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(54) **ELECTRIC LOCK DEVICE, ELECTRONIC LOCK SYSTEM, ACCESS MEMBER AND ACCESS MEMBER SYSTEM**

(57) An electric lock device (34) for installation in an access member (14) movable relative to a frame (12), the electric lock device (34) comprising an electric actuator (46) configured to control an unlocking function of the electric lock device (34); and a solar cell arrangement (36) configured to transform incident light to electric energy; wherein the electric actuator (46) is arranged to be electrically powered by the solar cell arrangement (36); and wherein the solar cell arrangement (36) is configured to be installed in an access member side surface (26) of the access member (14), substantially perpendicular to a main extension surface (24) of the access member (14), such that the solar cell arrangement (36) can receive incident light from a light emitting arrangement (38) installed in a frame side surface (28) of the frame (12) in a closed position of the access member (14).

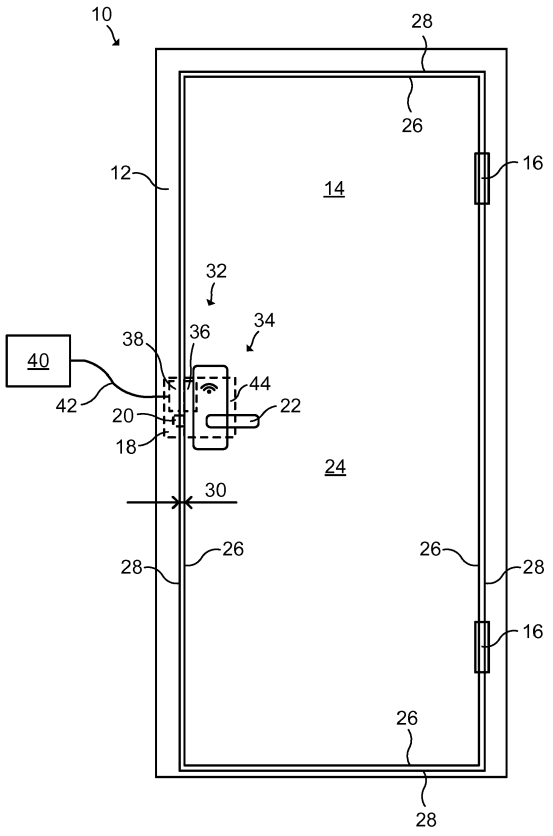

Fig. 1

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Description

Technical Field

[0001] The present disclosure generally relates to an electric lock device. In particular, an electric lock device for installation in an access member movable relative to a frame, an electric lock system for installation in an access member system, an access member for installation in a frame, and an access member system comprising a frame and an access member, are provided.

Background

[0002] Today, most electric lock devices in door leafs use primary batteries as power supply, for example three AA batteries. Such primary batteries need to be replaced at a regular basis, for example every second year. Replacement of batteries in such electric lock devices is a troublesome and costly process, in particular in large buildings, such as hotels, that may comprise hundreds of doors. The use of primary batteries to power electric lock devices in door leafs is also not environmentally friendly.

[0003] As an alternative solution to power electric lock devices in door leafs, hard wiring may be used. Hard wiring typically comprises routing a wire from a door frame on the hinge side of the door leaf, through a door loop, and across the interior of the door leaf to the electric lock device. The hard wiring solution therefore requires expensive and complicated modification of the door leaf and the door frame.

[0004] As a further alternative solution, electric lock devices in door leafs may be powered by means of electromagnetic transfer from the frame to the electric lock device. Electromagnetic transfer however has some challenges due to gap variations between the door leaf and the door frame. The electromagnetic transfer is also dependent on the types of material used in the door leaf and the door frame, such as metal and wood. Thus, each electromagnetic transfer solution is dependent on a specific configuration of the door leaf and the door frame.

[0005] JP H01304282 A discloses a solar cell panel arranged onto the surface of a door and a battery buried into the door is charged and an electric lock is supplied with a power supply by wirings into the door together with the solar cell panel and an electric lock body. The electric lock body and a side plate are provided with a locking and release detecting means, and a magnetic sensor is mounted on the door side and a relative position in the side plate is furnished with a magnetic generating means. A switch is operated when magnetism is generated from the magnetic generating means in response to the control signal of a controller, and a solenoid is worked and locking and release are conducted.

Summary

[0006] One object of the present disclosure is to provide an electric lock device for installation in an access member movable relative to a frame, which electric lock device can be electrically powered in a simple way.

[0007] A further object of the present disclosure is to provide an electric lock device for installation in an access member movable relative to a frame, which electric lock device avoids replacement of batteries.

