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(54) **ELECTROMECHANICAL LOCK**

(57) Electromechanical lock (1) comprising: an operating cylinder (2) extending between a first end (21) and an opposite second end (22); an inner knob (3) and an outer knob (4) rotatably connected to the operating cylinder (2) at the first end (21) and the second end (22), respectively; wherein the inner knob (3) comprises: an actuator (31) powered by a battery (32), a control unit (33) in signal communication with the actuator (31) and with the battery (32) and a detection device (34) in signal communication with the control unit (33) and connected to the outer knob (4); wherein the actuator (31) is configured to switch the operating cylinder (2) from a locking

position, wherein the outer knob (4) rotates idle, to an unlocking position, wherein the rotation of the outer knob (4) results in the operation of the operating cylinder (2), upon receiving an unlocking signal from the control unit (33) and wherein the detection device (34) is configured to detect the rotations of the outer knob (4) and to send a detection signal to the control unit (33) for each rotation of the outer knob (4), the control unit (33) is configured to process the detection signals from the detection device (34) and to send wireless output signals to an outer device.

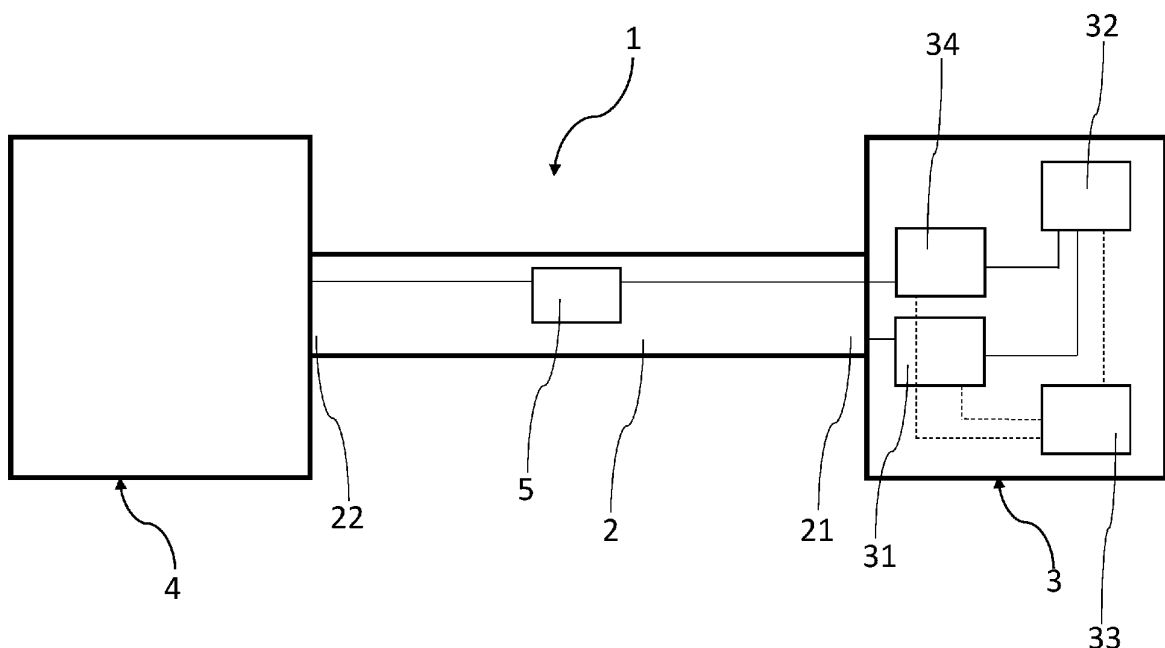


FIG.1

Description

Technical field

[0001] The present invention relates to an electromechanical lock which can be used, for example, to remotely control access to public and private buildings.

Background art

[0002] The use of a mechanical lock, applicable to a door of a building and operable by the use of a mechanical key, is known in the background art. Traditionally, a mechanical lock comprises an operating cylinder extending between a first end and a second end opposite each other along a longitudinal direction and which is configured to be placed inside a through cavity of the door. An inner knob is rotatably connected to the first end of the operating cylinder at the inner surface of the door. An outer knob is instead rotatably connected to the second end of the operating cylinder at the outer surface of the door.

