent 111. In the example of Fig. 2a, the actuator 150 according to the invention has been connected by two springs 151c and 151d to the lock body 110. The actuator 150 has also been permanently connected to the upper part of the body of the generator 130, and therefore the turning of the body of the generator 130 in relation to its longitudinal axis also turns the actuator 150.

[0035] In Fig. 2b, the key has been turned in the lock 100 about 90 degrees in the direction of arrow A. The movement of the key turns the electric generator 130, which produces electric energy for identifying the key and considering the acceptance. The detent bar 190 presses against the wall of the cavity of the lock body 110 lightly by the force of the spring 191. The torque experienced by the electric generator is low during the production of electric energy. Therefore the body of the generator 130

turns in the direction of arrow B only slightly. With regard to the invention, it is advantageous that the turning movement of the key 180 turns the body of the generator 130 in a different direction than the lock cylinder 120. When the key is turned further, the turning angle of 120 degrees is exceeded, in which case the sensor 122a sends a message on exceeding the angle to the control unit 121. The figure also shows a sensor 122b, which functions in systems in which the turning direction of the key 180 is different from that of the examples of figures 2a-2d. After this, the control unit 121 at the latest makes the decision on the opening or prevention of the lock.

[0036] Fig. 2c presents a situation in which the lock cylinder 120 has been turned by the key 180 almost 180 degrees in the direction of arrow C. However, in the case of Fig. 2c, the key has not been accepted for opening the lock. Then the control unit performs the switching by which the torque experienced by the generator 130 is minimized. It can be done, for example, by disconnecting (opening) the feed lines coming to the control unit 121. As a result of this, the body of the generator 130 turns only for a small distance in the direction of arrow D, because the torque transmitted by the generator is small. This small turn of the body of the generator 130 cannot turn the actuator 150 to such a position that the detent bar 190 would pass the detent 111 belonging to the lock body, but the spring 191 presses the detent bar 190 against the front edge of the detent 111. Thus the movement of the key 180 stops at the detent 111 and the lock 100 cannot be opened.

[0037] Fig. 2d shows a situation in which the identifier 181 of the key 180 has been accepted. Having accepted the identifier of the key 180, the control unit 121 electrically changes the coupling that loads the generator 130 by shorting the feed lines 122 coming from the generator, for example. This procedure considerably increases the torque transmitted by the generator 130 when the key 180 is turned in the direction of arrow E. As a result of that, the body of the generator 130 turns substantially in the direction of arrow F. Because the actuator 150 has been permanently connected to the body of the generator 130, the position of the actuator 150 also changes accordingly. When the actuator 150 turns sufficiently, the force exerted by the actuator 150 to the detent bar 190 is higher than the force of spring 191 in the opposite direction at the front edge of the detent 111. Then the actuator 150 can guide the detent bar 190 past the front edge of the detent 111.

[0038] Because the detent 111 has been passed, the turning of the key 180 can be continued further. After the detent 111, the prior art mechanical bolt of the lock is moved by the key 180, whereby the lock (not shown in the figures) connected to the shaft 101 can be opened mechanically.

[0039] Fig. 3 shows the main steps of the locking method according to the invention as an exemplary flow chart. In step 31, the key is inserted in the lock. The key is turned in step 32, whereby the electric generator, which

is powered by the movement of the lock cylinder, produces electric current to the control unit of the lock. By the electricity produced by the generator, the control unit can read the content of the identifier unit of the key, step 33. The information contained by the identifier unit can be encrypted by some prior art method.

[0040] In step 34, the control unit accepts or rejects the key on the basis of the identifier information it has read. If the key is not accepted, the control unit sees to it that the torque transmitted by the electric generator is minimized in step 39. In that case, the electric generator, which has been fastened as turnable in relation to its longitudinal axis, does not turn the actuator according to the invention to such a position that the detent bar of the lock cylinder could pass the detent in the lock body. Thus it is found in step 40 that the lock cannot be opened by the key in question.

[0041] If the key is accepted in step 34, the control unit changes the load of the generator in step 35. The change of the load maximises the torque transmitted by the generator, whereby turning the key in the lock also turns the body of the electric generator in relation to its longitudinal axis, step 36. As a result of the turning of the body of the electric generator, at least one actuator according to the invention is set in a position in which the detent bar can pass the front edge of the detent 111 belonging to the lock body. After this, the lock can be opened by turning the key further in the same direction. Then the mechanical bolt in the lock can be moved to the open position by turning the key, step 37. The end result is an opened lock, step 38.

[0042] Some preferred embodiments of the lock and operating system of the lock according to the invention have been described above. The invention is not limited to the solutions described above. For example, the electric control unit may also comprise various inputs and outputs and a connection of the programming port. The change of torque according to the invention can also be implemented at any point of the chain of power transmission from the key to the generator. In addition, the inventive idea can be applied in many different ways within the scope defined by the attached claims.

Claims

1. An electromechanical lock (100), which comprises means for electrically reading and checking (121) the information of an identifier unit (181) of a key (180) and means for mechanically opening the lock by turning the key in the lock, if the key has the opening right, and in which lock the electric energy required by the electrical identification has been produced from the movement of the key (180) by an electromagnetic generator (130), **characterized in that**

- a capacitor has been arranged to be loaded by

the key movement before the opening decision
- the identification of the key has been arranged to change an electric coupling of the generator (130) by coupling the outputs of the capacitor to the electromagnetic generator (130) either in the forward or reverse direction depending on the opening decision

- the change of the electric coupling of the generator (130) has been arranged to change the mechanical load of the generator, which has been arranged to change the position of the generator, and that

- the change of the position of the generator (130) caused by the change of the loading of the electromagnetic generator has been arranged to guide the lock open or to the prevention state.