[0008] A still further object of the present disclosure is to provide an electric lock device for installation in an access member movable relative to a frame, which electric lock device is simple to install in the access member.

[0009] A still further object of the present disclosure is to provide an electric lock device for installation in an access member movable relative to a frame, which electric lock device is cheap.

[0010] A still further object of the present disclosure is to provide an electric lock device for installation in an access member movable relative to a frame, which electric lock device has a reliable operation.

[0011] A still further object of the present disclosure is to provide an electric lock device for installation in an access member movable relative to a frame, which electric lock device provides an improved user experience.

[0012] A still further object of the present disclosure is to provide an electric lock device for installation in an access member movable relative to a frame, which electric lock device enables the provision of a main extension surface of the access member with few components visible to a user.

[0013] A still further object of the present disclosure is to provide an electric lock device for installation in an access member movable relative to a frame, which electric lock device has a slimmed design and/or enables a slimmed design of the access member.

[0014] A still further object of the present disclosure is to provide an electric lock device for installation in an access member movable relative to a frame, which electric lock device solves several or all of the foregoing objects in combination.

[0015] A still further object of the present disclosure is to provide an electric lock system for installation in an access member system, which electric lock system solves one, several or all of the foregoing objects.

[0016] A still further object of the present disclosure is to provide an access member for installation in a frame, which access member solves one, several or all of the foregoing objects.

[0017] A still further object of the present disclosure is to provide an access member system comprising a frame and an access member, which access member system solves one, several or all of the foregoing objects.

[0018] According to one aspect, there is provided an electric lock device for installation in an access member movable relative to a frame, the electric lock device comprising an electric actuator configured to control an un-

locking function of the electric lock device; and a solar cell arrangement configured to transform incident light to electric energy;
wherein the electric actuator is arranged to be electrically powered by the solar cell arrangement; and wherein the solar cell arrangement is configured to be installed in an access member side surface of the access member, substantially perpendicular to, or perpendicular to, a main extension surface of the access member, such that the solar cell arrangement can receive incident light from a light emitting arrangement installed in a frame side surface of the frame in a closed position of the access member.

[0019] By the use of a solar cell arrangement in the access member, the need for primary batteries, and the consequential regular replacement of primary batteries, is eliminated. Although a solar cell arrangement could be positioned on the main extension surface, if the access member is used indoors, a solar cell arrangement may not be capable of providing sufficient electric energy for the electric lock device. In any case, such solar cell arrangement positioned on the main extension surface would have to be unreasonably large in order to generate enough electric energy in indoor environments. This would make such access member expensive. Furthermore, large visible components would be needed on the main extension surface(s) and the user experience would be deteriorated.

[0020] By means of the solar cell arrangement configured to be installed in the access member side surface, the solar cell arrangement can be hidden in a gap between the access member and the frame when the access member is closed. Thereby, a slimmed design of the electric lock device and of the access member is enabled. By emitting light onto the solar cell arrangement positioned on the access member side surface, sufficient electric energy for powering the electric actuator (e.g. for locking or unlocking the electric lock device), and optionally also for performing an authorization process (e.g. reading a keycard), is ensured.

[0021] Due to the solar cell arrangement configured to be installed in the access member side surface, the installation of the electric lock device in the access member is simple and cheap, in particular in comparison with hard wiring solutions. Due to the use of a solar cell arrangement configured to be powered by incident light over a gap between the access member and the frame, the access member is less sensitive to gap tolerances between the access member and the frame, in particular in comparison with electromagnetic transfer solutions. A relaxation of tolerances in this way improves simplicity and reduces costs of the access member, or of an access member system comprising the access member and the frame.

[0022] Furthermore, due to the use of a solar cell arrangement configured to be powered by incident light over a gap between the access member and the frame, the solution is independent on the types of materials used in the access member and in the frame, in contrast to electromagnetic transfer solutions.

[0023] Throughout the present disclosure, the solar cell arrangement may comprise one or more solar panels. Each solar panel may comprise a plurality of solar cells.

[0024] The electric lock device may for example comprise a bolt functionally coupled to the electric actuator. The electric actuator may be movable between a locking position and an unlocking position. When the electric actuator adopts the locking position, the bolt is blocked by the electric actuator and cannot be retracted by manual actuation of a handle on the access member. When the electric actuator adopts the unlocking position, the bolt is unblocked and the bolt can be retracted by manually actuating the handle. The electric actuator may be driven by an electric motor. The bolt may for example be a deadbolt, a latch bolt, or a bolt that functions as both a deadbolt and a latch bolt.