[0003] The operating cylinder is configured to switch between a locking position, in which both the inner knob and the outer knob rotate idle without causing the operation of the operating cylinder, and an unlocking position in which the rotation of one of the two knobs involves the operation of the operating cylinder, i.e., opening the door.

[0004] The reversible switching between the locking position and the unlocking position is carried out by a user by means of a mechanical key. In other words, by means of a mechanical key, the user switches the operating cylinder from the locking position to the unlocking position, allowing the door to be opened by rotating one of the two knobs. At the same time, by means of the same key it is possible to switch the operating cylinder from the unlocking position to the locking position and therefore prevent the door from opening by rotating one of the two knobs.

[0005] An example of an electromechanical lock in accordance with the preamble of claim 1 is shown in document WO 2018/208154 A1.

Problems of the Background Art

[0006] Unfortunately, to switch the operating cylinder of the background art from the locking position to the unlocking position and vice versa, the user must necessarily reach the location where such a lock is located. In fact, the lock of the background art is not enabled for remote control. In other words, the mechanical lock of the background art does not allow to remotely lock or unlock the opening of the door to which such a lock is applied.

[0007] In addition, the mechanical lock of the prior art does not allow the user to be promptly notified of any attempts to access and/or break into the lock. Therefore, the mechanical lock of the background art does not ensure an adequate level of security. In fact, only through

a direct check can the user verify the condition of such a lock, and possibly notice any burglary attempts.

Summary of the invention

[0008] In this context, the technical task underlying the present invention is to propose an electromechanical lock which overcomes the drawbacks of the prior art.

[0009] In particular, it is an object of the present invention to provide an electromechanical lock which allows to remotely control the operating cylinder of the lock, i.e., which allows to reversibly and remotely switch the operating cylinder from the locking position to the unlocking position.

[0010] Furthermore, it is an object of the present invention to provide an electromechanical lock which allows the status of the lock to be controlled remotely, i.e., to verify whether attempts have been made to access and/or break in.

[0011] The mentioned technical task and the stated objects are substantially achieved by an electromechanical lock, comprising the technical features set out in one or more of the appended claims.

Advantages of the invention

[0012] By virtue of a preferred embodiment of the invention, a mobile device can be used to send a wireless signal to the electromechanical lock and change the position of the operating cylinder.

[0013] By virtue of the preferred embodiment of the invention it is also possible to control the rotations of the outer knob of the electromechanical lock and send a corresponding wireless signal to a mobile device. A user is thus promptly notified of any attempted access and/or break in.

Brief description of the drawings

[0014] Further features and advantages of the present invention will become more apparent from the description of an exemplary, but not exclusive, and therefore non-limiting preferred embodiment of an electromechanical lock, as illustrated in the appended figures, in which:

- figure 1 is a schematic depiction of the electromechanical lock in accordance with the present invention;
- figure 2 is a schematic sectional depiction of a door with the electromechanical lock of Figure 1 applied.

DETAILED DESCRIPTION

[0015] With reference to the appended figures, the number 1 indicates an electromechanical lock applicable to a door 6 to control access to a building (not illustrated in the appended figures).

[0016] The door 6, known to a person skilled in the art,

will be briefly described to better illustrate the operation of the electromechanical lock 1.

[0017] The door 6 comprises a closing body 61 extending between an inner surface 62 and an opposite outer surface 63 along a longitudinal direction X-X. Said closing body 61 is configured to reversibly close the entrance of the building. When the door 6 closes the building entrance, the inner surface 62 faces the interior of the building, while the outer surface 63 faces the exterior of the building.

[0018] In addition, the door 6 comprises a through cavity 64 from the inner surface 62 to the outer surface 63 and configured to house the electromechanical lock 1. Preferably, such a through cavity 64 has a cylindrical shape.