2. The electromechanical lock according to Claim 1, **characterized in that** the means for reading and checking the electrical identifier of the key comprise an electronic control unit (121) in a lock body (110), energy feed lines (131) of the control unit and signal lines (124).

3. The electromechanical lock according to Claim 1, **characterized in that** the means for reading and checking the electric identifier of the key comprise an electronic control unit (121) in a lock cylinder (120), energy feed lines (131) of the control unit and signal lines (124).

4. The electromechanical lock according to Claim 2 or 3, **characterized in that** the torque transmitted by the electric generator has been arranged to be increased for enabling the opening of the lock by shorting the feed lines coming from the electric generator (130) to the control unit (121) in the control unit (121) after accepting the key.

5. The electromechanical lock according to Claim 4, **characterized in that** the growth of the torque transmitted by the electric generator (130) has been arranged to turn the body of the electric generator to a position in which it further turns at least one actuator (150) fastened to the body of the electric generator to a position in which the actuator (150) has been arranged to guide a spring-loaded (191 a, 191 b) detent bar (190) past a detent (111) in the lock body (110) for allowing the opening of the lock.

6. The electromechanical lock according to Claim 1, **characterized in that** an opening right of the key (180) has been arranged to be installed in the control unit (121) through an external input connection (123) belonging to it.

7. The electromechanical lock according to Claim 1, **characterized in that** the movement of the key

(180) for producing electric energy has been arranged to be transmitted from the lock cylinder (120) to the electric generator by means of a gear wheel (171) in the lock cylinder and a gear system (140) connected on the shaft of the electric generator (130) and a gear wheel (172) connected to the gear system.

8. An operating method of an electromechanical lock, in which method

- the information of an identifier unit (181) of a key is read electrically (32, 33, 33)
- after the acceptance of an opening right, the lock is opened mechanically by turning the key (37), and in which
- the electric energy required by the electric identification of the key is produced by the movement of the key by means of an electromagnetic generator (130),

characterized in that

- an electric coupling of the generator (130) is changed by the identification of the key
- the mechanical load of the generator (130), by which the position of the generator is changed, is changed by the change of the electric coupling of the generator, and that
- the lock is brought open or to the prevention state by a change of the position of the generator (130) caused by a change of the loading of the electromagnetic generator.

9. The operating method according to Claim 8, **characterized in that** a capacitor loaded before the opening decision is used for the change of the loading of the generator (130), and this capacitor is coupled to the electromagnetic generator either in a forward or reverse direction depending on the opening decision.

10. The operating method according to Claim 8, **characterized in that** the information of an electric identifier unit (181) of the key is read and accepted by an electronic control unit (121) in a lock body (110).

11. The operating method according to Claim 8, **characterized in that** the information of an electric identifier unit (181) of the key (180) is read and accepted by an electronic control unit (121) in a lock cylinder (120).

12. The operating method according to Claim 10 or 11, **characterized in that** the torque transmitted by the electric generator (130) is increased for enabling the opening of the lock by shorting feed lines coming from the generator (130) to the control unit (121) in

the control unit (121) after accepting the key.

13. The operating method according to Claim 12, **characterized in that** the growth of the torque transmitted by the electric generator (130) turns the body of the electric generator to a position in which it further turns the at least one actuator (150) fastened to the body of the electric generator to a position in which the actuator (150) guides a detent bar (190) of the lock past a detent (111) in the lock body (110) for allowing the opening of the lock.

14. The operating method according to Claim 8, **characterized in that** for producing electric energy, the turning movement of the key (180) is transmitted from the lock cylinder (120) to the electric generator by means of a gear wheel (171) in the lock cylinder and a gear system (140) connected on a shaft of the electric generator (130) and a gear wheel (172) connected to the gear system.

Patentansprüche

1. Elektromechanisches Schloss (100), das Einrichtungen zum elektrischen Lesen und Prüfen (121) der Informationen einer Identifiziereinheit (181) eines Schlüssels (180) und Einrichtungen zum mechanischen Öffnen des Schlosses durch Drehen des Schlüssels in dem Schloss enthält, wenn der Schlüssel das Öffnungsrecht hat, und bei welchem Schloss die elektrische Energie, die durch die elektrische Identifikation benötigt wird, von der Bewegung des Schlüssels (180) durch einen elektromagnetischen Generator (130) erzeugt wurde, **dadurch gekennzeichnet, dass**

- ein Kondensator eingerichtet wurde, um durch die Schlüsselbewegung vor der Öffnungsentscheidung geladen zu werden,
- die Identifikation des Schlüssels eingerichtet wurde, um eine elektrische Kopplung des Generators (130) durch Koppeln der Ausgänge des Kondensators an den elektromagnetischen Generator (130) entweder in der Vorwärts- oder Rückwärtsrichtung in Abhängigkeit von der Öffnungsentscheidung zu ändern,
- die Änderung der elektrischen Kopplung des Generators (130) eingerichtet wurde, um die mechanische Belastung des Generators zu ändern, welche eingerichtet wurde, um die Position des Generators zu ändern, und dass
- die Änderung der Position des Generators (130), verursacht durch die Änderung der Belastung des elektromagnetischen Generators, eingerichtet wurde, um das Schloss in den geöffneten oder in den gesperrten Zustand zu führen.