[0025] The electric lock device may further comprise at least one electrical conductor. The electric actuator may be electrically connected to the solar cell arrangement via the at least one electrical conductor. The electric actuator may further be configured to control a locking function of the electric lock device.

[0026] The electric lock device may further comprise a lock case. In this case, the electric actuator may be arranged inside the lock case.

[0027] The solar cell arrangement may be mechanically connected to the lock case. For example, the solar cell arrangement may be provided in the lock case facing towards a strike plate in the frame.

[0028] Alternatively, the solar cell arrangement may be spatially separated from the lock case. For example, the solar cell arrangement may be positioned in the access member side surface above or below the lock case. Alternatively, the solar cell arrangement may be positioned on an access member side surface other than the access member side surface on which the lock case is positioned.

[0029] The solar cell arrangement may comprise an electric energy storage device. The electric energy storage device may be arranged to store electric energy and to electrically power the electric actuator. The electric energy storage device may for example be a rechargeable battery and/or a capacitor, such as a supercapacitor.

[0030] The electric lock device may comprise an electronic device arranged to be electrically powered by the solar cell arrangement and configured to produce an authorization signal, for actuating the unlocking function, upon authorization of a user.

[0031] According to a further aspect, there is provided an electric lock system for installation in an access member system, the electric lock system comprising an electric lock device according to the present disclosure and a light emitting arrangement configured to be installed in a frame side surface of the frame. The light emitting arrangement may be of any type according to the present

disclosure.

[0032] According to a further aspect, there is provided an access member, such as a door leaf, for installation in a frame, the access member comprising a main extension surface; an access member side surface substantially perpendicular to, or perpendicular to, the main extension surface; and an electric lock device according to the present disclosure; wherein the solar cell arrangement is installed in the access member side surface. In case the access member comprises a handle rotatable about a handle axis, the handle axis may be substantially normal to, or normal to, the main extension surface. The access member may comprise two opposite main extension surfaces, such as a front surface and a rear surface, and four access member side surfaces surrounding the main extension surfaces.

[0033] According to a further aspect, there is provided an access member system comprising a frame, such as a door frame, and an access member according to the present disclosure, wherein the access member is movable relative to the frame between a closed position and an open position.

[0034] The access member system may further comprise a light emitting arrangement configured to emit light directed towards the solar cell arrangement, and the light emitting arrangement may be installed in a frame side surface of the frame, the frame side surface facing the access member side surface when the access member is in a closed position. The solar cell arrangement may thus be substantially aligned with, or aligned with, the light emitting arrangement when the access member adopts the closed position. Thereby, when the light emitting arrangement emits light and the access member is closed, the light is received on the solar cell arrangement and the solar cell arrangement converts the incident light to electric energy. The electric energy generated in the closed position of the access member may be stored in the electric energy storage device. The light emitting arrangement may constantly emit light onto the solar cell arrangement, as long as the access member is closed.

[0035] The light emitting arrangement may comprise one or more diodes. The light emitting arrangement may be powered by the mains supply, e.g. via an AC adapter.

[0036] The light emitting arrangement may be configured to emit infrared light. The use of infrared light is advantageous since infrared light can power the solar cell arrangement while not being visible to the human eye.

[0037] The frame may comprise a strike plate in the frame side surface. In this case, the light emitting arrangement may be mechanically connected to the strike plate. For example, the solar cell arrangement may be provided in the lock case and the light emitting arrangement may be provided in the strike plate facing towards the solar cell arrangement in the lock case. Alternatively, the light emitting arrangement may be spatially separated from the strike plate.

[0038] The access member system may further comprise an access member sensor arranged to detect a closed position and/or an open position of the access member. In this case, the light emitting arrangement may be arranged to emit light directed towards the solar cell arrangement only when the access member adopts the closed position.

[0039] The access member system may further comprise at least one hinge rotationally coupling the access member to the frame. In this case, the solar cell arrangement may be positioned in the access member side surface opposite to the at least one hinge. The at least one hinge may for example rotationally couple the access member to the frame.

[0040] Throughout the present disclosure, the access member may be a door leaf, and the frame may be a door frame. Alternative types of access members and frames are however conceivable.

Brief Description of the Drawings

[0041] Further details, advantages and aspects of the present disclosure will become apparent from the following embodiments taken in conjunction with the drawings, wherein:

- Fig. 1: schematically represents a front view of an access member system comprising a frame, an access member, an electric lock device and an electric lock system;
- Fig. 2: schematically represents an enlarged partial view of the access member system in Fig. 1; and
- Fig. 3: schematically represents an enlarged view of a further example of an access member system.