[0019] With particular reference to the appended figures, the electromechanical lock 1 comprises an operating cylinder 2 extending between a first end 21 and an opposite second end 22 along the longitudinal direction X-X. Said operating cylinder 2 is configured to be located inside the through cavity 64 of the door 6. Preferably, the first end 21 of the operating cylinder 2 is placed at the inner surface 62 of the door 6 and the second end 22 is placed at the outer surface 63 of the door 6. Still preferably, the operating cylinder 2 is a European type cylinder. Such an operating cylinder 2 is known to the person skilled in the art and will therefore not be further described.

[0020] The electromechanical lock 1 further comprises an inner knob 3 rotatably connected to the operating cylinder 2 at the first end 21 and an outer knob 4 rotatably connected to the operating cylinder 2 at the second end 22. Both the inner knob 3 and the outer knob 4 can then rotate with respect to the operating cylinder 2 about the longitudinal axis X-X. In use the inner knob 3 is connected to the operating cylinder 2 at the inner surface 62 of the door 6, vice versa the outer knob 4 is connected to the operating cylinder 2 at the outer surface 63 of the door 6.

[0021] The operating cylinder 2 is configured to switch between a locking position, in which the outer knob 4 rotates idle, and an unlocking position, in which the rotation of the outer knob 4 results in the operation of the operating cylinder 2. Consequently, when the operating cylinder 2 is in the locking position, the rotation of the outer knob 4 does not allow the door 6 to be opened. Vice versa, when the operating cylinder 2 is in the unlocking position, the rotation of the outer knob 4 allows the door 6 to be opened. In other words, opening the door 6 by rotating the outer knob 4 is allowed only when the operating cylinder 2 is in the unlocking position.

[0022] The inner knob 3 comprises an actuator 31 powered by a battery 32 and a control unit 33 in signal communication with the actuator 31 and with the battery 32. Such an actuator 31 is configured to switch the operating cylinder 2 from the locking position to the unlocking position upon receiving an unlocking signal from the control unit 33. The mode of switching the operating cylinder 2 from the locking position to the unlocking position by

means of the actuator 31 is known to the person skilled in the art and will therefore not be further described herein.

[0023] The control unit 33 is configured to send the unlocking signal to the actuator 31 upon receiving a wireless opening signal from an outer device. In the present disclosure, an outer device is understood to be a device external to the electro-mechanical lock 1 such as smartphones, tablets, and a desktop computer or laptop. Advantageously, a user can remotely control the electro-mechanical lock 1 by means of, for example, their personal smartphone. Still for example, by means of an application installable on their smartphone, the user can send the wireless opening signal to the control unit 33.

[0024] In addition, the inner knob 3 comprises a detection device 34 in signal communication with the control unit 33. The detection device 34 is also powered by the battery 32. Such a detection device 34 is connected to the outer knob 4 by means of rotation transmission means 5 placed in the operating cylinder 2. The detection device 34 is configured to detect the rotations of the outer knob 4 and to send a detection signal to the control unit 33 for each rotation of the outer knob 4. In fact, the rotation transmission means 5 are mechanically connected to the outer knob 4 and transform the rotation of the outer knob 4 into a mechanical action acting on the detection device 34. For each mechanical action acting thereon, the detection device 34 sends a detection signal to the control unit 33.

[0025] The control unit 33 is configured to process the detection signals from the detection device 34 and to send wireless output signals to an outer device. For example, such wireless output signals are sent to a user's smartphone. Still for example, the user receives a notification on their smartphone for each wireless output signal received.

[0026] The wireless output signals contain information related to the rotation of the outer knob 4. As will be clearer in the following, receiving the wireless output signal allows the user to be informed, in real time, of any accesses to the building by means of the opening of the door 6 by rotating the outer knob 4 and/or any attempts to break into the electromechanical lock 1 which involve rotating the outer knob 4.

[0027] It should be noted that all the electronic components of the electromechanical lock 1, namely the actuator 31, the battery 32, the control unit 33 and the detection device 34, are placed in the inner knob 3. Advantageously, when the door 6 closes the entrance of the building, the electronic components are not accessible from the outside of the building, thus avoiding the risk of damage to such electronic components by malicious parties.

