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(54) **A COVER FOR A CAMERA**

(57) Disclosed is a method of determining a cover position of a camera unit in a security system, the security system comprising one or more control hubs which receive data from and/or transmit commands to the camera unit, the camera unit comprising:
a camera having a lens for receiving light from a field of view, FOV; a cover which is movable from an open position in which the lens is exposed, to a closed position in which the lens is covered, the method comprising: receiving, at the camera unit, a cover position status request from the control hub; and, determining the cover position status in response to receiving the cover position status request.

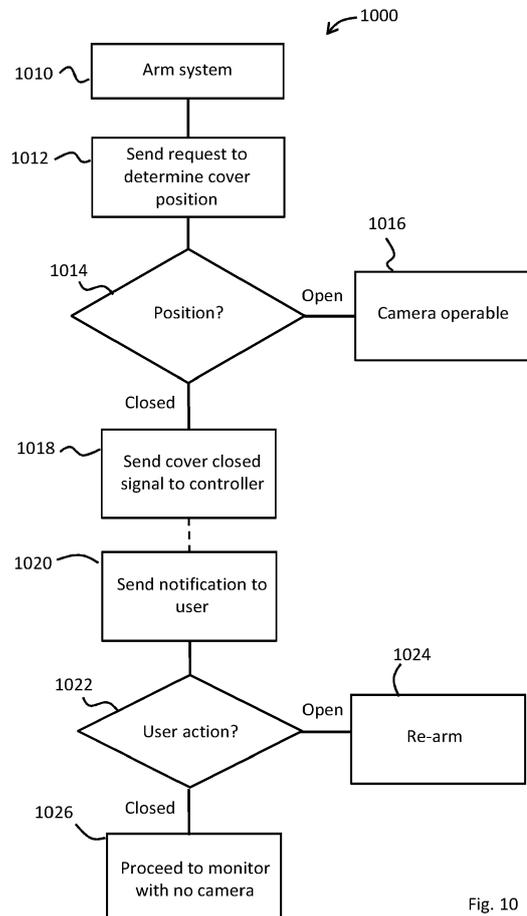


Fig. 10

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Description

Technical Field

[0001] This invention relates to a privacy cover for a camera. The camera may find particular application in the field of security in domestic and commercial premises, but this is not a limitation. The invention may also relate to a method of operating a camera with a privacy cover and determining when the privacy cover is in use.

Background

[0002] The use of privacy covers on cameras are known. Privacy covers provide an option for a user to block the camera lens to prevent the viewing or recording of images. Such privacy covers may be employed during predetermined times or events, such as when a resident is at home or during normal office hours, for example.

[0003] A privacy cover will typically comprise a removable cover or cap which can be placed over the lens of a camera to block the camera lens/aperture. The cap or cover may be attached to the camera housing and moved from an open position to a closed (i.e. covering position) using a hinged or sliding connection, for example.

[0004] An issue can arise with some privacy covers in that they are capable of being placed in an open state but believed to be fully closed by the user. For example, the user may forget the state of the cover, or another person may have changed the state of the cover, unbeknownst to that user. A further issue may arise when a user forgets to remove a privacy cover, for example, when leaving a premises that has the camera.

[0005] Such issues may be especially problematic in the cases where the camera is part of a security system.

[0006] The present invention seeks to address disadvantages or problems associated with known privacy covers or provide useful alternatives.

Summary of the Invention

[0007] The present invention provides a method of determining the cover position of a camera unit according to the appended claims. Disclosed herein are various examples and embodiments of camera units and methods of operating the camera units.

[0008] According to a first aspect of the disclosure a method of determining the cover position of a camera unit comprising: a camera having a lens for receiving light from a field of view, FOV; a cover which is movable from an open position in which the lens is exposed, to a closed position in which the lens is covered. The method may comprise: receiving a cover position status request at the camera unit from a central controller; and, determining the cover position status in response to receiving the cover position status request.

[0009] The camera unit may be in a security system comprising one or more control hubs which receive data

from and/or transmit commands to the camera unit.

[0010] The cover position status request may comprise an arm command. The camera unit may be configured to be placed in an armed state in which the camera is responsive to a motion detection signal from a motion detector in response to the arm command. The motion detector may be an integral motion detector within the camera unit.

[0011] The method may further comprise determining that the cover position status is either open or closed and transmitting the cover position status from the camera unit to the central controller. The transmission may only occur when the cover position status is closed. Transmitting the cover position status when the cover is closed may save power.

[0012] When the cover is determined to be closed a cover status notification may be transmitted to a user. The transmission may be provided by the central controller or a server.

[0013] The method may further comprise: receiving a second cover position status request at the camera unit in response to a re-arming command received by the central controller associated with the camera unit.

[0014] The method may further comprise: obtaining one or more images with the camera in response to a security sensor or upon receiving an image capture command from a central controller. The security sensor may comprise at least one: of a motion detector or an entry sensor.

[0015] The method may further comprise determining the cover position status in response to connecting the camera unit to a power source.

[0016] The connection to a power source may follow an installation of the camera unit, a change of the power source or re-connection of the power source following a disconnection. The disconnection may be due to a power failure or change of power source.

[0017] The determination of the cover position status may be carried out prior to or during the camera being activated for image capture.

[0018] The determination of the cover position status may be executed whilst the camera is being powered-up following a powered-down period. The powered-down period may be a stand-by mode or being off. The powered-down period may relate to either the camera unit or the camera alone.

[0019] The cover position status may be transmitted as part of another transmission.