Detailed Description

[0042] In the following, an electric lock device for installation in an access member movable relative to a frame, an electric lock system for installation in an access member system, an access member for installation in a frame, and an access member system comprising a frame and an access member, will be described. The same reference numerals will be used to denote the same or similar structural features.

[0043] Fig. 1 schematically represents a front view of an access member system 10 comprising a frame 12 and an access member 14 installed in the frame 12. In Fig. 1, the access member 14 is exemplified as a door leaf and the frame 12 is exemplified as a door frame. The access member 14 is rotationally coupled to the frame 12 by means of two hinges 16. The access member 14 is movable from the illustrated closed position, to an open position.

[0044] The frame 12 comprises a strike plate 18. The access member 14 comprises a bolt 20 arranged to engage the strike plate 18 to lock the access member 14.

In this example, the bolt 20 functions as both a deadbolt and a latch bolt. The access member 14 further comprises a handle 22 for actuating the bolt 20.

[0045] The access member 14 comprises two main extension surfaces 24. Only a front main extension surface 24 is visible in Fig. 1. Each main extension surface 24 is here generally flat (extending in the plane of Fig. 1). In this example, the handle 22 is rotatable about a handle axis perpendicular to the main extension surfaces 24.

[0046] The access member 14 further comprises four access member side surfaces 26 surrounding the main extension surfaces 24: two opposite vertical access member side surfaces 26, an upper horizontal access member side surface 26 and a lower horizontal access member side surface 26. Each access member side surface 26 is perpendicular to the main extension surface 24.

[0047] The frame 12 comprises four frame side surfaces 28: two opposite vertical frame side surfaces 28, an upper horizontal frame side surface 28 and a lower horizontal frame side surface 28. In the illustrated closed position of the access member 14, each access member side surface 26 is aligned with and faces a respective frame side surface 28. A gap 30 is provided between the access member 14 and the frame 12 around the access member 14, i.e. between each pair of access member side surface 26 and frame side surface 28.

[0048] The access member system 10 further comprises an electric lock system 32. The electric lock system 32 is installed in the access member system 10. The electric lock system 32 comprises an electric lock device 34. The electric lock device 34 comprises an electric actuator (not shown). The electric actuator is configured to control a locking function and an unlocking function of the electric lock device 34.

[0049] The electric lock device 34 further comprises a solar cell arrangement 36. The solar cell arrangement 36 is configured to transform incident light to electric energy and to power the electric actuator. The solar cell arrangement 36 is installed in the left access member side surface 26, i.e. opposite to the hinges 16.

[0050] The electric lock system 32 further comprises a light emitting arrangement 38. The light emitting arrangement 38 is configured to emit light over the gap 30 and to the solar cell arrangement 36 in the closed position of the access member 14. To this end, the light emitting arrangement 38 is installed in the frame side surface 28 facing the access member side surface 26 in which the solar cell arrangement 36 is positioned. In this example, the light emitting arrangement 38 is positioned in the strike plate 18. The light emitting arrangement 38 of this example is configured to emit infrared light.

[0051] The light emitting arrangement 38 is powered by a power supply 40 through cable 42. The power supply 40 may for example comprise a mains supply and an AC adapter.

[0052] The electric lock device 34 of this example further comprises a lock case 44. The lock case 44 is installed in the access member 14. The electric actuator is arranged inside the lock case 44. The solar cell arrangement 36 is mechanically connected to the lock case 44, in Fig. 1 at the left side of the lock case 44. The light emitting arrangement 38 in the strike plate 18 thereby faces the solar cell arrangement 36 in the lock case 44.

[0053] Fig. 2 schematically represents an enlarged partial view of the access member system 10 in Fig. 1. In Fig. 2, the electric actuator 46 arranged inside the lock case 44 can be seen.

[0054] The solar cell arrangement 36 comprises a solar panel 48 and an electric energy storage device 50. The solar panel 48 comprises a plurality of solar cells. The electric energy storage device 50 is here exemplified as a supercapacitor. The solar cell arrangement 36 of this example further comprises a DC/DC converter 52.

[0055] The electric lock device 34 of this example comprises an actuating device 54. The actuating device 54 comprises an electric motor (not shown) arranged to drive the electric actuator 46. The bolt 20 is functionally coupled to the electric actuator 46. The bolt 20 is arranged to move between the illustrated locking position to a retracted or unlocking position (and vice versa). The electric actuator 46 is movable between a locking position, in which the bolt 20 cannot be retracted by manual operation of the handle 22, and an unlocking position, in which the bolt can be retracted by manual operation of the handle 22.