[0028] According to a preferred embodiment of the invention, the detection device 34 comprises an accelerometer connected to the rotation transmission means 5 and configured to detect the accelerations of the outer knob 4 at least along a transverse direction Y-Y with re-

spect to the longitudinal direction X-X. The operation of an accelerometer is known to the person skilled in the art and for this reason will not be further described herein.

[0029] Preferably, the actuator 31 is configured to switch the operating cylinder 2 from the unlocking position to the locking position upon receiving a locking signal from the control unit 33. The switching of the operating cylinder 2 from the unlocking position to the locking position by means of the actuator 31 is known to the person skilled in the art and will not be further described herein.

[0030] Still preferably, the control unit 33 is configured to send the locking signal to the actuator 31 upon receiving a wireless closing signal from an outer device. In other words, a user by means of, for example, their personal smartphone, places the operating cylinder 2 in the locking position, thereby preventing the opening of the door 6 by means of rotation of the outer knob 4.

[0031] It should therefore be noted that both the switching of the operating cylinder 2 from the locking position to the unlocking position and the reverse switching can be carried out remotely.

[0032] In accordance with a first embodiment of the invention, the control unit 33 is configured to send the locking signal to the actuator 31 after a first predetermined unlocking time from sending the unlocking signal from the control unit 33 to the actuator 31. Preferably, such a first predetermined unlocking time is user settable by the outer device, for example, by the smartphone. Advantageously, in accordance with such a first embodiment, even if the user has not sent the wireless closing signal to the control unit 33, after the first predetermined unlocking time has elapsed, the control unit 33 places the operating cylinder 2 in the locking position, thus preventing the door 6 from opening by rotating the outer knob 4.

[0033] In accordance with a second embodiment of the invention alternative to the first embodiment of the invention, the control unit 33 is configured to send the locking signal to the actuator 31 in the absence of receiving at least one detection signal from the detection device 34 in a second predetermined unlocking time. Preferably, as for the first embodiment of the invention, the second predetermined unlocking time is also user settable by the outer device, for example by the smartphone.

[0034] Consequently, in accordance with the second embodiment of the invention, if the operating cylinder 2 is in the unlocking position and the control unit 33 does not detect any rotation of the outer knob 4 within the second predetermined unlocking time, the operating cylinder 2 is switched to the locking position, preventing the opening of the door 6 by means of rotation of the outer knob 4.

[0035] In accordance with the preferred embodiment of the invention, the wireless output signal sent by the control unit 33 to an outer device is an occurred access signal when the operating cylinder 2 is in the unlocking position and the control unit 33 receives at least one detection signal from the detection device 34. In other words, when the operating cylinder 2 is in the unlocking

position and the detection device 34 detects the rotation of the outer knob 4, the control unit 33 sends an occurred access notification, for example, to the user's smartphone.

[0036] Still in accordance with the preferred embodiment of the invention, the wireless output signal sent by the control unit 33 to an outer device is an alarm signal when the operating cylinder 2 is in the locking position and the control unit 33 receives from the detection device 34 a number of detection signals higher than a rotation threshold value. Preferably, said rotation threshold value is settable by the user by means of, for example, the smartphone.

[0037] If the operating cylinder 2 is in the locking position, and the detection device 34 detects a number of rotations of the outer knob 4 higher than the rotation threshold value, the control unit 33 sends an alarm notification, for example, to the user's smartphone. Consequently, if the alarm notification is received, the user can intervene promptly.

[0038] Still in accordance with the preferred embodiment of the invention, the control unit 33 is configured to send a wireless battery depletion signal to an outer device. The control unit 33 is then configured to read the power status of the battery 32 and is preferably configured to send the wireless battery depletion signal to the outer device when the power status of the battery 32 is lower than a power threshold value. The power threshold value corresponds to the minimum power status value which allows the optimal operation of all the electronic components. Upon receiving the wireless battery depletion signal 32, the user is immediately informed of the status of the battery 32, allowing the user to promptly charge and/or replace it.