[0020] Determining the cover position status may comprise obtaining the cover position status from a position sensor. The position sensor may comprise: a light sensor which is covered by the cover when in the closed position and exposed when the cover is in the open position, or, an actuator position sensor configured to provide positional information to an actuator.

[0021] In a second aspect, the method of determining the cover position of a camera unit may comprise: a camera having a lens for receiving light from a field of view,

FOV; a cover which is movable from an open position in which the lens is exposed, to a closed position in which the lens is covered. The method may comprise: transmitting a cover position status request from a central controller to the camera unit; and, in the event of receiving a closed cover position status from the camera unit in response to the request, determining that the camera is ineffective.

[0022] The camera unit may be in a security system comprising one or more control hubs which receive data from and/or transmit commands to the camera unit.

[0023] In the event of not receiving a cover position status from the camera unit in response to the request, determining that the cover is in the open position.

[0024] The cover position status may be transmitted in response to an arm command.

[0025] When the cover position status is closed, the method may further comprise sending a notification to a user or server to inform the user or server of the cover position status.

[0026] The notification may comprise one or more selectable response options for the user to select in response to the cover position status.

[0027] In a third aspect, the present disclosure provides a method of confirming a security system configuration, comprising: receiving, by a user device, a cover position status of a camera cover when the cover is in a closed position; displaying a notification for a user on the user device in response to receiving the cover position status, wherein the notification comprises an indication that the cover position is closed.

[0028] The receiving of the cover position status may be in response to an arm request transmitted from the user device and, optionally, further comprising providing one or more user selectable options for a user to select in response to the notification of the cover position status, wherein, optionally, the user selectable options comprise one or more of: a disarm command for disarming the security system; an accept command for accepting the cover position status; or an open application command for opening an application for interfacing with the security system on the user device.

[0029] In a fourth aspect, the present disclosure may comprise: a camera comprising a lens for receiving light from a field of view, FOV; a cover which is movable from an open position in which the lens is exposed, to a closed position in which the lens is covered, and, at least one processor configured to carry out the method according to of the first to third aspects.

[0030] In a fourth aspect of the present disclosure, a camera unit may comprise an actuator for moving the cover from an open position to a closed position. The actuator may comprise a position sensor for determining the position of the cover.

[0031] In a fifth aspect, the present disclosure provides a security system controller comprising at least one processor and at least one memory, wherein the processor is configured to carry out the method according to the

second aspect or any combination of features associated with the second aspect.

[0032] In a sixth aspect, the present disclosure may provide a user device comprising at least one processor and at least one memory, wherein the processor is configured to carry out the method according to the third aspect or any combination features associated with the third aspect.

[0033] In a seventh aspect, the present disclosure may provide a non-transitory storage medium comprising electronic-processor readable code that, when read by one or more electronic processors, cause performance of the method according to any combination of the first aspect of the disclosure.

[0034] In an eight aspect, the present disclosure may provide a non-transitory storage medium comprising electronic-processor readable code that, when read one or more electronic processors of a user device, configure the user device to carry out the method according to the second aspect or any combination of features relating to the second aspect.

[0035] In a ninth aspect, the present disclosure provides a camera unit comprising: a camera comprising a lens for receiving light from a field of view, FOV; a cover which is movable from an open position in which the lens is exposed, to a closed position in which the lens is covered; and, an actuator for moving the cover between the closed position to the open position.

[0036] The actuator may comprise an electromagnetic actuator.

[0037] The actuator may comprise a position sensor configured to provide an indication of the cover position.

[0038] The position sensor may be configured to provide a position signal for controlling the actuator. The position sensor may be an encoder.

[0039] The actuator may comprise one or more of a linear drive or rotary drive.

[0040] The actuator may comprise at least one electrical solenoid or an electric motor. The electric motor is a DC motor.

[0041] The camera unit may further comprise: at least one memory, wherein the memory is configured to store the cover position status.

The camera unit may be configured to transmit the cover position status to a central controller upon receipt of a request for the cover position status.

[0042] The request for the cover position status may comprise an arm command in response to which the camera unit is placed in an armed state.

[0043] The camera unit may be configured to open the cover in response to a determination that the cover position is closed.

[0044] The may be configured to open the cover in response to receiving a signal from a central controller. The signal may be an arm command.

[0045] Disclosed herein in a tenth aspect is a camera unit comprising: a light source; a light sensor; a camera comprising a lens for receiving light from a field of view,

FOV, and an image sensor for capturing of images of the FOV; a cover which is movable from an open position in which the light source, the light sensor and the lens are exposed, to a closed position in which the light source, the light sensor and the lens are covered.

[0046] Providing a cover which is movable between an open position and a closed position in which the light sensor, light source and lens are covered in the closed position, provides an improved camera unit which can be used in various ways to determine whether the cover is open or closed, thereby improving the utility and reliability of the system.

[0047] The cover may be slidably movable from the open position to the closed position. A sliding cover provides a convenient way of actuating the cover between position. Further, the linear action of the cover can be usefully employed in combination with the positioning of the light source, lens and light sensor to aid the detection process of the cover.

[0048] Either or both of the light source and the light sensor may be located on an opposing side of the lens to the cover when the cover is in the open position, such that either or both of the light source and light sensor are covered by the cover only when the lens is covered. If both the light source and light sensor are covered only once the lens is covered, any effects the cover has on the light received by the light sensor from the light source when in the closed position can be determined to be occurring when the cover is closed so as to obscure the lens. Thus, the determination of the lens being covered or uncovered can be made more readily.