2. Elektromechanisches Schloss nach Anspruch 1, **dadurch gekennzeichnet, dass** die Einrichtungen zum Lesen und Prüfen des elektrischen Identifizierers des Schlüssels eine elektronische Steuereinheit (121) in einem Schlosskörper (110), Energieversorgungsleitungen (131) der Steuereinheit und Signalleitungen (124) enthalten. 5
3. Elektromechanisches Schloss nach Anspruch 1, **dadurch gekennzeichnet, dass** die Einrichtungen zum Lesen und Prüfen des elektrischen Identifizierers des Schlüssels eine elektronische Steuereinheit (121) in einem Schließzylinder (120), Energieversorgungsleitungen (131) der Steuereinheit und Signalleitungen (124) enthalten. 10 15
4. Elektromechanisches Schloss nach Anspruch 2 oder 3, **dadurch gekennzeichnet, dass** das Drehmoment, das von dem elektrischen Generator übertragen wurde, eingerichtet wurde, um erhöht zu werden, um das Öffnen des Schlosses durch Kurzschließen der Versorgungsleitungen, die von dem elektrischen Generator (130) zu der Steuereinheit (121) kommen, in der Steuereinheit (121) nach dem Akzeptieren des Schlüssels zu ermöglichen. 20 25
5. Elektromechanisches Schloss nach Anspruch 4, **dadurch gekennzeichnet, dass** die Zunahme des Drehmoments, das durch dem elektrischen Generator (130) übertragen wurde, eingerichtet wurde, um den Körper des elektrischen Generators zu einer Position zu drehen, in welcher er ferner wenigstens einen Aktuator (150), der an dem Körper des elektrischen Generators befestigt ist, zu einer Position dreht, in welcher der Aktuator (150) eingerichtet wurde, um einen mittels einer Feder gespannten (191a, 191b) Raststab (190) hinter eine Raste (111) in dem Schlosskörper (110) zu führen, um das Öffnen des Schlosses zu gestatten. 30 35
6. Elektromechanisches Schloss nach Anspruch 1, **dadurch gekennzeichnet, dass** ein Öffnungsrecht des Schlüssels (180) eingerichtet wurde, um in der Steuereinheit (121) durch eine zugehörige externe Eingabeverbinding (123) installiert zu werden. 40 45
7. Elektromechanisches Schloss nach Anspruch 1, **dadurch gekennzeichnet, dass** die Bewegung des Schlüssels (180) zum Erzeugen von elektrischer Energie eingerichtet wurde, um von dem Schließzylinder (120) zu einem elektrischen Generator mittels eines Zahnrades (171) in dem Schließzylinder und eines Getriebesystems (140), das an die Welle des elektrischen Generators (130) angeschlossen ist, und eines Zahnrades (172), das mit dem Getriebesystem verbunden ist, übertragen zu werden. 50 55
8. Betätigungsverfahren eines elektromechanischen

Schlosses, bei welchem Verfahren

- die Informationen einer Identifiziereinheit (181) eines Schlüssels elektrisch (32, 33, 33) gelesen werden,
- nach der Akzeptanz eines Öffnungsrechts das Schloss mechanisch durch Drehen des Schlüssels (37) geöffnet wird, und wobei
- die elektrische Energie, die durch die elektrische Identifikation des Schlüssels benötigt wird, durch die Bewegung des Schlüssels mittels eines elektromagnetischen Generators (130) erzeugt wird,

dadurch gekennzeichnet, dass

- eine elektrische Kopplung des Generators (130) durch die Identifikation des Schlüssels geändert wird,
- die mechanische Belastung des Generators (130), durch welche die Position des Generators geändert wird, durch die Änderung der elektrischen Kopplung des Generators geändert wird, und dass
- das Schloss in den geöffneten oder in den gesperrten Zustand durch eine Änderung der Position des Generators (130), verursacht durch eine Änderung der Belastung des elektromagnetischen Generators, gebracht wird.

9. Betätigungsverfahren nach Anspruch 8, **dadurch gekennzeichnet, dass** ein vor der Öffnungsentscheidung geladener Kondensator für die Änderung der Belastung des Generators (130) verwendet wird, und dieser Kondensator an den elektromagnetischen Generator entweder in einer Vorwärts- oder Rückwärtsrichtung in Abhängigkeit von der Öffnungsentscheidung gekoppelt wird. 35 40
10. Betätigungsverfahren nach Anspruch 8, **dadurch gekennzeichnet, dass** die Informationen einer elektrischen Identifiziereinheit (181) des Schlüssels (180) gelesen und akzeptiert werden von einer elektronischen Steuereinheit (121) in einem Schlosskörper (110). 45
11. Betätigungsverfahren nach Anspruch 8, **dadurch gekennzeichnet, dass** die Informationen einer elektrischen Identifiziereinheit (181) des Schlüssels (180) gelesen und akzeptiert werden von einer elektronischen Steuereinheit (121) in einem Schließzylinder (120). 50
12. Betätigungsverfahren nach Anspruch 10 oder 11, **dadurch gekennzeichnet, dass** das Drehmoment, das von dem elektrischen Generator (130) übertragen wird, erhöht wird, um das Öffnen des Schlosses durch Kurzschließen von Versorgungsleitungen, die

von dem Generator (130) zu der Steuereinheit (121) kommen, in der Steuereinheit (121) nach dem Akzeptieren des Schlüssels zu ermöglichen.