[0056] The electric lock device 34 further comprises an electronic device 56. The electronic device 56 of this example comprises reading electronics 58 and credential evaluation electronics 60. The reading electronics 58 may comprise a receiving unit (e.g. an RFID antenna), for receiving an input signal (e.g. from a keycard), and a reading unit. The reading electronics 58 may be configured to send an access signal to the credential evaluation electronics 60. The credential evaluation electronics 60 may be configured to determine whether or not authorization should be granted based on the access signal. If access is granted, e.g. if a valid credential is presented, the credential evaluation electronics 60 may issue an authorization signal to the actuating device 54. As an alternative example, the receiving unit of the reading electronics 58 may be configured to receive a BLE (Bluetooth Low Energy) signal from a mobile phone.

[0057] The electric lock device 34 further comprises two electrical conductors 62. One electric conductor 62 is connected between the solar cell arrangement 36 and the actuating device 54 and one electrical conductor 62 is connected between the electronic device 56 and the actuating device 54. In this way, the electric actuator 46 is electrically connected to the solar cell arrangement 36 via at least one electrical conductor 62.

[0058] The light emitting arrangement 38 of this example comprises one or several infrared LED's (Light Emitting Diodes) 64. The light emitting arrangement 38 further comprises an access member sensor 66. The access member sensor 66 is configured to determine whether or not the access member 14 is in the closed position. If

the access member 14 is not in the closed position, as determined by the access member sensor 66, it may be concluded that the access member 14 is in the open position. The light emitting arrangement 38 is configured to emit light only when the access member 14 adopts the closed position. To this end, the light emitting arrangement 38 may comprise a control device (not shown). The access member sensor 66 may for example be a proximity sensor for sensing a proximity target (e.g. a magnet) on the access member 14.

[0059] Fig. 3 schematically represents an enlarged view of a further example of an access member system 10. Mainly differences with respect to Figs. 1 and 2 will be described. In Fig. 3, the solar cell arrangement 36 is spatially separated from the lock case 44 and the light emitting arrangement 38 is spatially separated from the strike plate 18. However, the solar cell arrangement 36 is still positioned in the access member side surface 26 and the light emitting arrangement 38 is still positioned in the frame side surface 28. The light emitting arrangement 38 and the solar cell arrangement 36 are aligned such that the light emitting arrangement 38 can emit light over the gap 30 onto the solar cell arrangement 36 for producing electric energy to drive the electric actuator 46.

[0060] While the present disclosure has been described with reference to exemplary embodiments, it will be appreciated that the present invention is not limited to what has been described above. For example, it will be appreciated that the dimensions of the parts may be varied as needed. Accordingly, it is intended that the present invention may be limited only by the scope of the claims appended hereto.

Claims

1. An electric lock device (34) for installation in an access member (14) movable relative to a frame (12), the electric lock device (34) comprising:

- an electric actuator (46) configured to control an unlocking function of the electric lock device (34); and
- a solar cell arrangement (36) configured to transform incident light to electric energy;

wherein the electric actuator (46) is arranged to be electrically powered by the solar cell arrangement (36); and
wherein the solar cell arrangement (36) is configured to be installed in an access member side surface (26) of the access member (14), substantially perpendicular to a main extension surface (24) of the access member (14), such that the solar cell arrangement (36) can receive incident light from a light emitting arrangement (38) installed in a frame side surface (28) of the frame (12) in a closed position of the access member (14).

2. The electric lock device (34) according to claim 1, wherein the electric lock device (34) further comprises a lock case (44), and wherein the electric actuator (46) is arranged inside the lock case (44).

3. The electric lock device (34) according to claim 2, wherein the solar cell arrangement (36) is mechanically connected to the lock case (44).

4. The electric lock device (34) according to claim 2, wherein the solar cell arrangement (36) is spatially separated from the lock case (44).

5. The electric lock device (34) according to any of the preceding claims, wherein the solar cell arrangement (36) comprises an electric energy storage device (50) arranged to store electric energy and to electrically power the electric actuator (46).

6. The electric lock device (34) according to any of the preceding claims, wherein the electric lock device (34) comprises an electronic device (56) arranged to be electrically powered by the solar cell arrangement (36) and configured to produce an authorization signal, for actuating the unlocking function, upon authorization of a user.

7. An electric lock system (32) for installation in an access member system (10), the electric lock system (32) comprising an electric lock device (34) according to any of the preceding claims and a light emitting arrangement (38) configured to be installed in a frame side surface (28) of the frame (12).

8. An access member (14), such as a door leaf, for installation in a frame (12), the access member (14) comprising:

- a main extension surface (24);
- an access member side surface (26) substantially perpendicular to the main extension surface (24); and
- an electric lock device (34) according to any of claims 1 to 6;

wherein the solar cell arrangement (36) is installed in the access member side surface (26).