[0049] The light sensor and light source may be located on opposing sides of the lens. By placing the light sensor and light source on opposing sides of the lens, the amount of light received by the light sensor from the light source can be more accurately controlled by the position of the cover. That is, when the light source and light sensor are located adjacent one another, light may be received by the light sensor from the light source when the cover is open by virtue of the proximity, which reduces the accuracy of the positional determination.

[0050] The light sensor may be located proximal to the cover when the cover is in the open position.

[0051] The cover may be movable sequentially from the open position through a first intermediate position in which the light sensor is covered, through a second intermediate position in which the lens is covered, to the closed position in which the light source, the light sensor and the lens are all covered. A sequential closing further defines the relative positions of the lens, light sensor and light source and aids the determination of the cover position by ensuring that the lens is covered prior to both the light source and light sensor both being covered.

[0052] The cover may comprise an inner side which is located opposite the light source and the light sensor when the cover is in the closed position. The inner side may comprise a light reflecting surface for directing light from the light source to the light sensor when the light

source and light sensor are covered by the cover.

[0053] The camera unit may further comprise an inner side which has a channel therein. The channel may oppose the light sensor and light source when the cover is in the closed position. The channel may help receive and guide light from the light source to the light sensor, thereby improving the amount of light which is received. This may in turn aid with the setting of one or more threshold values for determining whether the cover is open or closed. The channel may provide the light reflecting surface.

[0054] The inner side may comprise a light blocking layer on a body of the cover. The light blocking layer may reduce a transmissibility of ambient light to the light sensor from outside of the cover when the light sensor is covered by the cover. Thus, the light blocking layer may reduce the amount of light which is received within the cover from the exterior of the camera unit.

[0055] The camera may further comprise a processor configured to: measure the output from the light sensor when the light source is deactivated. Additionally, or alternatively, the processor may be configured to: measure the output from the light sensor when the light source is activated. Controlling the activation of the light source and corresponding measurements can aid with the determination of the cover position.

[0056] Thus, the processor may be further configured to determine the cover position on the basis of either or both of the measured outputs from when the light is activated and when the light is deactivated.

[0057] The determination of the cover position may comprise a comparison of either or both measured outputs with a predetermined threshold. The thresholds may be set at levels which correspond to expected levels of light which are received when the cover is open or closed, and the light source is activated (on), or deactivated (off).

[0058] The measured output when the light source is activated may be compared with a higher threshold than the measured output when the light source is deactivated. The setting of the second threshold at a higher level corresponds to the higher light level which would be expected to be received by the light sensor when the cover is closed, due to light being reflected of the inner side of the cover.

[0059] The processor may be configured to activate and deactivate the light source. The processor may be further configured to determine whether an ambient light level is below a predetermined level. By determining the level of the ambient light with respect to a predetermined threshold or level, it is possible to determine whether the cover is open, particularly when the ambient light level is above the predetermined level. The ambient light may be taken to be the light level in the field of view. The ambient light may correspond to the level of light when the light source is off.

[0060] The image sensor and the light sensor may be independent of one another so as to comprise different/discrete components having separate light transduc-

ers. As such, the image sensor may be deactivated during the measuring of the outputs from the light sensor for said determining of the cover position, thereby making the camera unit more energy efficient.

[0061] Also described herein in a eleventh aspect is a camera unit comprising: a camera lens for receiving light from a field of view; a cover which is movable from an open position in which the camera lens can capture the full field of view, FOV, and a closed position in which the cover obscures the FOV; a light source; a light sensor; a processor configured to: measure the amount of light received by the light sensor when the light source is deactivated; and, compare the measured light with a predetermined value to determine whether the cover is in an open or closed position. Measuring the amount of light when the light source is deactivated allows a determination of the ambient light which can indicate whether the cover is open under certain circumstances, for example, when the cover is open in daylight hours or when the FOV of otherwise illuminated.

[0062] The predetermined value may be selected on the basis of an attributed maximum detectable ambient light level when the cover is in a closed position. By attributed maximum detectable ambient light, it is meant the amount of light which can be attributed to the ambient light conditions which can be received by the sensor when the cover is closed and the light source is off. Setting the predetermined value on the basis of the attributed maximum detectable ambient light when the camera is closed provides a sensible lower limit which is indicative of whether the cover is open.

[0063] When the measured light is below the predetermined value the processor may be further configured to: activate the light source; measure a second amount of light received by the light sensor; and, compare the measurement of the second amount of light with a second predetermined value to determine whether the cover is in the open or closed position.

[0064] When the light received by the sensor is less than the predetermined level, it may be indicative that the FOV external to the camera unit is too low, that is, too dark, or the cover is closed. By activating the light source and taking a second measurement, it is possible to determine whether the light sensor is receiving light from the light source, for example as reflected off the inner side of the cover so as to determine that the cover is closed.

[0065] The camera unit may be further configured to instruct transmission of an open signal to a controller based on a determination that the cover is open. The camera unit is further configured to instruct the transmission of a closed signal to a controller based on a determination that the cover is closed. The camera unit may be configured to pass the determination of the cover positional status to a control system such that the status may be used for determining an associated action. The action may, for example, be providing a notification to a user indicating the status of the cover, or an action, such

as configuring the camera unit for image capture.

