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

(11) EP 2 666 937 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
27.11.2013 Bulletin 2013/48

(51) Int Cl.:
E05B 47/00 *(2006.01)* ***E05B 47/06*** *(2006.01)*

(21) Application number: **12169162.0**

(22) Date of filing: **23.05.2012**

(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
Designated Extension States:
BA ME

(71) Applicant: **Param Technologies Corporation, S.L.**
08034 Barcelona (ES)

(72) Inventor: **Teja, Puneet K. Singh**
1160 Vienna (AT)

(74) Representative: **ZBM Patents**
Zea, Barlocci & Markvardsen
Plaza Catalunya, 1
08002 Barcelona (ES)

(54) Devices and methods for electronically controlling a mechanical door lock

(57) Devices and methods of controlling a mechanical door lock are disclosed. In one aspect a device mountable on the mechanical door lock comprises an electronic controller coupled to a mechanism attachable to a key. A remote centre communicates with the device over a communication network. The remote centre actuates the device and controls the locking and unlocking state of the mechanical door lock. In another aspect, the device carries out a set of steps to effectuate a desired lock state of a mechanical door lock while ensuring reasonable high level of security.

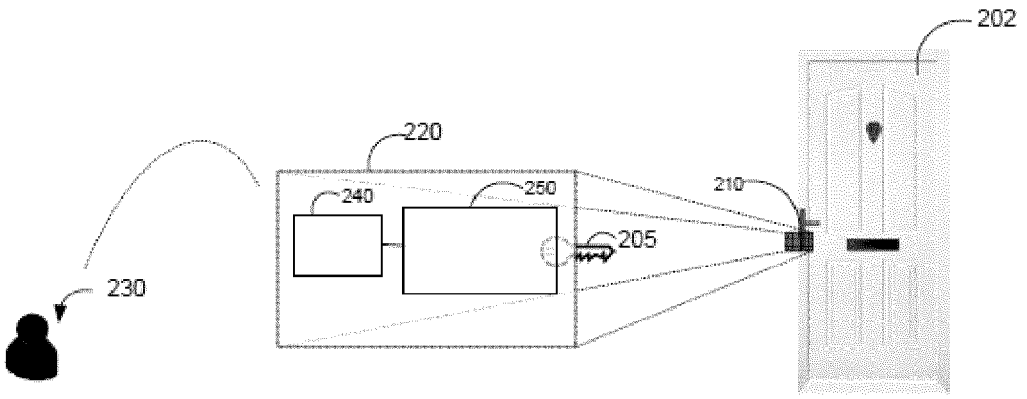

FIG. 2

EP 2 666 937 A1

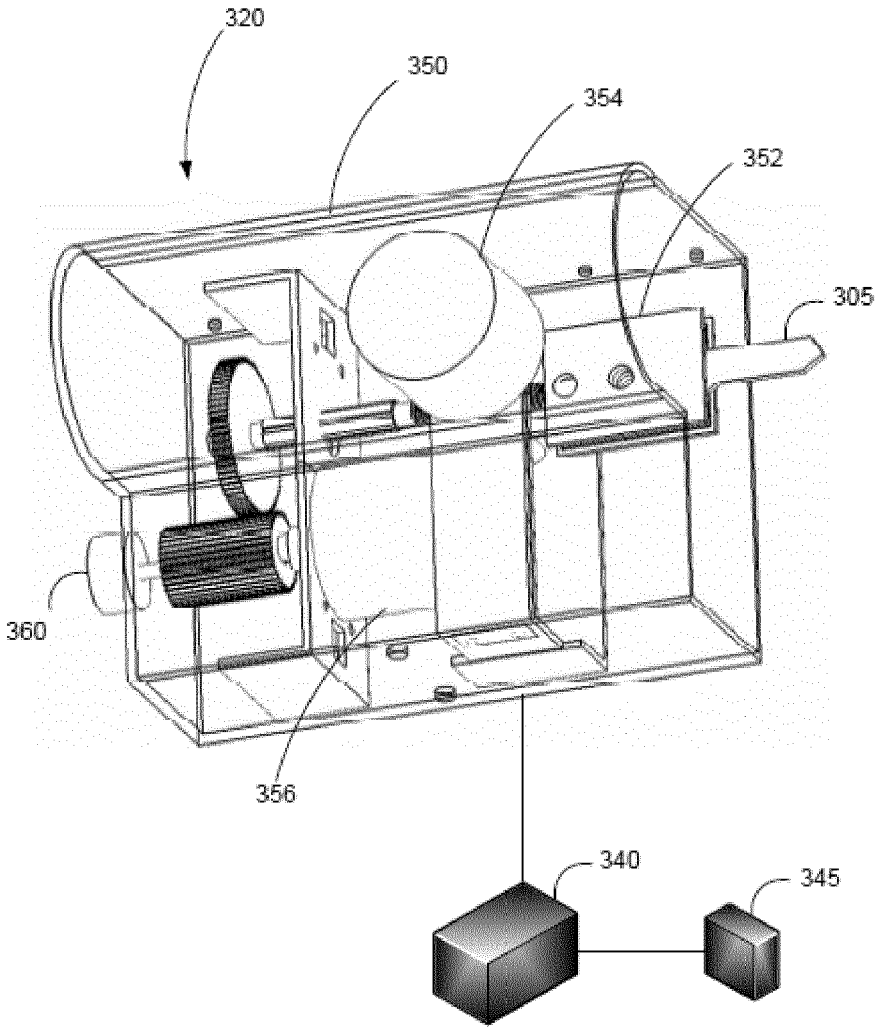

FIG. 3

Description

[0001] The present invention relates to door locks and more specifically to techniques for electronically controlling and operating a mechanical door lock.

BACKGROUND ART

[0002] Cylinder locks are widely known and used as locking mechanisms in doors, windows, boxes, cases, drawers, safes, padlocks, bicycle locks, etc. A mechanical cylinder lock has one or two cylinder-shaped plugs rotatable by an inserted key to move a locking bolt from the door into the door frame or backwards, thereby locking or unlocking the door. The mechanical varieties of cylinder locks are standardized to allow mass production and convenient replacement and retrofitting of existing doors.