13. Betätigungsverfahren nach Anspruch 12, **dadurch gekennzeichnet, dass** die Zunahme des Drehmoments, das durch dem elektrischen Generator (130) übertragen wird, den Körper des elektrischen Generators zu einer Position dreht, in welcher er ferner den wenigstens einen Aktuator (150), der an dem Körper des elektrischen Generators befestigt ist, zu einer Position dreht, in welcher der Aktuator (150) einen Raststab (190) des Schlosses hinter eine Raste (111) in dem Schlosskörper (110) führt, um das Öffnen des Schlosses zu gestatten.

14. Betätigungsverfahren nach Anspruch 8, **dadurch gekennzeichnet, dass** zum Erzeugen von elektrischer Energie die Drehbewegung des Schlüssels (180) von dem Schließzylinder (120) zu dem elektrischen Generator mittels eines Zahnrades (171) in den Schließzylinder und eines Getriebesystems (140), das an eine Welle des elektrischen Generators (130) angeschlossen ist, und eines Zahnrades (172), das mit dem Getriebesystem verbunden ist, übertragen wird.

Revendications

1. Serrure électromécanique (100), qui comprend des moyens pour lire et contrôler électriquement (121) les informations d'une unité d'identifiant (181) d'une clé (180) et des moyens pour ouvrir mécaniquement la serrure en tournant la clé dans la serrure, si la clé a le droit d'ouverture, et dans laquelle serrure l'énergie électrique nécessaire à l'identification électrique a été produite par le mouvement de la clé (180) par un générateur électromagnétique (130), **caractérisée en ce que**

- un condensateur a été agencé pour être chargé par le mouvement de la clé avant la décision d'ouverture,
- l'identification de la clé a été agencée pour modifier un couplage électrique du générateur (130) en couplant les sorties du condensateur au générateur électromagnétique (130) dans la direction avant ou arrière en fonction de la décision d'ouverture,
- la modification du couplage électrique du générateur (130) a été agencée pour modifier la charge mécanique du générateur, qui a été agencée pour modifier la position du générateur, et **en ce que** :
- la modification de la position du générateur (130) provoquée par la modification de la charge du générateur électromagnétique a été agencée

pour guider la serrure vers l'état d'ouverture ou vers l'état de prévention.

2. Serrure électromécanique selon la revendication 1, **caractérisée en ce que** les moyens pour lire et contrôler l'identifiant électrique de la clé comprennent une unité de commande électronique (121) dans un corps de serrure (110), des lignes d'alimentation en énergie (131) de l'unité de commande et des lignes de signal (124).

3. Serrure électromécanique selon la revendication 1, **caractérisée en ce que** les moyens pour lire et contrôler l'identifiant électrique de la clé comprennent une unité de commande électronique (121) dans un barillet de serrure (120), des lignes d'alimentation en énergie (131) de l'unité de commande et des lignes de signal (124).

4. Serrure électromécanique selon la revendication 2 ou 3, **caractérisée en ce que** le couple transmis par le générateur électrique a été agencé pour être augmenté pour permettre l'ouverture de la serrure par la mise en court-circuit des lignes d'alimentation provenant du générateur électrique (130) vers l'unité de commande (121) dans l'unité de commande (121) après l'acceptation de la clé.

5. Serrure électromécanique selon la revendication 4, **caractérisée en ce que** l'augmentation du couple transmis par le générateur électrique (130) a été agencée pour faire tourner le corps du générateur électrique vers une position dans laquelle il fait tourner en outre au moins un actionneur (150) fixé au corps du générateur électrique vers une position dans laquelle l'actionneur (150) a été agencé pour guider une barre de cliquet (190) sollicitée par ressort (191a, 191b) au-delà d'un cliquet (111) dans le corps de serrure (110) pour permettre l'ouverture de la serrure.

6. Serrure électromécanique selon la revendication 1, **caractérisée en ce qu'un** droit d'ouverture de la clé (180) a été agencé pour être installé dans l'unité de commande (121) par l'intermédiaire d'une connexion d'entrée externe (123) lui appartenant.

7. Serrure électromécanique selon la revendication 1, **caractérisée en ce que** le mouvement de la clé (180) pour produire de l'énergie électrique a été agencé pour être transmis du barillet de serrure (120) au générateur électrique au moyen d'une roue dentée (171) dans le barillet de serrure et d'un système à pignon (140) relié sur l'arbre du générateur électrique (130) et d'une roue dentée (172) reliée au système à pignon.

8. Procédé d'actionnement d'une serrure électroméca-

nique, dans lequel procédé

- les informations d'une unité d'identifiant (181) d'une clé sont lues électriquement (32, 33, 33),
- après l'acceptation d'un droit d'ouverture, la serrure est ouverte mécaniquement en tournant la clé (37), et dans lequel
- l'énergie électrique nécessaire à l'identification électrique de la clé est produite par le mouvement de la clé au moyen d'un générateur électromagnétique (130), **caractérisé en ce que**
- un couplage électrique du générateur (130) est modifié par l'identification de la clé,
- la charge mécanique du générateur (130), par laquelle la position du générateur est modifiée, est modifiée par la modification du couplage électrique du générateur, et **en ce que**
- la serrure est ouverte ou amenée dans l'état de prévention par une modification de la position du générateur (130) provoquée par une modification de la charge du générateur électromagnétique.