[0066] The light sensor may be an image sensor or part thereof, wherein the image sensor is configured for capturing images of the FOV. The disclosure does not necessarily require a separate light sensor, or may, in some examples, use the image sensor as a secondary light sensor, for example to verify the operation of the independent light sensor or position of the cover. Equally, the camera unit may further comprise an image sensor configured for capturing images from the FOV, wherein the light sensor is distinct from the image sensor. The image sensor may be deactivated when the light source is activated and the measurement of light is taken. Providing a distinct light sensor allows the camera unit to be more power efficient.

[0067] Where two predetermined values are used for determining the position of the cover, the first predetermined value may be less than the second predetermined value. The first predetermined value may correspond to the measurement taken when the light source is deactivated (off).

[0068] Also disclosed herein, in a twelfth aspect, is a camera unit comprising: a camera lens for receiving light from a field of view; a cover which is movable from an open position in which the camera lens can capture the full field of view, FOV, and a closed position in which the cover obscures the FOV; a light source; a light sensor; a processor configured to: measure the amount of light received by the light sensor when the light source is activated; and, compare the measured light with a predetermined value to determine whether the cover is in an open or closed position.

[0069] As noted above, providing a measurement when the light source is activated may be useful when the cover is closed as the light received by the light sensor as reflected (or not reflected) off the inner side of the light source can be determinative of the cover position. Hence, the predetermined value may be selected on the basis of an expected level of light redirected from the light source to the light sensor by an inner side of the cover.

[0070] The comparison of the measured light with a predetermined value may result in a determination that the cover is closed if the measured light is above the predetermined value. The comparison of the measured light with a predetermined value may result in a determination that the cover is open if the measured light is below the predetermined value.

[0071] The processor may be configured to instruct a transmission of an open signal to a controller based on a determination that the cover is open. Alternatively or additionally, the processor may be configured to instruct transmission of a closed signal to a controller based on a determination that the cover is closed.

[0072] The light sensor may be an image sensor or part thereof, the image sensor may be configured for capturing images said FOV.

[0073] The camera unit may further comprise an image sensor for sensing images from the FOV, said light sen-

sor being distinct from said image sensor.

[0074] The camera units disclosed herein may comprise a motion sensor. The camera unit may be configured to capture one or more images of the FOV in response to a detected motion based on the motion sensor. The camera unit may be battery powered. The camera unit may be configured to store the one or more images and upon receiving a request for said images wirelessly transmit said images to a controller.

[0075] A further aspect disclosed herein is a cover for a camera unit. The camera unit may comprise a light source, a light sensor and a camera lens. The cover may have sides shaped for sliding along rails on the camera unit to move between an open position in which the camera lens, light sensor and light source are uncovered and a closed position in which the camera lens, light sensor and light source are covered. The cover may comprise a side for facing the camera unit, wherein the side for facing the camera unit has a reflective surface for directing light from the light source to the light sensor. As noted above, the reflective surface may comprise a recessed region of the inner side of the cover. The reflective surface may be metallic. The reflective surface may be on a plastic body. The reflective surface is provided in an open channel in said side.

[0076] Also disclosed herein are methods pertaining to the use of the disclosed camera units and the detection of the cover position. Thus, in a thirteenth aspect there may be a method of determining the cover position of a camera unit, the method comprising: measuring the light detected by a light sensor when the light source is deactivated; compare the measured light level with a predetermined value to determine whether the cover is in the open position or closed position.

[0077] The method may further comprise: selecting the predetermined value on the basis of a minimum expected ambient light level for the FOV when the cover is in the open position. Setting the value on the basis of a minimum expected ambient light level for the field of view may be useful for particular times of day, particularly if the camera unit is located outside.

[0078] The method may further comprise: selecting the predetermined value on the basis of a maximum expected noise level in the light level measurement. Setting the predetermined level on the basis of a maximum amount of noise may allow the system to account for a minimum level of ambient light which is detectable over a noise floor of the system. This provides the effective detectable minimum ambient light level.

[0079] The predetermined value may be selected on the basis of an attributed maximum detectable ambient light level when the cover is in a closed position. Setting the predetermined value on the basis of the attributed maximum detectable ambient light when the camera is closed provides a sensible lower limit which is indicative of whether the cover is open or potentially closed. By attributed maximum detectable ambient light, it is meant the amount of light which can be attributed to the ambient

light conditions which can be received by the sensor when the cover is closed and the light source is off.

[0080] The method may further comprise, when the measured light is below the predetermined value, activating the light source; measuring the second amount of light received by the light sensor; and, comparing the measurement of the second amount of light with a second predetermined value to determine whether the cover is open or closed.

[0081] Upon a determination that the cover is open, the camera unit may transmit an open signal to a controller. Additionally, or alternatively, upon a determination that the cover is closed, the camera unit may be configured to transmit a closed signal to the controller.

[0082] The method may further comprise, using an image sensor of the camera unit as the light sensor. The image sensor may be configured for capturing images of the FOV.

The method may further comprise when the light source is activated and the measurement of light is taken, the image sensor is in a deactivated state.

[0083] The first predetermined value may be less than the second predetermined value.

A fifth aspect may disclose a method comprising: measuring the amount of light received by the light sensor when the light source is activated; and, comparing the measured light with a predetermined value to determine whether the cover is in an open position or closed position.

[0084] The predetermined value may be selected on the basis of an expected light level redirected from the light source to the light sensor by a reflective surface of the cover. The comparison of the measured light with the predetermined value may result in a determination that the cover is open if the measured light is above the predetermined value.

[0085] Upon a determination that the cover is open, the camera unit may transmit an open signal to a controller. Additionally or alternatively, upon a determination that the cover is closed, transmitting a closed signal to a controller.