[0003] On the other hand, various types of security and remote access systems for premises are known in the state of the art. Some of them are mainly focused to avoid access to the premises to any person with no authorisation. In this type of security systems, the authorisation for accessing to the premises is usually obtained by providing to the system a pertinent security parameter for deactivating the system and, then, obtaining access to the premises once said security parameter has been recognized and accepted by the system. Such systems typically assume the presence of an electromechanical lock coupled to a security mechanism for providing the security parameters.

[0004] However, the majority of installed doors in houses, offices or similar premises is actuated only with mechanical means. More specifically, the majority of installed doors comprise a mechanical door lock that is actuated by a common house key. The aforementioned security or remote access systems require placing an electromechanical door lock or replacing the mechanical door lock with an electromechanical door lock or bypassing the mechanical door lock with an electromechanical access system in order to remotely provide access to the premises. Due to the prevalence of mechanical door locks in typical house or office entrance access doors, such replacements or bypass options are costly and cumbersome.

[0005] For example, the European patent application EP0168884 A2 discloses an electromechanical door lock installed in a door that includes a solenoid selectively pulsed to raise or lower a pin in response to a remote associated infra-red or magnetic card reader. Raising or lowering of said pin selectively permits or restricts access through the doorway to all persons encountering the door.

[0006] The installation disclosed in EP0168884 A2 and other similar disclosures are not only costly but also of a permanent and fixed nature. However, there are occasions, when selective access to a premises is required only for specific time periods. It is not practical or worth the expense to install an electromechanical door lock only if selective access is required for a predetermined or limited time period. An example is when a user/owner of the premises may be interested in giving access to the premises to arbitrary people in accordance with domestic and/or business requirements. For example, the user/owner could be interested in remotely giving instantaneous and secure access to a plumber (or any kind of worker) in case of domestic services. Another example is when certain premises are offered for sale or rent. In such a case, a real estate agent authorised to show the premises to potential buyers or tenants is typically required to either hand a key to the potential buyers or tenants, or to be physically present at the premises to open the door to the interested parties. In both cases the real estate agent is required to meet the interested parties at least once. This restricts an agent from being able to make arbitrary appointments, or simultaneous appointments at different premises. The existing security and access systems are not focused on said kind of operations. It would, thus, be desirable to have a system that overcomes the above deficiencies and solves at least partially the aforementioned problems.

SUMMARY OF THE INVENTION

[0007] There thus exists a need for a new device and method for controlling the access of a visitor to a premises having a mechanical door lock ensuring a reasonable high level of security, without requiring replacement or retrofitting of the mechanical door lock. The object of the present invention is to fulfil such a need.

[0008] In a first aspect of the invention the device is attachable to a mechanical door lock of a door on the inside of the premises, for controlling said mechanical door lock from a remote centre, the mechanical door lock comprising at least a lock cylinder operable by a key. The device comprises at least a mechanism, attachable to the key, for controlling movement of the key; and an electronic controller, coupled to the mechanism, for receiving instructions from a remote centre and for commanding the mechanism to control the movement of the key to lock or unlock the mechanical door lock, respectively.

[0009] This device makes it possible to automate access for interested parties (e.g. for renting/buying) to premises (e.g. apartments, houses, offices and other areas requiring secure access), since with said device the doors giving access to the premises can be opened remotely using their existing mechanical door lock and an existing communication network. A premises agent (or the owner of the premises or any person assigned and authorized by the owner or the agent) may establish a communication with the device, said way of establishing the communication being according to a known communication protocol. Once the communication has been established, the premises agent can send an instruction, in a coded form, to the device to control the mechanical door lock and either unlock or lock the door permitting or

restricting access to a visitor that is e.g. waiting for accessing the premises.

[0010] Said instruction sent by the agent through e.g. a mobile phone is received by the electronic controller. Once instruction has been received, said instruction is validated by a validation module. Then, in case the instruction has been correctly validated, the door operating mechanism is actuated and a key is inserted and rotated in the mechanical door lock giving access to the premises. Once the door is unlocked it may be opened by the visitor by manually acting on the door, e.g. by pushing or pulling the door.

[0011] This device and its operation allow the prospective visitor to visit the premises without the need of a premises agent to travel where the premises is located for manually opening the doors to the visitor. Thus, the time and costs of travelling for the agents/owners of the premises (or real estate properties) is significantly reduced. Moreover, high flexibility is provided to the visitors in terms of time of visit, since the visit may be carried out at any time, even outside office hours and/or on weekends/holidays. In summary, this device and its related operation may increase the number of visits by prospective visitors, may reduce the costs per visit and may provide high flexibility and security.

[0012] Most of the previous considerations with respect to the device of the invention in a context of automatic control of the access for prospective visitors (for renting/buying) to premises, may be equally applied to other situations/contexts in which remote permission/denial for accessing a premises may be useful. For instance, the owner of a premises may be interested in remotely giving instantaneous and secure access to a plumber (or any kind of worker) in case of domestic services.

[0013] In some embodiments, the mechanism of the device may comprise a clamp for attaching securely a key and a first motor, coupled to the clamp, wherein rotation of the first motor results in rotating the clamp in a desired direction around the longitudinal axis of the key to lock or unlock the door.

[0014] In other embodiments the mechanism may further comprise a second motor coupled to the clamp, wherein rotation of the second motor results in movement of the clamp in a desired direction along the longitudinal axis of the key to insert or retract the key to or from the mechanical door lock, respectively.

[0015] In some embodiments, the electronic controller of the device may comprise a motor controller coupled to each motor for commanding the motors to rotate in the desired direction and a communication unit coupled to the motor controller, wherein the communication unit receives instructions from a remote centre and instructs the motor controller based on commands received from the remote centre to control the mechanism to either lock or unlock the mechanical door lock. The communication unit may be connected to a communication network to communicate with the remote centre. The communication network may be wired or wireless. Accordingly, the communication unit may be connected to the communication network either by cable or wirelessly. In some of the embodiments the communication unit is a wireless unit, such as a GSM unit, adapted to receive instructions from the remote centre over a mobile communication network.

[0016] In some embodiments, the device may include also fastening means for attaching the device to the door. An example of fastening means is a cradle, wherein the cradle may be suspended from a handle of the mechanical door lock. One skilled in the art may appreciate that any fastening means could be used to attach the device to the door without departing from the scope of the invention.

[0017] In some preferred embodiments, the device may further comprise a knob attached to the mechanism to bypass the electronic control and control the device manually in case of an emergency.