9. Procédé d'actionnement selon la revendication 8, **caractérisé en ce qu'un** condensateur chargé avant la décision d'ouverture est utilisé pour la modification de la charge du générateur (130), et ce condensateur est couplé au générateur électromagnétique dans une direction avant ou arrière en fonction de la décision d'ouverture.
10. Procédé d'actionnement selon la revendication 8, **caractérisé en ce que** les informations d'une unité d'identifiant électrique (181) de la clé sont lues et acceptées par une unité de commande électronique (121) dans un corps de serrure (110).
11. Procédé d'actionnement selon la revendication 8, **caractérisé en ce que** les informations d'une unité d'identifiant électrique (181) de la clé (180) sont lues et acceptées par une unité de commande électronique (121) dans un barillet de serrure (120).
12. Procédé d'actionnement selon la revendication 10 ou 11, **caractérisé en ce que** le couple transmis par le générateur électrique (130) est augmenté pour permettre l'ouverture de la serrure par la mise en court-circuit des lignes d'alimentation provenant du générateur électrique (130) vers l'unité de commande (121) dans l'unité de commande (121) après l'acceptation de la clé.
13. Procédé d'actionnement selon la revendication 12, **caractérisé en ce que** l'augmentation du couple transmis par le générateur électrique (130) fait tourner le corps du générateur électrique vers une position dans laquelle il fait tourner en outre ledit au moins un actionneur (150) fixé au corps du généra-

teur électrique vers une position dans laquelle l'actionneur (150) guide une barre de cliquet (190) de la serrure au-delà d'un cliquet (111) dans le corps de serrure (110) pour permettre l'ouverture de la serrure.

14. Procédé d'actionnement selon la revendication 8, **caractérisé en ce que**, pour produire de l'énergie électrique, le mouvement de rotation de la clé (180) est transmis du barillet de serrure (120) au générateur électrique au moyen d'une roue dentée (171) dans le barillet de serrure et d'un système à pignon (140) relié sur un arbre du générateur électrique (130) et d'une roue dentée (172) reliée au système à pignon.