[0086] The method may further comprise using the image sensor of the camera unit as the light sensor.

[0087] The above disclosed camera units and features thereof may be used in any combination, where possible.

Thus, a camera unit according to the tenth aspect, and any combination of its optional features, may be combined with the camera unit according to the eleventh aspect, and any combination of its optional features. The camera unit of the eleventh aspect, and any combination of its optional features, may be combined with the camera unit of the twelfth aspect and any combination of its optional features. Similarly, the camera unit of the tenth aspect and any combination of its optional features may be used with the camera unit of the twelfth aspect and any combination of its optional features. Finally, the camera units of the tenth, eleventh and twelfth aspects may be used in combination with any combination of the re-

spective optional features. Similar combinations are also possible within the combination of first to third aspects of the disclosed methods.

[0088] Also described herein is a camera unit or controller comprising: at least one processor; at least one memory comprising computer readable instructions; the at least one processor being configured to read the computer readable instructions to cause performance of one or more of the methods described herein.

[0089] Also disclosed herein is a computer program that, when read by a computer or camera unit, causes performance of the method as described herein.

[0090] Also disclosed is non-transitory computer readable storage medium comprising computer readable instructions that, when read by a computer or camera unit, cause performance of the method as claimed in any of claims.

[0091] The skilled person will appreciate that except where mutually exclusive, a feature described in relation to any one of the aspects, examples or embodiments described herein may be applied to any other aspect, example, embodiment or feature. Further, the description of any aspect, example or feature may form part of or the entirety of an embodiment of the invention as defined by the claims. Any of the examples described herein may be an example which embodies the invention defined by the claims and thus an embodiment of the invention.

Brief Description of the Drawings

[0092] The invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figures 1a and 1b show schematic representations of a camera unit with a cover in open and closed positions respectively;

Figures 2a and 2b show schematic representations of an alternative camera unit which include a light sensor that is independent of an image sensor;

Figures 3a and 3b respectively show schematic representations of the inner side and a section of a cover for a camera unit;

Figures 4a and 4b respectively show schematic representations of the inner side and a section of an alternative cover for a camera unit;

Figure 5 shows a method of detecting the status of a cover;

Figure 6 shows a further method of detecting the status of a cover;

Figure 7 shows a yet further method of detecting the status of a cover;

Figure 8 shows a schematic representation of a camera unit and a central controller showing a processor and memory parts thereof;

Figure 9 shows a flow diagram for a method of operating an arm aware camera unit;

Figure 10 shows a flow diagram for a method of op-

erating an arm unaware camera unit;

Figures 11a,b and 12a,b show two example actuation mechanisms for a cover.

5 Detailed description of the embodiments

[0093] The present invention may provide a camera lens cover, a camera comprising a camera lens cover and method of detecting the position of the cover. The present invention may also provide a method of determining (that is, identifying) when a camera is operable.

[0094] Some aspects of the present disclosure are concerned with improving the energy efficiency of a camera comprising a cover. The camera in question may be resource constrained. For example, instead of having a connection to a mains supply, the camera may be powered by a local power source such as a battery or solar panel.

[0095] Figures 1a and 1b show a schematic representation of a camera unit 10. The camera unit 10 may comprise a camera shown generally by reference numeral 12 and a cover 14. The cover 14 is movable from an open or stowed configuration in which the camera lens is exposed (Figure 1a), to a closed position 14' in which the camera lens is covered so as to prevent viewing or recording (Figure 1b). The prime reference numeral 14' is used to denote the cover in the closed configuration. This is also the case for the other components which are effected by the closure of the covers, such as the camera lens 16, 16' and the light sensor 24, 24', as described below. This described prime notation is used throughout the drawings.

[0096] The camera 12 may be conventional in many respects and include a lens 16 which is arranged to receive light from a field of view, FOV, and one or more image sensors (behind the lens and therefore not shown) which receive light from the FOV to generate an electrical signal which is representative of the image provided in the FOV. This image data may be processed locally, or transmitted via a suitable transmission medium for handling by a remote signal processor. The transmission, particularly in embodiments not powered by a mains supply, may be wireless, and may, in some embodiments use a short range network, for example as ZigBee (or other IEEE802.12.4 based network) or WiFi, to a wide area network (WAN) connected hub, as opposed to a cellular network.

[0097] The camera unit 10 may comprise a housing 18 to provide containment and support for the camera 12 and any associated electronics. The camera unit 10 may be hardwired or operate wirelessly with respect to power supply and data transmission. Hence, the camera may comprise one or more local power sources such as a battery (not shown) or solar generator, for example. Further the camera unit 10 may comprise one or more antennas for transmitting image data to, and receiving commands from, a remote device. The camera and/or remote device may comprise one or more processing devices,

memory, controllers, signal processing equipment. The remote device may comprise a control hub of a system that provides at least premises security monitoring functions. The hub may be a WAN connected hub as described above. In another example, the remote device may be a server.

[0098] The cover 14 may be generally referred to as a privacy cover and enable a user to obscure the camera lens and FOV to prevent unwanted viewing or recording of a location. The cover 14 comprise a cap, door, panel, shutter or other object which can be positioned on the device so as to obstruct the camera lens.

[0099] The cover 14 may be configured to be removably locatable in front of the camera lens. In the example shown in Figure 1a, the camera lens 16 is located above the cover 14 such that the cover 14 may be moved upwards from a stowed position below the camera 12 to a closed position 14' in which the camera lens 16' is covered (Figure 1b).