[0039] Additionally, the control unit 33 is configured to send the locking signal to the actuator 31 when the power status of the battery 32 is less than the power threshold value. Consequently, if the power status of the battery 32 is lower than the power threshold value, the operating cylinder 2 is switched to the locking position, thereby preventing the operating cylinder 2 from remaining in the unlocking position.

Claims

1. Electromechanical lock (1) comprising:

- an operating cylinder (2) extending between a first end (21) and an opposite second end (22) along a longitudinal direction (X-X);
- an inner knob (3) rotatably connected to the operating cylinder (2) at the first end (21);
- an outer knob (4) rotatably connected to the operating cylinder (2) at the second end (22); wherein the operating cylinder (2) is configured to switch between a locking position, wherein the outer knob (4) rotates idle, and an unlocking

position, wherein the rotation of the outer knob (4) results in the operation of the operating cylinder (2);

wherein the inner knob (3) comprises:

- an actuator (31) powered by a battery (32) and a control unit (33) in signal communication with the actuator (31) and with the battery (32), said actuator (31) being configured to switch the operating cylinder (2) from the locking position to the unlocking position upon receiving an unlocking signal from the control unit (33), the control unit (33) being configured to send the unlocking signal to the actuator (31) upon receiving a wireless opening signal from an outer device;
- a detection device (34) in signal communication with the control unit (33), said detection device (34) being connected to the outer knob (4) by means of rotation transmission means (5) placed in the operating cylinder (2), said detection device (34) being configured to detect rotations of the outer knob (4) and to send a detection signal to the control unit (33) for each rotation of the outer knob (4), the control unit (33) being configured to process detection signals from the detection device (34) and to send wireless output signals to an outer device;

characterized in that:

- the wireless output signal sent by the control unit (33) to an outer device is an occurred access signal when the operating cylinder (2) is in the unlocking position and the control unit (33) receives at least one detection signal from the detection device (34).

2. Lock (1) according to claim 1, wherein the detection device (34) comprises an accelerometer connected to the rotation transmission means (5) and configured to detect the accelerations of the outer knob (4) at least along a transverse direction (Y-Y) with respect to the longitudinal direction (X-X).
3. Lock (1) according to claim 1 or 2, wherein the actuator (31) is configured to switch the operating cylinder (2) from the unlocking position to the locking position upon receiving a locking signal from the control unit (33), the control unit (33) being configured to send the locking signal to the actuator (31) upon receiving a wireless closing signal from an outer device.
4. Lock (1) according to any one of claims 1 to 3, wherein the actuator (31) is configured to switch the operating cylinder (2) from the unlocking position to the locking position upon receiving a locking signal from

the control unit (33), the control unit (33) being configured to send the locking signal to the actuator (31) after a first predetermined unlocking time starting from the action of sending the unlocking signal by the control unit (33) to the actuator (31).

5. Lock (1) according to anyone of claims 1 to 3, wherein the actuator (31) is configured to switch the operating cylinder (2) from the unlocking position to the locking position upon receiving a locking signal from the control unit (33), the control unit (33) being configured to send the locking signal to the actuator (31) in absence of the reception of at least one detection signal from the detection device (34) in a second predetermined unlocking time.
6. Lock (1) according to any one of claims 1 to 5, wherein the wireless output signal sent by the control unit (33) to an outer device is an alarm signal when the operating cylinder (2) is in the locking position and the control unit (33) receives from the detection device (34) a number of detection signals higher than a rotation threshold value.
7. Lock (1) according to any one of claims 1 to 6, wherein the control unit (33) is configured to send a wireless battery depletion signal to an outer device and to send the locking signal to the actuator (31) when the battery (33) power status is lower than a power threshold value.