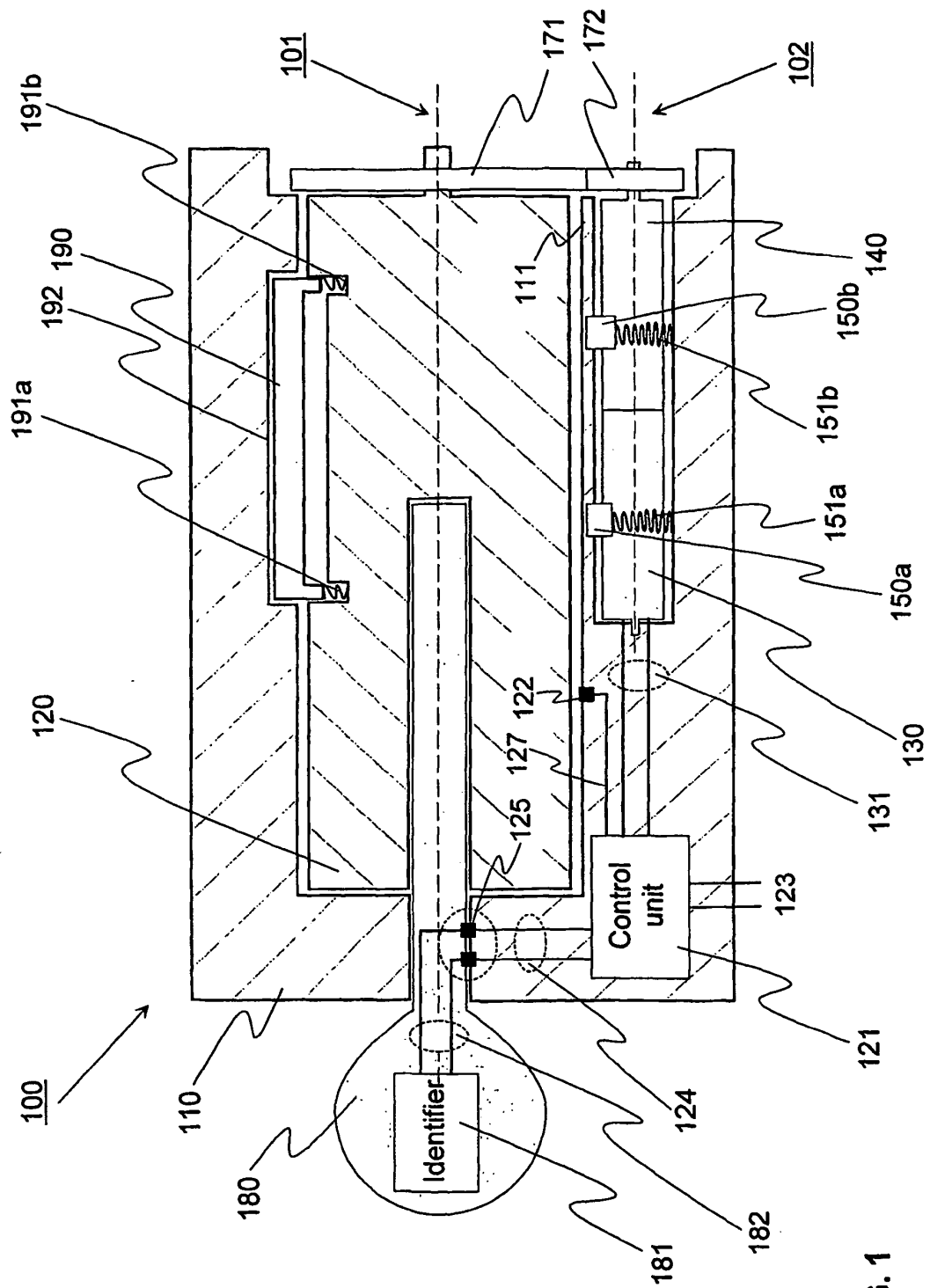
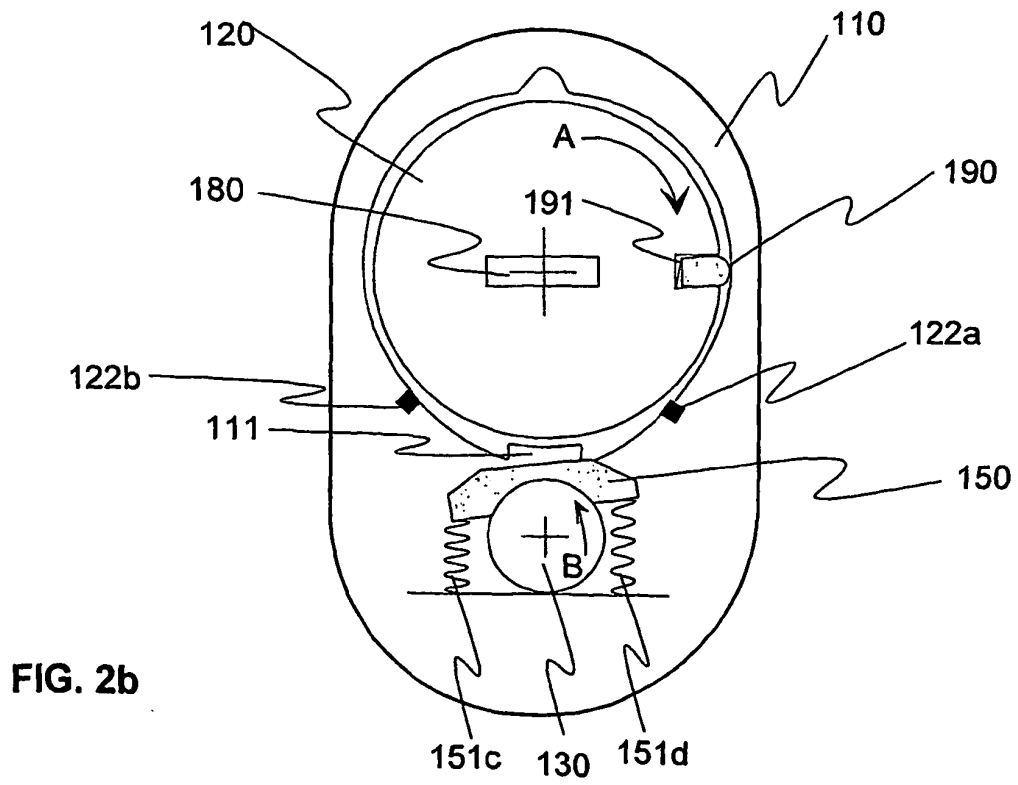
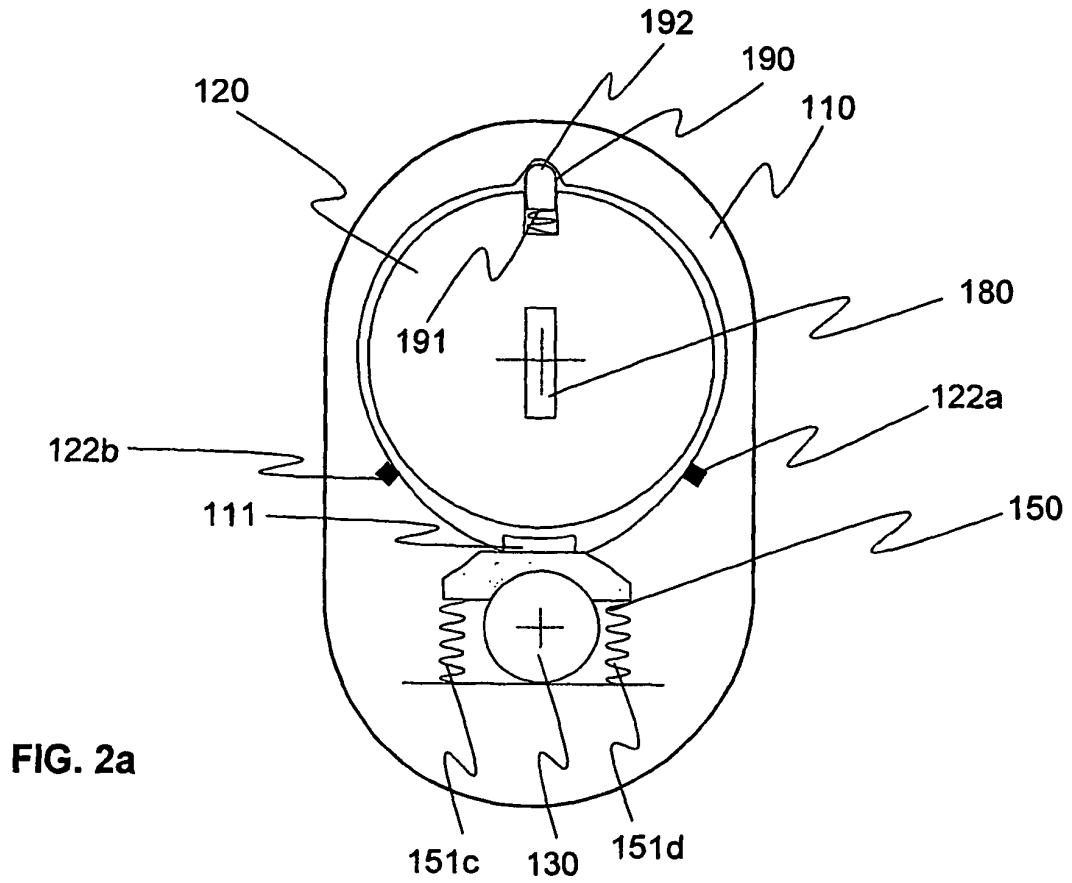