[0100] The cover 14 may be attached to the camera unit 10 via any suitable arrangement such as one or more hinges or a sliding arrangement, for example. In a linear sliding arrangement the cover 14 and/or camera unit housing 18 comprises one or more runners 20 along which the cover 14 can slide relative to the camera lens 16. The runners 20 may, for example, be provided by the lateral edges 15 of the cover 14 which, are vertically extending as shown in Figure 1, and corresponding rails in the form of grooves provided in the camera unit housing 18, into which the lateral edges 15 have a sliding fit. In other examples, the cover 14 may be located above or to the side of the camera lens 16 and may pivot into place by way of one or more hinges. Other arrangements for providing a displaceable cover 14 may be possible.

[0101] During use, the cover 14 may be moved from the open position to the closed position 14' by a user and vice-versa, as desired.

[0102] The camera unit 10 may be installed at a premises, typically for security purposes. The camera unit 10 may be mounted on a wall or other vertical or horizontal surface which is capable of providing the necessary support to locate the camera unit in a desired viewing location. The location may be internal or external. The premises may be any premises but will typically be a domestic premises such as a dwelling or an associated outbuilding building of a dwelling such as a garage or shed, or a commercial building such as a restaurant, shop or other facility. Thus, for a dwelling, the privacy cover 14 may be employed when a resident is home and does not feel comfortable with the camera being operable. For a commercial property, such as a restaurant, the camera may be covered during opening hours and exposed only for out of hours security.

[0103] An image capturing function of the camera 12 may be triggered automatically using one or more local sensors, such as a motion sensor (in some embodiments, a passive infrared, PIR, detector) or other activity sensor (a microphone or other acoustic wave sensor, for

example), and/or may be responsive to an external signal provided from a remote controller.

[0104] As such, in some embodiments, such as in those presently exemplified, the camera unit 10 may further comprise a passive infrared, PIR sensor 22 which may be used to determine the presence of a person (or other infrared source, such as an animal) in at least part of the FOV of the camera lens 16. The PIR sensor 22 may be used to trigger the operation of the camera 12 and the beginning of capturing and recording one or more images. The camera unit 10 may also (or in other embodiments, instead) initiate image capturing based indication of a detected motion received wirelessly from another device that may be located remotely from the camera unit 10, or on command.

[0105] As noted above, a possible issue with a privacy cover 14 may arise in a situation when a user forgets to open the cover 14 making the camera unit effectively inoperable.

[0106] A possible solution for reducing the likelihood of this is for the camera unit 10 to identify the position of the cover 14 upon being prompted to do so. The camera unit 10 may, in some embodiments, determine light at one or more levels within an image recorded by the camera 12 to determine whether the camera lens 16 is uncovered. Thus, in one example, the camera 12 may be configured to undertake image recordings on a periodic basis such that the light levels can be determined. In this way, the camera image sensor can be used to establish whether the cover 14 is open or closed.

[0107] However, this method requires the camera 12 to be powered, recording and some image processing or transmission of image data to allow the images to be analysed and determine whether the camera 12 is viewing the correct FOV. This clearly requires an amount of power and reduces the energy efficiency of the system. Further, it is possible that a room may be photographed or filmed during night hours or when the room is otherwise dark. Under such conditions, it would be difficult to determine whether the cover is in place or whether the dark image is merely a result of dark environmental conditions.

[0108] To help ameliorate these issues, it may be desirable to use a light source in tandem with the camera 12. The light source may be selectively operable and used to illuminate the FOV of the camera 12 such that the captured image data can be assessed and a determination made as to whether the cover 14 is open or closed on the basis of a threshold value which is set on the basis of an expected level or intensity of light, rather than determining whether a FOV is being viewed.

[0109] The inside of the lens cover 14 may be reflective such that, if the cover 14 is open but the ambient conditions are dark, the camera 12 will detect no reflected light from the cover when the light is on. If the cover 14' is closed, there will be light from the light source that is reflected by the cover to the image sensor of the camera, so the camera will detect light as being above a certain level. The determination of the cover 14 position using

this method may comprise determining a level of illumination in a captured image, for example. The method may further comprise capturing an image with the light source on, and the light source off, and comparing the 'light on' image with the 'light off' image to determine whether the comparison, that is, the contrasting light levels, are above or below a threshold value which is indicative of the cover 14 position.

[0110] As shown in the example of Figures 1a and 1b, the camera unit 10 comprises the light source 24. The light source 24' is at a location where it is behind the cover 14' when the cover 14' is in the closed position and the camera lens 16' is fully obscured. More specifically, the light source 24 may be located on an opposing side of the camera lens 16 with respect to the stowed position of the cover 14. Hence, the cover 14 may be movable from an open position to an intermediate position to a closed position 14'. In the open position, the camera lens 16 and light source 24 may be exposed. In the intermediate position the camera lens 16' may be obscured and the light source 24 may be exposed. In the closed position 14', the camera lens 16' and light source 24' may both be covered. For the sliding cover 14 shown in Figure 1, this results in the light source 24 being proximal to the terminal end of the throw of the cover 14 (relative to the camera lens 16), and the camera lens 16 being proximal to the cover 14 when the cover 14 is in the open position.

[0111] With this arrangement, when the cover 14' is closed, the light from the light source 24' may be reflect off the inner side (i.e. the camera lens 16' and light source 24 facing surface) of the cover 14 and provide a distinct light signal to an image sensor behind the lens 16 that senses the light. When ambient light is low and the cover 14 is open, the camera 12 will receive a light signal that is lower than that which would be received when the cover 14 is fully closed. When there is appreciable ambient light and the cover 14 is open the measured light level may be relatively high. The measured light level may also be relatively high if the cover 14 is closed and the light source 24 is on. It can be determined which of the two possible scenarios exists by analyzing the images (by a person or automatically by imaging processing) to determine whether the content of the image depicts a scene.