9. An access member system (10) comprising a frame (12), such as a door frame, and an access member (14) according to claim 8, wherein the access member (14) is movable relative to the frame (12) between a closed position and an open position.

10. The access member system (10) according to claim 9, further comprising a light emitting arrangement (38) configured to emit light directed towards the solar cell arrangement (36), and wherein the light emit-

ting arrangement (38) is installed in a frame side surface (28) of the frame (12), the frame side surface (28) facing the access member side surface (26) when the access member (14) is in a closed position.

11. The access member system (10) according to claim 10, wherein the light emitting arrangement (38) is configured to emit infrared light.

12. The access member system (10) according to claim 10 or 11, wherein the frame (12) comprises a strike plate (18) in the frame side surface (28), and wherein the light emitting arrangement (38) is mechanically connected to the strike plate (18).

13. The access member system (10) according to any of claims 10 to 12, further comprising an access member sensor (66) arranged to detect a closed position and/or an open position of the access member (14), and wherein the light emitting arrangement (38) is arranged to emit light directed towards the solar cell arrangement (36) only when the access member (14) adopts the closed position.

14. The access member system (10) according to any of claims 9 to 13, further comprising at least one hinge (16) rotationally coupling the access member (14) to the frame (12), and wherein the solar cell arrangement (36) is positioned in the access member side surface (26) opposite to the at least one hinge (16).

15. The access member system (10) according to any of claims 9 to 14, wherein the access member (14) is a door leaf, and wherein the frame (12) is a door frame.

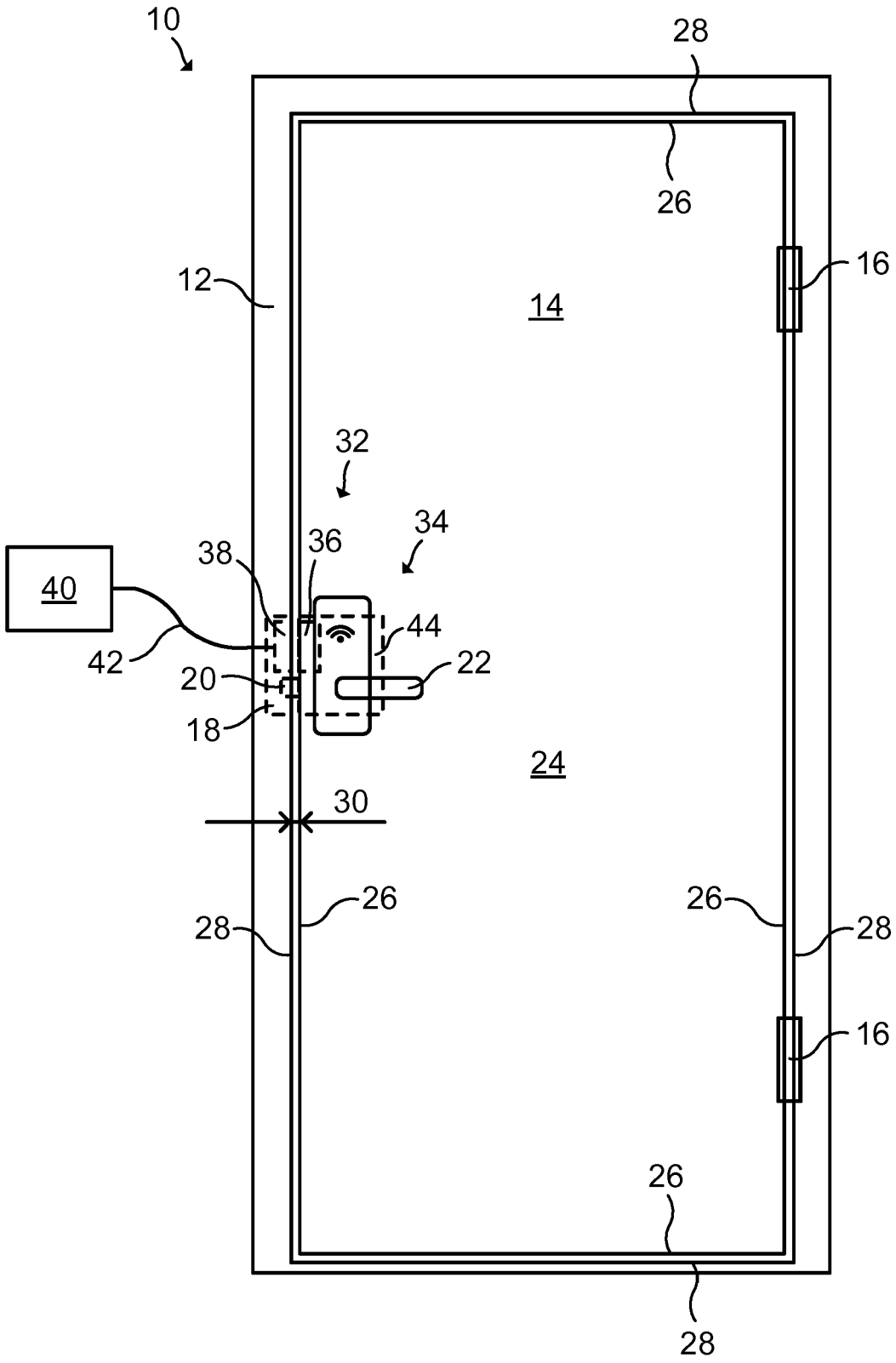
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Fig. 1