[0018] In some of the embodiments, the motor controller of the device may comprise a micro-controller and associated electronic circuitry.

[0019] In preferred embodiments, the device may also comprise a motion detecting means to detect movement of at least one motor to identify either the state of a mechanical lock or the position of the key inside a lock.

[0020] In some embodiments, a first motion detector may detect motion of the first motor and a second motion detector may detect motion of the second motor.

[0021] In some of the embodiments, the motion detectors may be position encoders incorporated in the mechanism. In other embodiments, the motion detectors may be current sensing circuits incorporated in the electronic controller.

[0022] In a preferred embodiment, the device may further comprise a timer coupled to the electronic controller or forming part of the electronic controller, wherein the electronic controller commands the mechanism to relock the door when a predetermined time, counted by the timer, has elapsed, after unlocking has been completed and no action to open the door has been detected.

[0023] The electronic controller is powered by a power source. In some embodiments the power source may be in the form of batteries incorporated in the device or in an external piece coupled to the device. In other embodiments the power source may be the mains power source, and power to the electronic controller is supplied through an AC/DC adaptor. One skilled in the art may appreciate that the AC/DC adaptor may be internal or external to the device.

[0024] In some embodiments, the device may be in one piece where the mechanism and the electronic controller are integrated in the same case. In other embodiments the device may be implemented in more than one connected pieces. In this case, only the piece including the mechanism may be attached to the door. The electronic controller may be in a separate piece and the power source in yet another piece.

[0025] In a second aspect of the invention, a method is proposed of controlling a mechanical door lock. According to some embodiments of the method, an instruction is first received at a device attachable to a mechanical door lock from a remote centre to alter the state of a mechanical door lock to a desired lock or unlock state. Then a first motor is rotated and a clamp attached to a key is rotated accordingly in a direction so as to achieve the desired state of the mechanical door lock. Finally an identification takes place that the mechanical door lock is in the desired state.

[0026] In other method embodiments a second motor coupled to the clamp may be rotated until the key is completely inserted in the lock prior to rotating the first motor to. Then a detection takes place that the key is completely inserted in the mechanical door lock prior to rotating the first motor. Then the second motor is rotated to the opposite direction to remove the key from the mechanical door lock after rotating the first motor.

[0027] In some embodiments of the proposed method, the first motor is rotated in the opposite direction prior to rotating the second motor in the opposite direction, to position the key in a suitable position with respect to the mechanical door lock to allow removal.

[0028] In some embodiments of the method, the door may be relocked when a predetermined time has elapsed, after unlocking has been completed, and no action to open the door has been performed.

[0029] In some embodiments of the method, the number of revolutions may be counted to ensure that the door has not been accidentally unlocked after being locked and the key was removed.

[0030] In some embodiments, the electronic controller may send an acknowledgment message to the remote centre indicating that the lock state of the mechanical door lock is the desired state.

[0031] In some embodiments, the electronic controller may send an acknowledgment message to the remote centre indicating that a door action has been detected.

[0032] The remote centre may be a communications device, either fixed or wireless, or a computer coupled to a server connected to a communication network such as the Internet or any other network, or a combination of network connected communication devices.

[0033] The remote control of the mechanical door lock may be with a signal sent by the remote centre to the device attachable to the mechanical door lock over a communications network and more preferably over a wireless communication network. The wireless communications network can be a GSM network or an alternative to the GSM technology such as 3G/LTE technology or any other wireless communications technology and the remote centre is a correspondingly GSM/3G/LTE/etc. terminal.

[0034] The signal may be a call placed from the remote centre to the device. As commented before, the signal may be a signal establishing a mobile phone communication, as for example a call placed to the device. Then, once the GSM communication has been established, the user of the mobile phone may send any kind of data required by the device through said communication. However, one skilled in the art may appreciate that any other type of signal, such as a Short Message Service (SMS) message may be used to establish communication and carry instructions and/or acknowledgment data between the terminal and the device.

[0035] In general, most of the operational principles and advantages commented with respect to the embodiments of the device for controlling the mechanical door lock, are also of application to the embodiments of the method for controlling the mechanical door lock with the use of said device.

[0036] Throughout the description and claims the word "comprise" and variations of the word, are not intended to exclude other technical features, additives, components, or steps. Additional objects, advantages and features of the invention will become apparent to those skilled in the art upon examination of the description or may be learned by practice of the invention. The following examples and drawings are provided by way of illustration, and they are not intended to be limiting of the present invention. Reference signs related to drawings and placed in parentheses in a claim, are solely for attempting to increase the intelligibility of the claim, and shall not be construed as limiting the scope of the claim. Furthermore, the present invention covers all possible combinations of particular and preferred embodiments described herein.

BRIEF DESCRIPTION OF THE DRAWINGS

[0037] Particular embodiments of the present invention will be described in the following by way of non-limiting examples, with reference to the appended drawings, in which:

Figure 1A shows a typical door key (105) used to operate a conventional mechanical door lock with its longitudinal axis indicated as x-x'.

Figure 1 B is a schematic representation of a conventional mechanical door lock (110) operable by a typical door key (105).

Figure 2 is a high level schematic representation of a use scenario of a device for controlling a mechanical door lock, according to an embodiment of the invention.

Figure 3 is a diagram of a device (320) for controlling a mechanical door lock, according to another embodiment of the invention.

Figure 4 is a diagram of a device (420) for controlling access of a visitor to a premise, according to yet another embodiment of the invention.

Figure 5 is a flow diagram of a method of unlocking a mechanical door lock, according to another exemplary embodiment.

Figure 6 is a flow diagram of a method of locking a

mechanical door lock, according to another embodiment of the invention.

Figure 7 is a transition diagram of a method of electronically controlling a mechanical door lock, according to another exemplary embodiment.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

[0038] In the following descriptions, numerous specific details are set forth in order to provide a thorough understanding of the present invention. It will be understood, however, by one skilled in the art, that the present invention may be practiced without some or all of these specific details. In other instances, well known elements have not been described in detail in order not to unnecessarily obscure the description of the present invention.

[0039] **Figure 1A** shows a typical door key (105) used to operate a conventional mechanical door lock with its longitudinal axis indicated as x-x'. Any door key that is used in relation to a mechanical door lock of the type including a cylinder lock may be used with relation to the claimed invention.