[0112] The above described example in which the light source 24' is provided behind the cover 14' in the closed position addresses several problems in determining if the cover 14 is open and/or closed. However, the methods which use the camera image sensor as a light sensor require power for the camera 12 and any transmission of image data and/or signal processing. Hence, for remotely powered cameras this is less than ideal. Further, as noted immediately above, there is potential for situations where the camera cannot differentiate between ambient light and that issued from the light source 24 and requires either human intervention or image analysis.

[0113] Figures 2a and 2b show a schematic representation of a camera unit 110 which is similar in many respects to that described in connection with Figures 1a

and 1b and shares corresponding reference numerals incremented by 100. As with Figures 1a and 1b, the primed references denote the items of the camera unit when the cover is in a closed position. Thus, there may be provided a camera unit 110 comprising a camera 112 having a camera lens 116, a cover 114 and a light source 124. The cover 114 may be movable from an open position in which the camera lens 116 is exposed and operable to capture images from the scene surrounding the camera unit 110, to a closed position 114' in which the camera lens 116' is obscured.

[0114] The camera unit 110 shown in Figures 2a and 2b includes a light sensor 126. The light sensor is separate from the camera 12 and may be any suitable light sensor known in the art, but is preferably a solid state light sensor. The light sensor is independent of the image sensor of the camera 12, both physically and operatively. In some examples, the image sensor and/or camera more generally, may be deactivated whilst a light level is measured using the light sensor 126 to determine the position of the cover 114. The light sensor 126 may be configured to provide an output on the level of light only. The light sensor 126 may be used to determine the level of light and associated position of the cover 114.

[0115] Optionally, the light sensor 126 may also be used to determine ambient light levels before an image is captured, for adjusting a camera setting(s), e.g. aperture size, so that the settings used to capture the first image are at or approximate an appropriate setting(s).

[0116] Likewise the light source 124 may double as a flash for illuminating the field of view in dark conditions. Further the need for the flash can be determined based on ambient light conditions measured by the light sensor 126.

[0117] The light sensor 126 may be located anywhere on the camera unit 110 but in the described embodiment is located behind the cover 114' when the cover 114' is closed such that it can detect light which is reflected back off the interior of the cover 114' when there is light emitted from the light source 124', which is also located behind the cover 114' when closed. In some examples, the light sensor 126 and light source 124 may be located adjacent to one another. Thus, the light source 124 and light sensor 126 may be side-by-side above the camera 112 (or elsewhere). In other examples, the light source 124 may be located away from the light sensor 126. The light source 124 and light sensor 126 may be separated by the camera 112. Such a separation of the light source 124 and light sensor 126 may advantageously reduce an amount of stray light that from the light source 124 that may be detected by the light sensor 126 when the cover 114 is open. The cover 114 and light sensor 126 may be provided in close fitting relation to one another, such that when the cover 114 is placed over the light sensor 126, the light entering the light sensor 126 from outside of the cover 114 and camera unit 110 is significantly reduced. Hence, the cover blocks (for example, stops all or substantially all) light from entering the sensor 126.

[0118] In the example shown in Figures 2a and 2b, the light sensor 126 and light source 124 are separated by the camera lens 116. The light sensor 126 may be located proximal to the cover 114 when the cover 114 is in the open position. The light source 124' may be located proximal to the terminal end of the cover 114' throw when the cover 114' is in the closed position. The cover 114 may move sequentially from an open position to a first intermediate position to a second intermediate position to a closed position. In the open position the light sensor 126, camera lens 116 and light source 124 may all be exposed. In the first intermediate position, the light sensor 126' may be covered and the camera lens 116 and light source 124 are exposed. In the second intermediate position, the light sensor 126' and camera lens 116' may be covered, and the light source 124 may be exposed. In the closed position, the light sensor 126', camera lens 116' and light source 124' may be covered.

[0119] It will be appreciated that the open position, first intermediate position, second intermediate position and closed position do not necessarily represent discrete positions. Rather they are intended to show stages along the throw (i.e. the path of travel from open to closed) of the cover 114. It will also be appreciated that the positions of the light sensor 126 and light source 124 may be switched so as to provide the light sensor 126 above the camera lens 116, and the light source 124 below.

[0120] The camera 112 of the camera unit 110 comprises an image sensor (not shown) that receives light from the lens 116 to capture images of the FOV. The camera 112 may comprise processing circuitry (which may comprise one or more processing chip(s)) that controls the capturing of images from, and compression of data by, the image sensor. To save power, the image sensor or the processing circuitry (and in some embodiments both) of the camera 112 are default to a low power or off state and are temporarily woken to an active state to capture a one or more images (of a predefined number or for a predefined duration of time) in response to a detected motion.

[0121] Providing a separate light sensor 126 allows the power consumption of the camera unit 110 to be much reduced as a dedicated light sensor 126 will typically require less power than the imaging sensor of the camera 112 to detect a light level.

[0122] In use, the light sensor 126 signal may be used to determine whether the cover 114 is open and/or closed. When the cover 114 is determined to be open, the camera 112 may be operated to capture images in response to the detected motion.