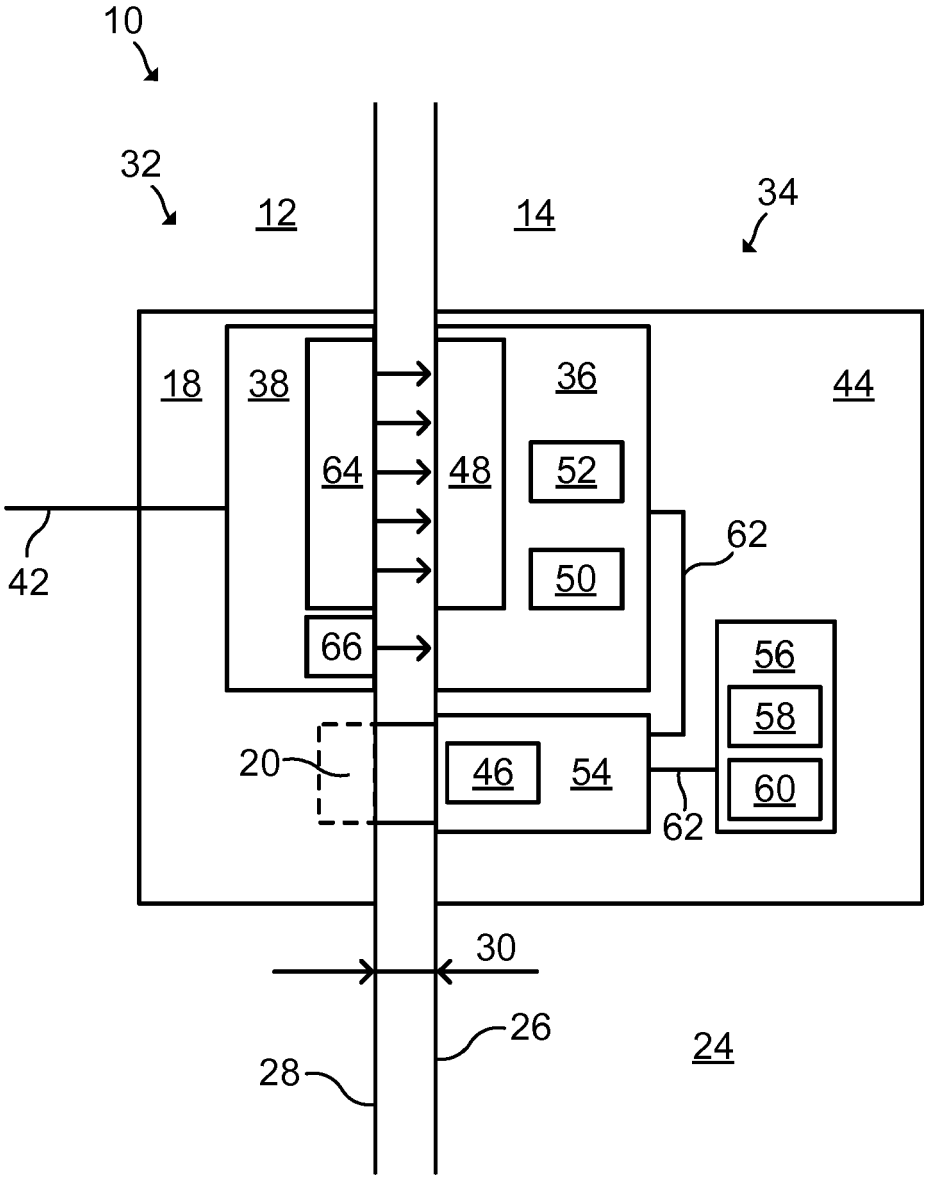
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Fig. 2