[0040] **Figure 1 B** is a schematic representation of a conventional mechanical door lock (110) operable by a typical door key (105). Mechanical door lock 110 comprises two cylinder locks, two plates and two handles. However, it is simply shown for illustrative purposes. Any mechanical door lock of the type comprising at least one cylinder lock may be controlled by the devices and methods according to the invention.

[0041] **Figure 2** is a high level schematic representation of a use scenario of a device for controlling a mechanical door lock, according to an embodiment of the invention. Door 202 is adapted to accommodate mechanical door lock 210. To actuate the mechanical door lock 210, key 205 has to be inserted in an orifice of the mechanical door lock 210. Mechanical door lock 210 is mounted in an aperture of door 202. Mechanical door lock 202 can be actuated by both sides of door 202. That is, key 205 may be introduced in both sides of mechanical door lock 210. Key 205 is movable along its longitudinal axis x-x' in order to be inserted and extracted from the mechanical door lock and it is rotated around its longitudinal axis x-x' in order to lock or unlock the door. Device 220 includes electronic controller 240 and mechanism 250. Key 205 is securely attached to device 220 and more specifically to mechanism 250. Mechanism 250 is adapted to control movement of key 205 at least around its longitudinal axis. Mechanism 250 may also be adapted to also control movement of key 205 along its longitudinal axis. Device 220 is attached to mechanical door lock 210 in such a way that the longitudinal axis x-x' of key 205 is aligned with the longitudinal axis y-y' of mechanical door lock 210. In a mode of operation according to the invention, remote centre 230 transmits a control signal to electronic controller 240 of device 220 to instruct the device to control the movement of key 205 in order to operate the mechanical door lock. The signal may be any type of signal. In one example, remote terminal 230 is a mobile phone and the signal is a call including a code sent from the mobile phone to the electronic controller 240 of the device. Electronic controller 240 includes a communication unit, that may be a GSM unit, adapted to receive wireless control signals. Examples of control signals are a GSM call or an SMS control message. One skilled in the art may appreciate that other types of control signals, wireless or non-wireless, may be used without departing from the scope of the invention. Upon receipt of such a control signal, electronic controller 240 instructs mechanism 250 to control the movement of key 205 in order to lock or unlock the door, according to the instruction received.

[0042] In this typical scenario device 220 is attached to door 202 from the inside of the premises that the door belongs to. In that way mechanical door lock 210 and consequently door 205 can be operated as usual by someone having a qualified key who intends to enter the premises in a conventional way.

[0043] **Figure 3** is a diagram of a device for controlling a mechanical door lock, according to another embodiment of the invention. Device 320 comprises mechanism 350. Mechanism 350 comprises clamp 352, first motor 354 and second motor 356. Clamp 352 includes fastening means for securely holding key 305 firmly in place. Device 320 further comprises electronic controller 340. Electronic controller is powered by power source 345. Power source 345 may be internal or external to electronic controller 340. Power source 345 may be a DC power source, in the form of batteries, or an AC power source coupled to the electronic controller through an AC/DC adapter. Device 320 may further comprise a timer (not shown) coupled to electronic controller 340 or incorporated in the electronic controller 340, wherein electronic controller 340 commands the mechanism to relock the door when a predetermined time, counted by the timer, has elapsed, after unlocking has been completed and no action to open the door has been detected.

[0044] Mechanism 350 includes further detecting means for detecting when each of the two motors is not moving or rotating. In one example the detecting means are position encoders. A position encoder comprises a slotted disk and an infrared and detector pair. The slotted disk is mounted on the shaft of the motor whose motion is to be detected. The slotted disk cuts the path of the infrared LED and detector pair. The output of the detector is a pulsed output if the motor shaft, and consequently the slotted disk, is moving. The output of the detector is zero or one if the motor shaft, and consequently the slotted disk, is not moving. However, one skilled in the art may appreciate that the use of encoders is not limiting and any other detecting means known in the art may be used to detect when either of the two motors is not moving. Device 320 may further include suspension means for securely attaching the device to the door knob or handle. One example of fastening means is a cradle for sus-

pending the device from a door handle. The suspension means may be selectably designed to be attachable to a door knob or handle in such a way as to align the longitudinal axis of key 305 to the longitudinal axis of the desired mechanical door lock associated with the door knob or handle. Mechanism 350 may further comprise knob 360 to bypass the electronic control and allow manual control of the device in case of an emergency.

[0045] A typical unlocking scenario will be described with reference to Fig. 3. Mechanism 350 is actuated upon receipt of an unlocking command from electronic controller 340 which in turn is based on an instruction from a remote terminal. Firstly, first motor 354 of mechanism 350 is rotated to insert key 305 into a mechanical door lock. Then, when a first encoder detects that first motor 354 has stopped rotating, a first command is sent to the electronic controller to actuate second motor 356. Second motor 356 starts rotating to a first direction so as to unlock the door. When the door is unlocked, second motor 356 cannot rotate any further. Thus, a second encoder detects that second motor 356 has stopped to rotate and sends a corresponding signal to the electronic controller. Then the electronic controller sends a second command to second motor 356 to rotate key 305 in a direction opposite to the one associated with the first command until the key is brought to a suitable position for extraction. When the key is in the suitable position for extraction the electronic controller commands first motor 344 to rotate in a second direction opposite to the first one so that the key may be extracted from the mechanical door lock.

[0046] **Figure 4** is a diagram of a device (420) for controlling access of a visitor to a premise, according to yet another embodiment of the invention. Device 420 includes mechanism 450 and electronic controller 440. Electronic controller 440 includes motor controller 442 and communication unit 444. In a preferred implementation, motor controller 442 is a micro-controller on a printed circuit board (PCB). In the exemplary embodiment of Fig. 4, motor controller 442 includes detecting means 470. Detecting means 470 includes first current sensing circuit 472 and second current sensing circuit 474. First current sensing circuit 472 measures the current of the first motor to detect rotation of the first motor and second current sensing circuit 474 measures the current of the second motor to detect rotation of the second motor.

[0047] Communication unit 454 may be a wireless unit adapted to receive messages over a wireless communications network. An example of a wireless unit is a GSM unit, adapted to receive calls or messages over a mobile communication network. However, one skilled in the art may appreciate that the wireless unit 454 may implement any type of wireless technology such as GSM, 3G, LTE, CDMA, WCDMA, WiFi etc.