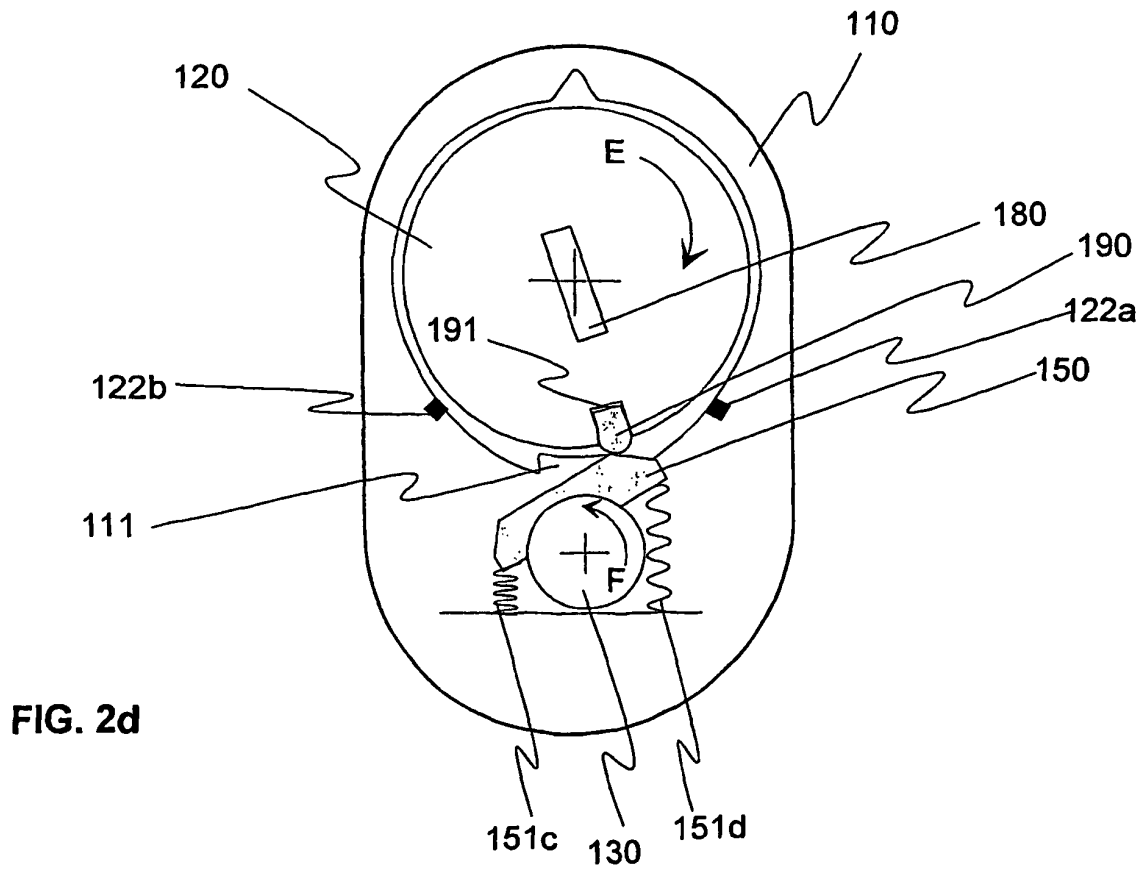
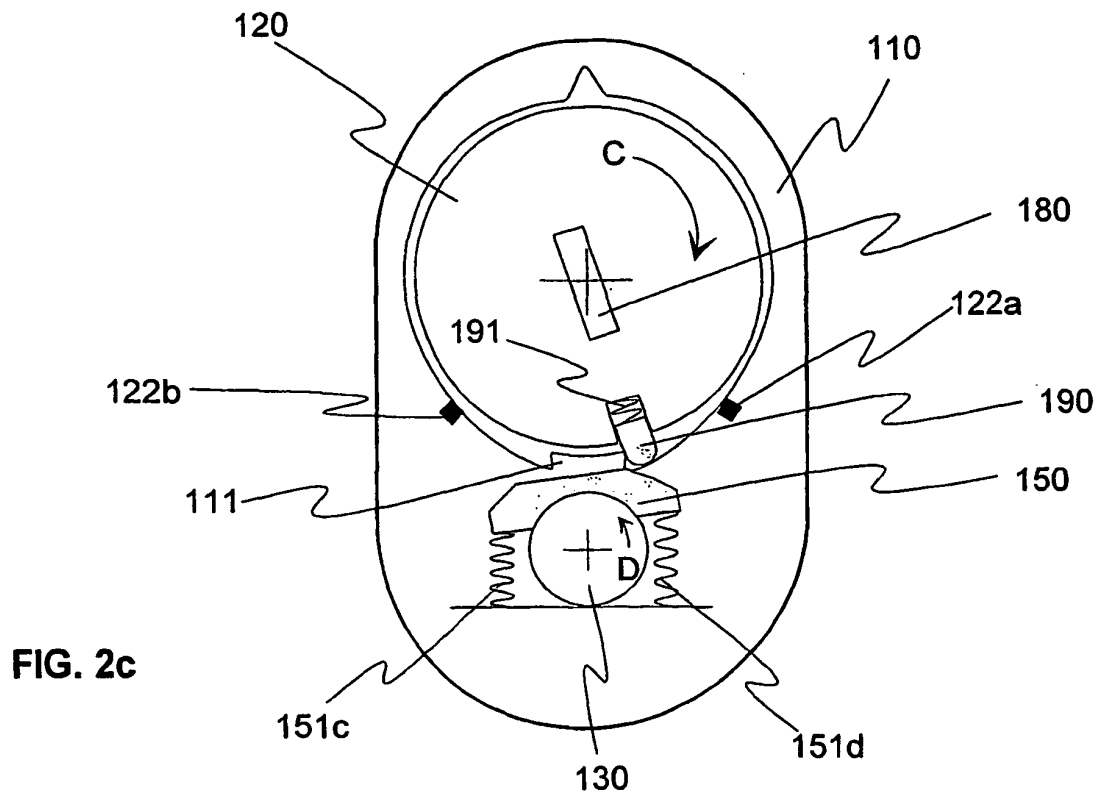