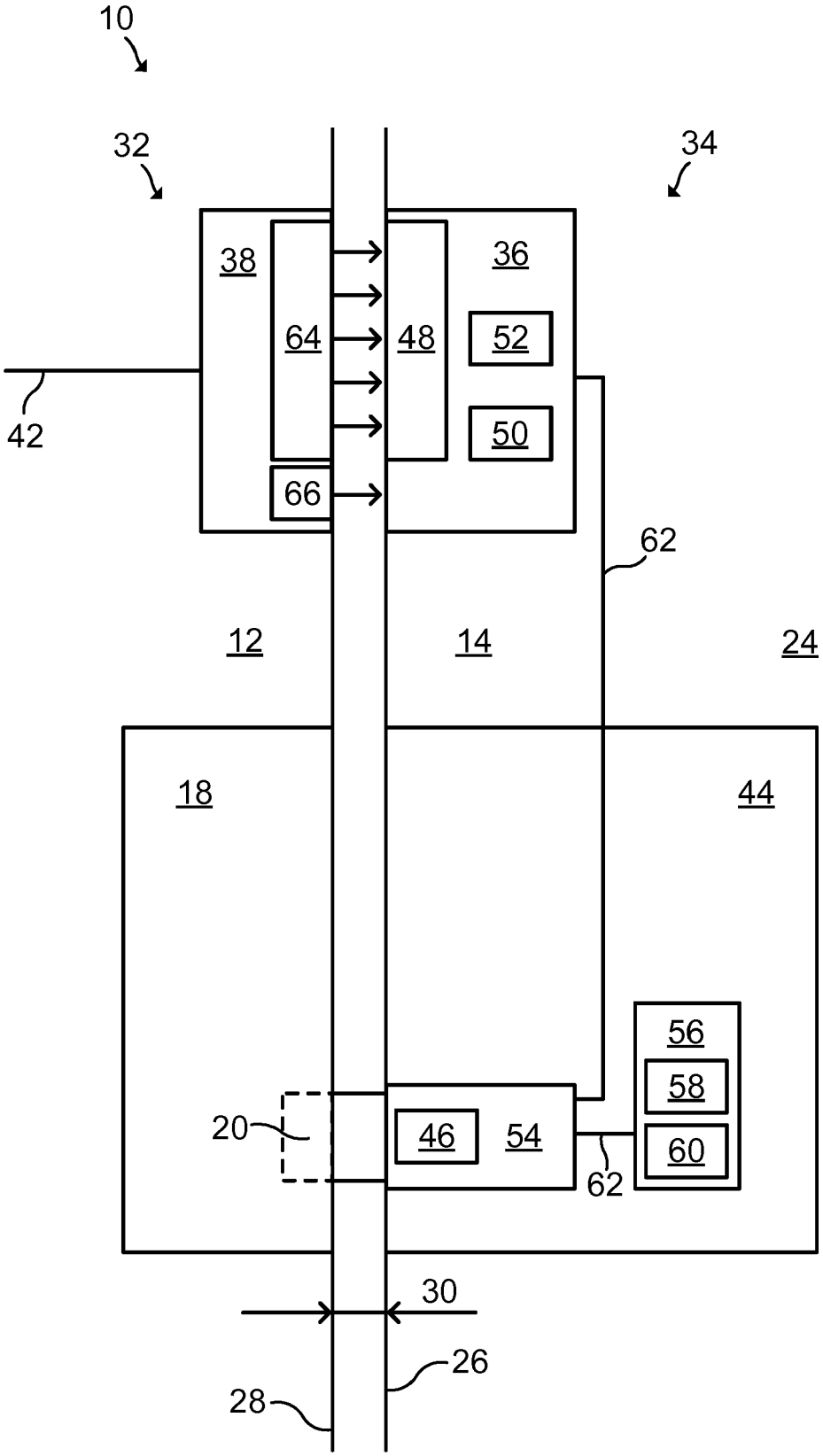
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Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 19 17 1671

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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X	US 2007/146115 A1 (ROOSLI PHILIPP A [US] ET AL) 28 June 2007 (2007-06-28) * paragraphs [0005], [0006] * * paragraph [0015] - paragraph [0036]; figures 1-4 *	1-10, 13-15	
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X	US 2017/191287 A1 (MITTLEMAN ADAM DUCKWORTH [US] ET AL) 6 July 2017 (2017-07-06) * paragraph [0033] - paragraph [0049]; figures 1, 8, 9 *	1-10,12, 14,15	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	16 October 2019	Koster, Michael

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 19 17 1671

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