[0048] **Figure 5** is a flow diagram of a method of unlocking a locked door, according to another exemplary embodiment. In a first step 505, an instruction is received by the device to unlock a door by changing a mechanical door lock state from a current lock state to a desired unlock state. Then, in step 510, a first motor is instructed to rotate to a first direction so as to insert a key to the mechanical door lock. In step 15, the first motor is rotated in a first direction and a key is correctly and completely inserted in the mechanical door lock. In step 520, a detection takes place that the key is completely inserted. Then in step 525, a second motor is instructed to rotate in a first direction so as to unlock the door. In step 530, a second motor is rotated in a first direction and the door is unlocked. In step 535, a detection takes place that the second motor is not moving anymore which results in identifying that the door is unlocked. In step 540, after the door has been unlocked, a timer countdown is initiated. The purpose of the timer is to ensure that a visitor will open the door as a result of the door being unlocked. If within the timer countdown a door action is detected, according to decision box 545, the countdown is terminated, in step 550 and the unlocking process ends, in step 570. If no door action is detected, according to decision box 545, and the timer countdown has finished, according to decision box 555, then, in step 560, a lock process is initiated. This is a safety measure so that the door does not remain unlocked if a visitor does not access the premises.

[0049] **Figure 6** is a flow diagram of a method of locking a mechanical door lock, according to another embodiment of the invention. In a first step 605, an instruction is received by the device to lock a door by changing a mechanical door lock state from a current unlock state to a desired lock state. Then, in step 610, a first motor is instructed to rotate to a first direction so as to insert a key to the mechanical door lock. In step 615, the first motor is rotated in a first direction and a key is inserted in the mechanical door lock. In step 720, a detection takes place that the key is correctly and completely inserted. Then in step 625, a second motor is instructed to rotate in a first direction so as to lock the door. In step 630, a second motor is rotated in a first direction and the door is locked. In step 635, a detection takes place that the second motor is not moving anymore which results in identifying that the door is locked. Then, after the door is locked, a command is sent to the second motor, in step 640, to rotate in a second direction opposite to the direction of step 630, so as to position the key in a suitable position for extraction. Then, in step 645, a command is sent to the first motor to rotate in a second direction opposite to the first direction of step 615, so as to remove the key from the mechanical door lock. In step 650, after the key has been removed from the mechanical door lock, both motors are switched off. In step 655, as a precaution, the motors are switched off and the number of revolutions of the second motor and consequently then corresponding number of revolutions of the key is counted to ensure that the mechanical door lock has not been accidentally unlocked while attempting to position the key in a vertical position for extraction.

[0050] **Figure 7** is a transition diagram of a method of electronically controlling a mechanical door lock, accord-

ing to another exemplary embodiment. **FIG. 7** shows the communications processes that take place between a remote centre, which may be a wireless communication device, and the device attached to the mechanical door lock. The device attached to the mechanical door lock receives a desired lock stated for the mechanical door lock, in step 755. Then, in step 760, the device alters the lock state of the mechanical door lock to provide the desired lock state. Step 760 may comprise any of the methods described with reference to FIG. 7 and FIG. 8. When the desired lock state has been provided, then, in step 765, the device may send an acknowledgment message to the remote terminal. In step 770, in case the desired lock state is an unlocked state, a door action is identified. Finally, in step 775, an acknowledgment of the identified door action may be sent to the remote terminal.

[0051] The electronic controller may store in a memory a computer program implementing an embodiment of the method for controlling the mechanical door lock, and a processing unit of the electronic controller may access to the memory for retrieving and executing said computer program in such a way that the embodiment of the method for controlling the mechanical door lock implemented by the computer program is carried out.

[0052] Although only a number of particular embodiments and examples of the invention have been disclosed herein, it will be understood by those skilled in the art that other alternative embodiments and/or uses of the invention and obvious modifications and equivalents thereof are possible. Furthermore, the present invention covers all possible combinations of the particular embodiments described. Reference signs related to drawings and placed in parentheses in a claim, are solely for attempting to increase the intelligibility of the claim, and shall not be construed as limiting the scope of the claim. Thus, the scope of the present invention should not be limited by particular embodiments, but should be determined only by a fair reading of the claims that follow.

[0053] Further, although the embodiments of the invention described with reference to the drawings comprise computer apparatus and processes performed in computer apparatus, the invention also extends to computer programs, particularly computer programs on or in a carrier, adapted for putting the invention into practice. The program may be in the form of source code, object code, a code intermediate source and object code such as in partially compiled form, or in any other form suitable for use in the implementation of the processes according to the invention. The carrier may be any entity or device capable of carrying the program.

[0054] For example, the carrier may comprise a storage medium, such as a ROM, for example a CD ROM or a semiconductor ROM, or a magnetic recording medium, for example a floppy disc or hard disk. Further, the carrier may be a transmissible carrier such as an electrical or optical signal, which may be conveyed via electrical or optical cable or by radio or other means.

[0055] When the program is embodied in a signal that may be conveyed directly by a cable or other device or means, the carrier may be constituted by such cable or other device or means.

[0056] Alternatively, the carrier may be an integrated circuit in which the program is embedded, the integrated circuit being adapted for performing, or for use in the performance of, the relevant processes.

Claims

1. A device attachable to a mechanical door lock when the mechanical door lock is mounted on a door, the mechanical door lock comprising at least a lock cylinder operable by a key, the device comprising:

   - a mechanism, attachable to the key, for controlling movement of the key;
   and
   - an electronic controller, coupled to the mechanism, for receiving instructions from a remote centre and for commanding the mechanism to control the movement of the key to lock or unlock the mechanical door lock, respectively.

2. The device according to claim 1, wherein the mechanism comprises:

   - a clamp for attaching securely the key; and
   - a first motor, coupled to the clamp, wherein rotation of the first motor results in rotating the clamp in a desired direction around the longitudinal axis of the key to lock or unlock the door.

3. The device according to claim 2, wherein the mechanism further comprises a second motor coupled to the clamp, wherein rotation of the second motor results in movement of the clamp in a desired direction along the longitudinal axis of the key to insert or retract the key to or from the mechanical door lock, respectively.

4. The device according to any of claims 1 to 3, wherein the electronic controller comprises:

   - a motor controller coupled to said first and second motors for commanding the motors to rotate in the desired direction; and
   - a communications unit coupled to said motor controller, wherein the communications unit receives instructions from the remote centre and instructs the motor controller based on commands received from the remote centre to control the mechanism to either lock or unlock the mechanical door lock.