FIG. 1





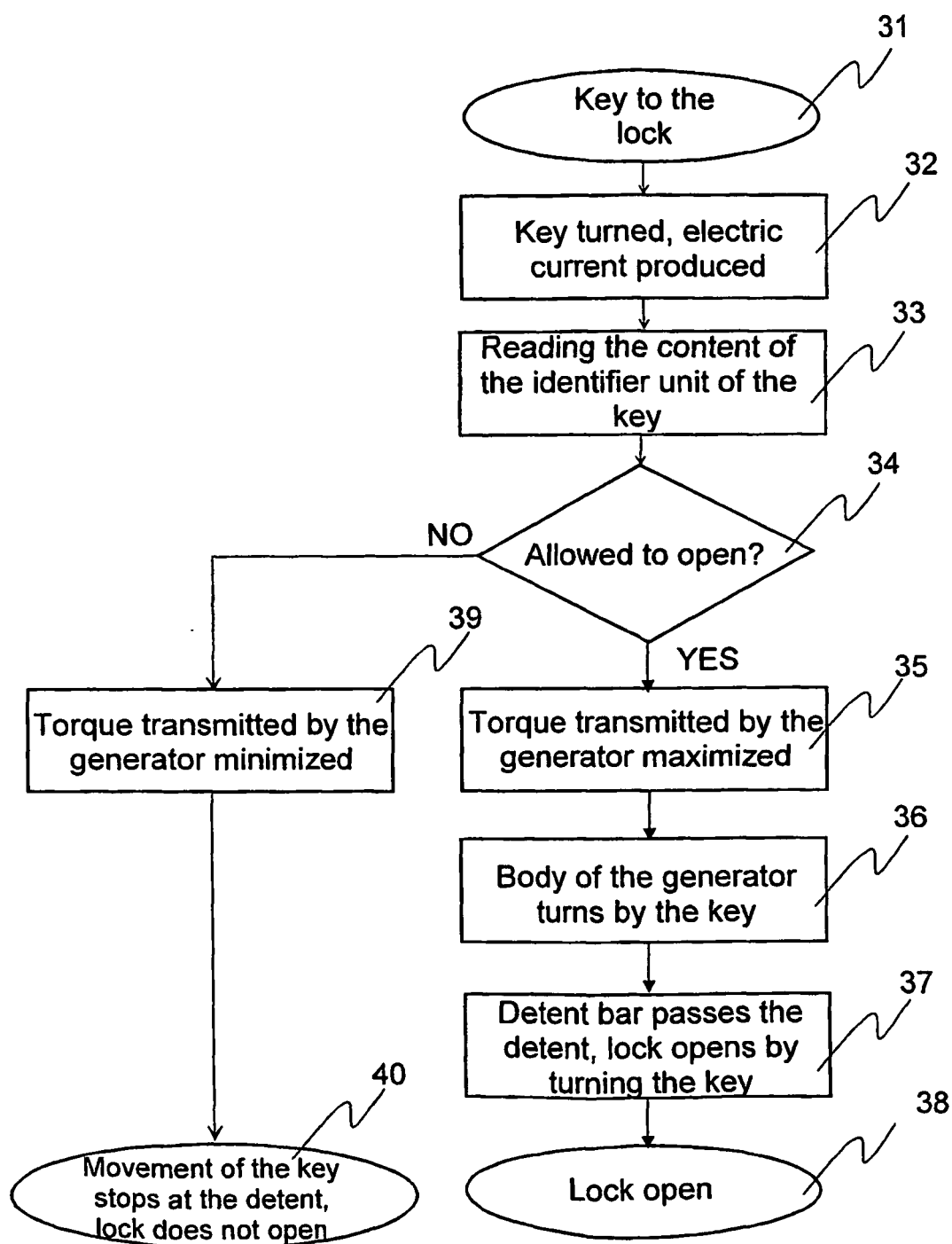


FIG. 3

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 6331812 B [0005]
- WO 0068536 A [0005]
- WO 8102603 A [0006]
- DE 19918817 [0007]
- US 6437684 B [0008]
- FR 2764625 [0009]
- US 5265452 A [0009]