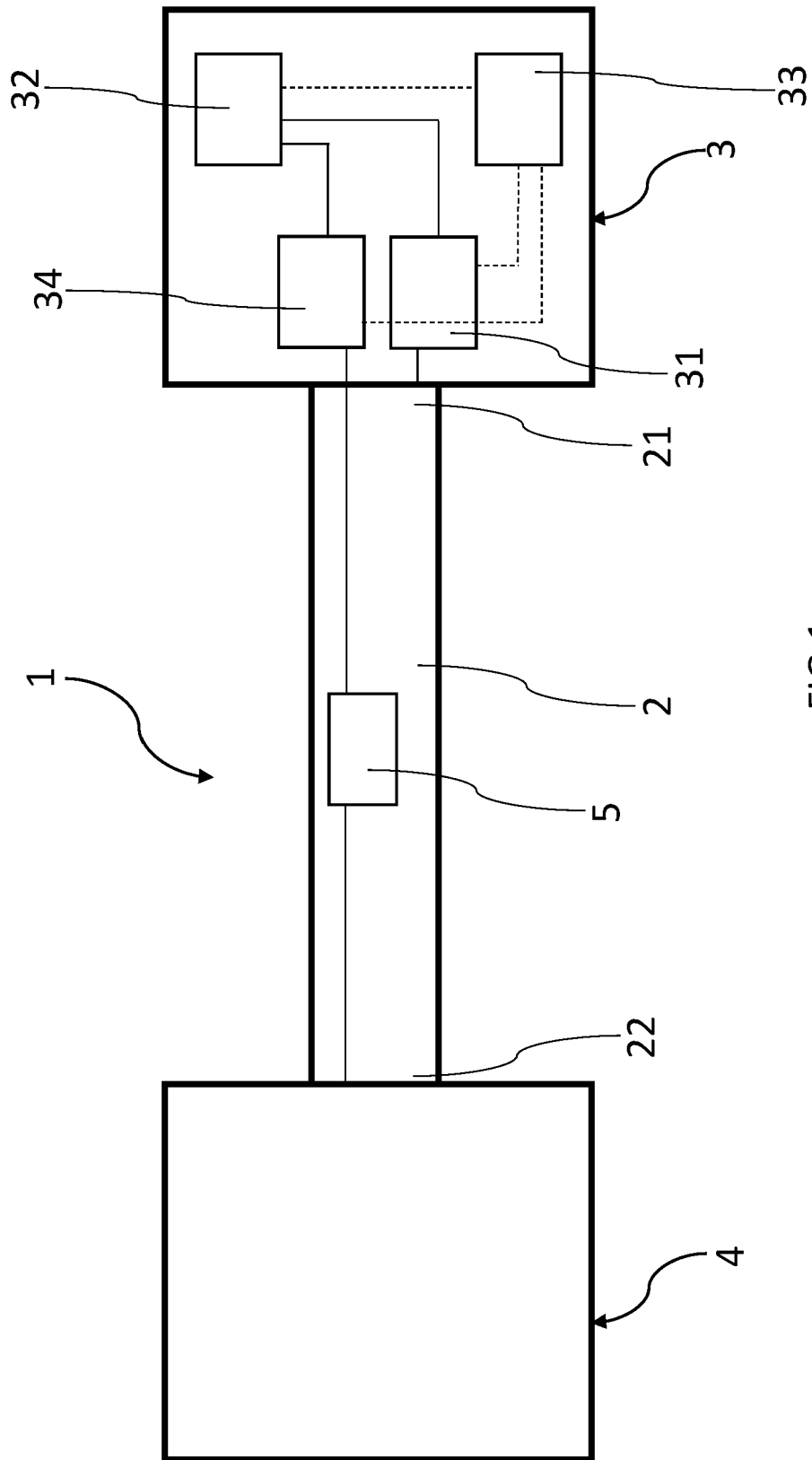


FIG.1

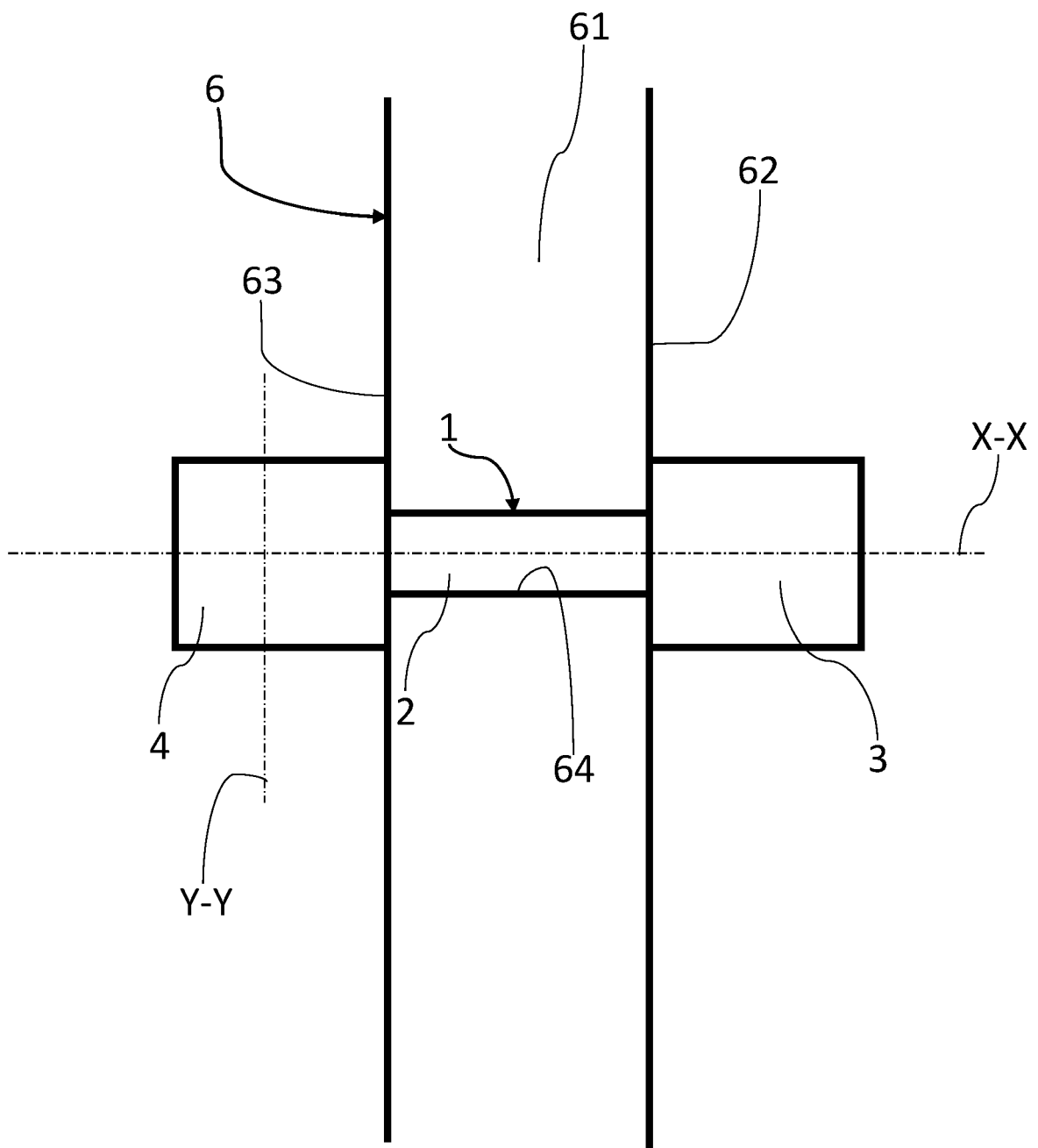


FIG.2



EUROPEAN SEARCH REPORT

Application Number
EP 21 17 3751

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	WO 2018/208154 A1 (BOLD SECURITY TECH B V) 15 November 2018 (2018-11-15) * the whole document *	1-7	INV. E05B47/06 E05B45/06
A	GB 2 463 943 A (COOPER SECURITY LTD [GB]) 7 April 2010 (2010-04-07) * the whole document *	1	
A	EP 2 569 496 A1 (HENNIG HOLM [DE]) 20 March 2013 (2013-03-20) * the whole document *	1	
			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		15 September 2021	Ansel, Yannick
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			

EPO FORM 1503 03.82 (P04C01)

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

EP 21 17 3751

5 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
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15-09-2021

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REFERENCES CITED IN THE DESCRIPTION

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