5. The device according to any of claims 1 to 4, further comprising fastening means for attaching the device

to the door.

6. The device according to any of claims 1 to 5, further comprising a knob attached to the mechanism to control the device manually in case of an emergency.

7. The device according to any of claims 4 to 6, wherein the motor controller comprises a micro-controller and associated circuitry.

8. The device according to any of claims 4 to 7, wherein the communications unit is a GSM unit adapted to receive instructions from the remote centre over a mobile network.

9. The device according to any of claims 2 to 8, further comprising at least one motion detector to detect movement of at least one motor.

10. The device according to claim 9, wherein at least one of the motion detectors is a position encoder.

11. The device according to any of claims 9 or 10, wherein at least one of the motion detectors is a current sensing circuit.

12. The device according to any of claims 1 to 11, further comprising a timer, wherein the electronic controller commands the mechanism to relock the door when a predetermined time, counted by the timer, has elapsed, after unlocking has been completed and no action to open the door has been detected.

13. A method of controlling a mechanical door lock using the device according to any of claims 1 to 12 comprising:

- receiving an instruction from a remote centre to alter the state of a mechanical door lock to a desired lock or unlock state;
- rotating a first motor coupled to a clamp securely attached to a key in a direction so as to achieve the desired state of the mechanical door lock; and
- identifying that the mechanical door lock is in the desired state.

14. The method according to claim 13, further comprising:

- rotating a second motor coupled to the clamp until the key is completely inserted in the lock prior to rotating the first motor to;
- detecting that the key is completely inserted in the mechanical door lock prior to rotating the first motor; and
- rotating the second motor to the opposite direction to remove the key from the mechanical door lock after rotating the first motor.

15. The method according to claim 14, further comprising rotating the first motor to the opposite direction prior to rotating the second motor to the opposite direction, to position the key in a suitable position with respect to the mechanical door lock, to allow removal of the key.

16. The method according to any of claims 13 to 15, further comprising relocking the door when a predetermined time has elapsed, after unlocking has been completed, and no action to open the door has been performed.

17. The method according to claim 15, further comprising counting the number of revolutions to ensure that the door does not get unlocked.

18. The method according to any of claims 13 to 17, further comprising sending an acknowledgment message that the lock state of the mechanical door lock is the desired lock state.

19. The method according to any of claims 13 to 17, further comprising sending an acknowledgment message that a door action has been detected.

FIG. 1A

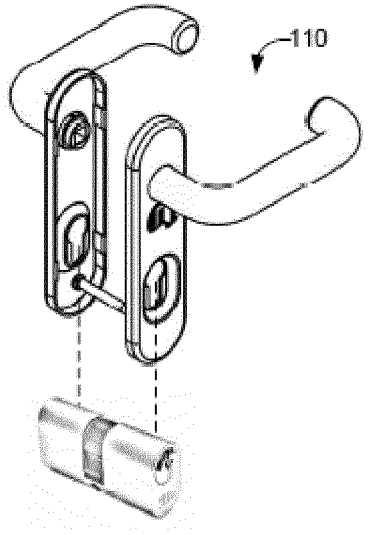

FIG. 1B

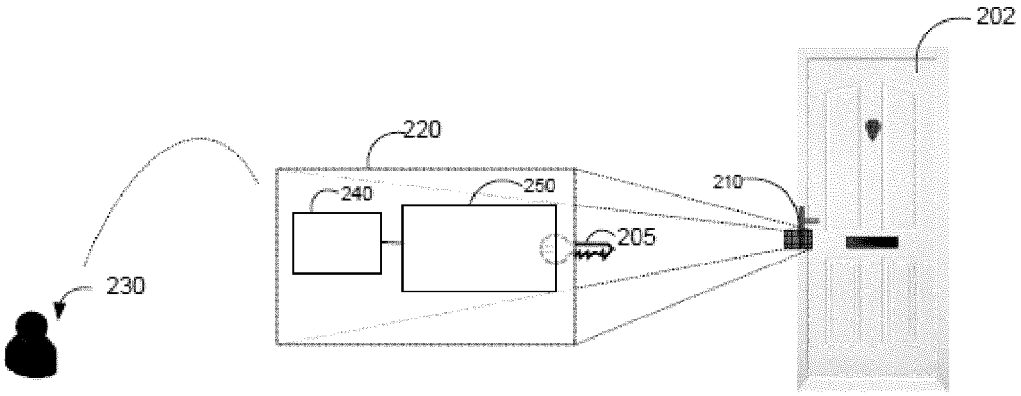

FIG. 2

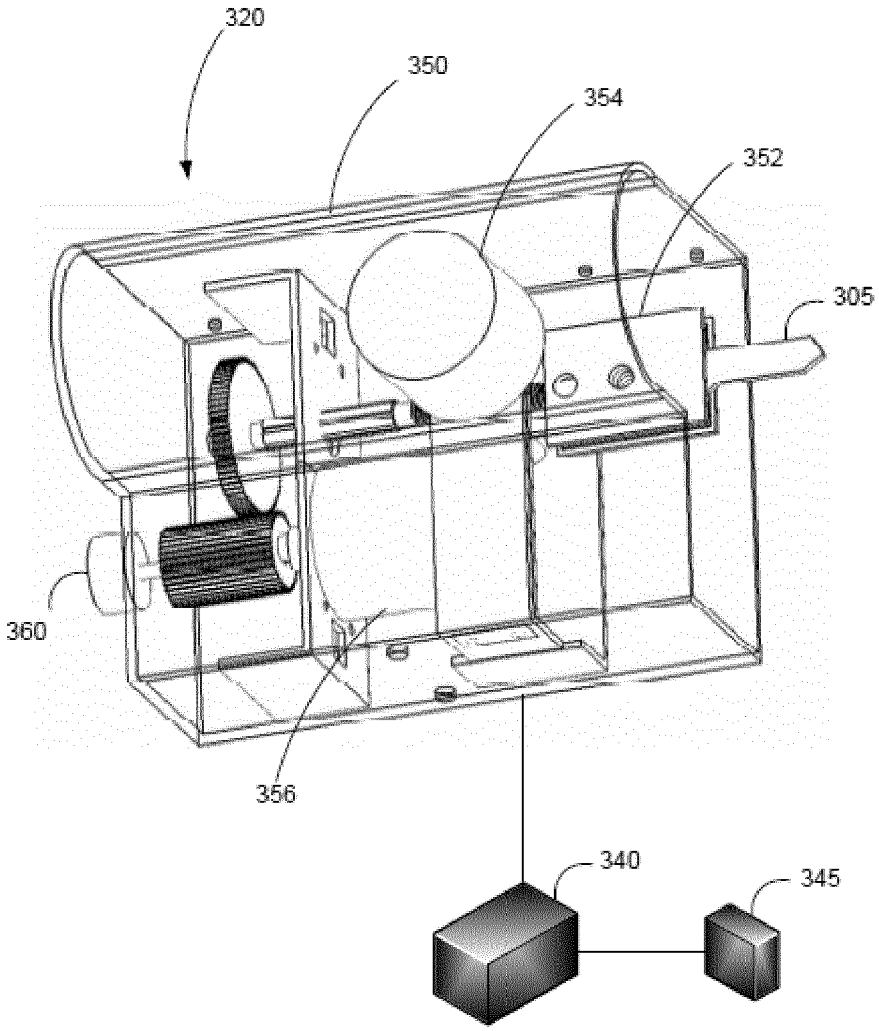

FIG. 3

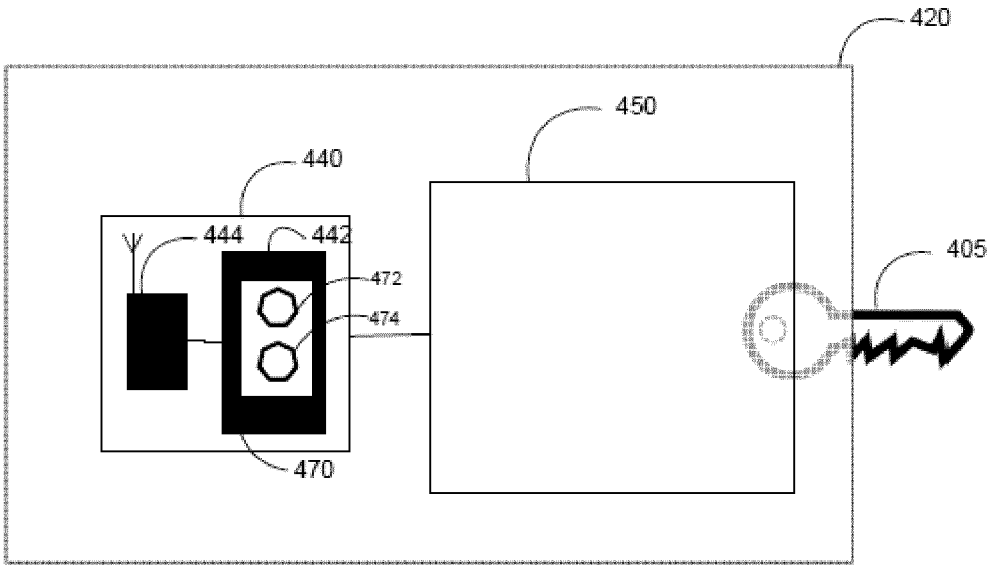

FIG. 4

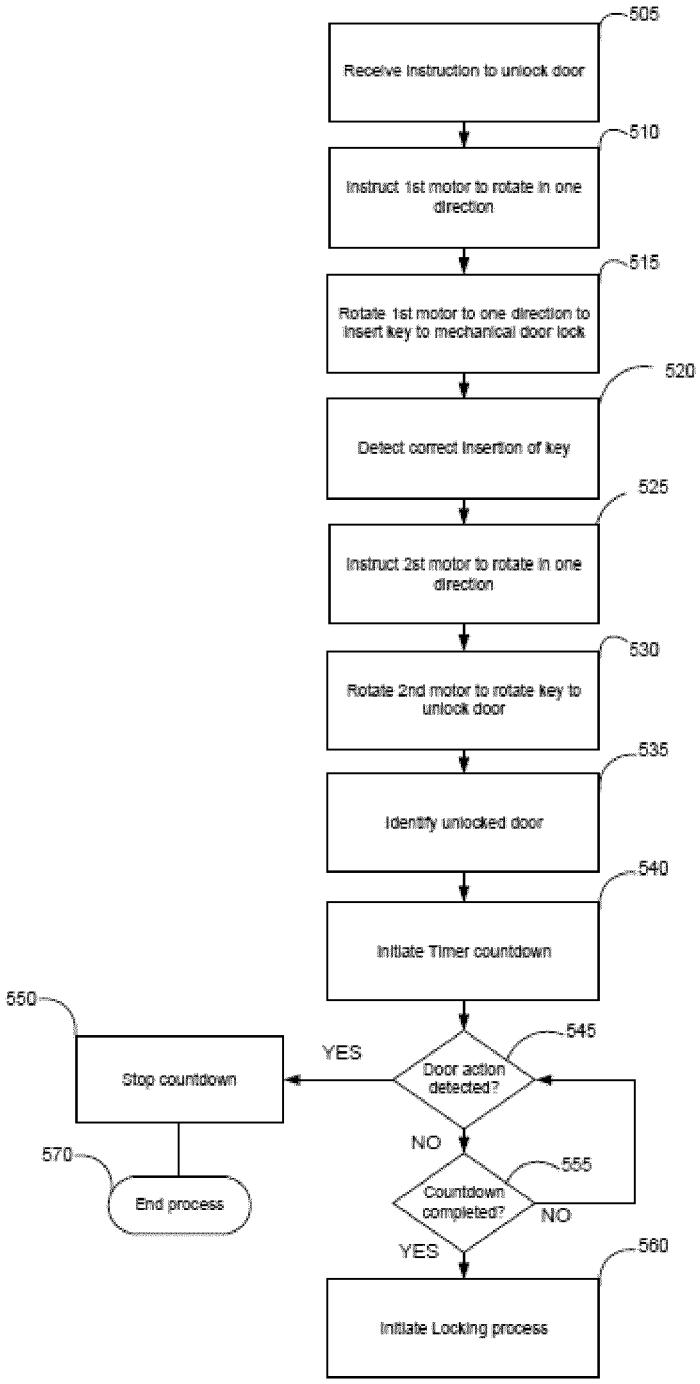
505
Receive instruction to unlock door
510
Instruct 1st motor to rotate in one direction
515
Rotate 1st motor to one direction to insert key to mechanical door lock
520
Detect correct insertion of key
525
Instruct 2st motor to rotate in one direction
530
Rotate 2nd motor to rotate key to unlock door
535
Identify unlocked door
540
Initiate Timer countdown
545
Door action detected?
YES
550
Stop countdown
570
End process
NO
555
Countdown completed?
NO
YES
560
Initiate Locking process

FIG. 5

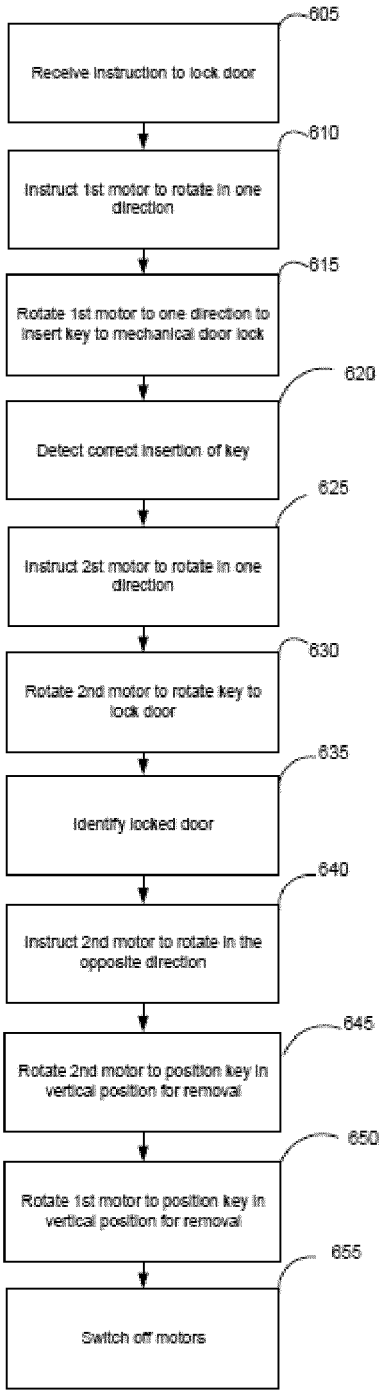
605
Receive instruction to lock door
610
Instruct 1st motor to rotate in one direction
615
Rotate 1st motor to one direction to insert key to mechanical door lock
620
Detect correct insertion of key
625
Instruct 2st motor to rotate in one direction
630
Rotate 2nd motor to rotate key to lock door
635
Identify locked door
640
Instruct 2nd motor to rotate in the opposite direction
645
Rotate 2nd motor to position key in vertical position for removal
650
Rotate 1st motor to position key in vertical position for removal
655
Switch off motors

FIG. 6

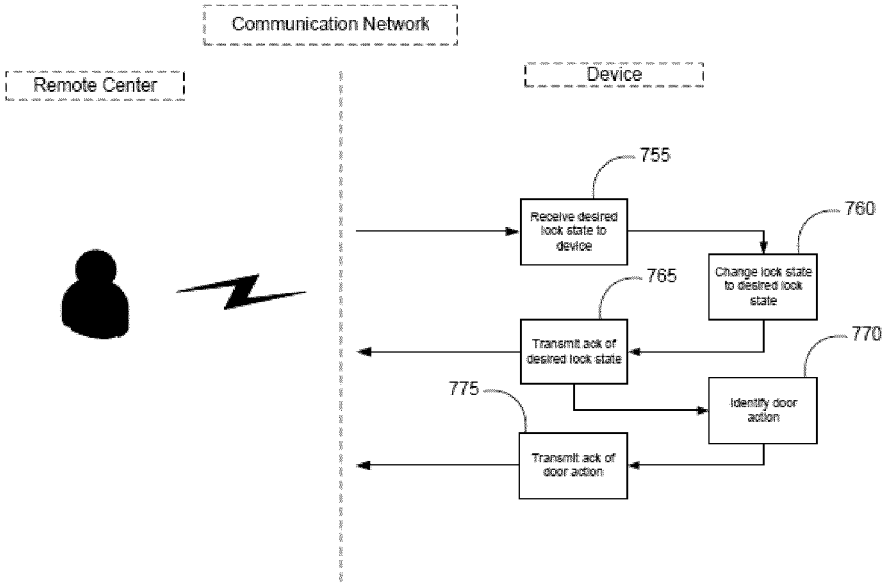
Communication Network
Remote Center
Device
755
Receive desired lock state to device
760
Change lock state to desired lock state
765
Transmit ack of desired lock state
770
Identify door action
775
Transmit ack of door action

FIG. 7

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 12 16 9162

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 200 03 715 U1 (LANGBEIN PETER [DE]) 10 August 2000 (2000-08-10) * page 9, line 21 - page 12, line 22 * * figures 1-3 *	1,2,4,5, 7-13, 16-19	INV. E05B47/00 E05B47/06
X	US 5 678 436 A (ALEXANDER CURTIS EARL [US]) 21 October 1997 (1997-10-21) * column 2, line 38 - column 3, line 67 * * figures 1-3 *	1,2,4,5, 7-13, 16-19	
X A	DE 10 2004 021704 B3 (ELV ELEKTRONIK AG [DE]) 22 December 2005 (2005-12-22) * paragraph [0019] - paragraph [0036] * * figures 1-4 *	1,2,4-12 3	
A	US 2006/016230 A1 (LOUGHLIN ROBERT [US] ET AL) 26 January 2006 (2006-01-26) * paragraph [0115] * * paragraph [0162] - paragraph [0171] * * figures 8-10 *	1,7-10	

TECHNICAL FIELDS SEARCHED (IPC)
E05B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	1 November 2012	Antonov, Ventseslav

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

1 EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 12 16 9162

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

01-11-2012

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 20003715 U1	10-08-2000	DE 10009700 A1	09-11-2000
		DE 20003715 U1	10-08-2000
US 5678436 A	21-10-1997	NONE	
DE 102004021704 B3	22-12-2005	NONE	
US 2006016230 A1	26-01-2006	EP 1807585 A2	18-07-2007
		US 2006016230 A1	26-01-2006
		WO 2006047239 A2	04-05-2006

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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

- EP 0168884 A2 **[0005] [0006]**