[0123] In some embodiments the camera unit 110 may be configured so the function of having a detected motion trigger the capturing of an image(s) may be disabled. For example the processor of the camera unit 110 may disable the function in response determining that the cover 114 is closed. The operation of the camera unit is described in more detail below.

[0124] Figures 3a and 3b show schematic representa-

tions of a cover 214 removed from a camera unit showing an inside side 228 of the cover 214 as viewed from the inside (Figure 3a) and in section (Figure 3b). The cover may comprise a plate member having an inner side 228 and an outer side 234. The plate member may be planar or shaped to correspond to the opposing surface of the camera unit housing 18, as required. The runners 20 may be provided by the lateral edges of the cover 214, as described above. The inner side 228 may face the light sensor 126, camera lens 116 and light source 124 when mounted to the housing 18 and in the closed position. The outer side of cover 214 may face externally and be viewable from the outside of the camera unit 10.

[0125] The inner side 228 may comprise one or more light reflective surfaces. The light reflective surface(s) are configured to redirect light from the light source 124 to the light sensor 126 (or to the camera lens 116 in the instances where the image sensor of the camera 112 is the light sensor).

[0126] The light reflecting surface(s) may take any suitable form and may be provided by one or more of: a specular reflective layer on the inner side of the cover; a diffusive reflective layer on the inner side of the cover; and internal surfaces of an optical waveguide included on the inner side of the cover. Layers may comprise coatings applied on the cover or may be integrally formed within the thickness of the cover material. The layers may be provided sequentially. Thus, the inside of the cover 114 may be provided with a reflective layer which is disposed to reflect light from the light source 124 to the light sensor 126, which may be on a light blocking coating to prevent ambient external light reaching the light sensor 126 when the cover 214 is closed so as to cover the light sensor 126.

[0127] As shown in Figures 3a and 3b, the inner side of the cover 214 comprises a channel 232 having a reflective surface. The channel 232 may comprise an indentation in the inner side 228 so as to provide a greater separation between the reflective surface of the inner side 228 and the opposing surface of the housing 18. The channel 228 is provided for the purpose of increasing light transmission between the light sensor 126 and light source 124 to increase the light signal which is received by the sensor 126 when the cover 114 is shut. Hence, the channel 232 may be located opposite the light source 124' and the light sensor 126' when the cover 114' is in the closed position. Light from the light source 124 may reflect one or more times on the inner side 228 of the cover 214 before reaching the light sensor 126. In the case of multiple reflections, the opposing surface of the housing 18, between the light source 124 and the light sensor 126, may reflect light back to inner side 228 of the cover 214 until the final reflection from the inner side 228 of the cover 214 reaches the light sensor 126. Thus, the opposing surface may be involved in the redirection of light from the light source 124 to the light sensor 126 (or camera lens 116 in the instances where the image sensor of the camera 112 is the light sensor). As such

the inside 228 of the cover in combination with the opposing surface of the housing 18 may collectively form a kind of light guide.

[0128] The channel 232 may be an elongate depression in the inner side 228 and have a length at least as great as the separation between the light source 124 and light sensor 126. The depth and width of the channel 232 may be adjusted to suit a desired arrangement and provide a required level of light conductance between the light source 124 and light sensor 126.

[0129] It will be appreciated that the inner side 228 of the cover 214 may comprise reflective layers without the channel in some embodiments. Further, a channel may be provided in the outwardly facing of the housing to provide an increased separation between the light sensor 126 and light source 124 as well as or in place of the channel in the cover 114.

[0130] As noted above, the inner side 228 may include one or more layers/coatings to enhance, or inhibit, the conductance of light from the light source 124 to the light sensor 126. The layers/coatings may include or be restricted to the inside of the channel 232. Thus, as per Figure 3b, a cross sectional view of the cover 114 shows an open channel having a depth into the thickness of the cover 114. At the bottom surface of the channel 232 (which provides the reflective surface of the channel 232) there may be one or more coatings. The first coating 234 comprises an opaque or light blocking coating, for example one or more layers of a black ink, which prevents transmission of light from the exterior of the cover 114 into the channel 232 and light sensor 126 when the cover 114 is closed. This may be desirable where the reduction in thickness of the cover 114 due to the presence of the channel 232 may result in parasitic light transmissions through the cover when using the light source 124 or in light ambient conditions. Such parasitic transmissions may occur in embodiments in which the cover has a plastic body, for example. Hence, with such a coating the light being received by the light sensor 126 can be minimised to aid the detection process and setting of and adherence to any thresholds.

[0131] The channel may comprise a layer/second coating 236 on the inner side 228, on top of the first layer/coating. The second coating 236 may be restricted to the channel 232. The second coating 236 may aid the conductance of light from the light source 124 to the light sensor 126. The second coating 236 may comprise coating that provides diffusive reflection, for example one or more layers of a white ink, which diffusively reflects the light to provide a more diffuse light field to the light sensor 126.

[0132] In other embodiments, a single layer may provide both blocking of ambient light transmission and reflection of light from the light source 124. In one example, the layer may comprise a reflective metal or alloy. In some embodiments the layer provides specular reflection. The layer and/or coating may for example be a metallic sticker. The metallic sticker may comprise aluminium, for ex-

ample.

[0133] In addition to the above layers/coatings, a protective coating may be provided in some embodiments. The protective coating may include one or more layers to prevent oxidisation of the reflective surface, for example.

[0134] Figures 4a and 4b show an alternative cover 314 which is provided with an optical waveguide 338. The optical waveguide 338 is configured to receive light from the light source 124 and transmit it to the light sensor 126. The optical waveguide 338 may be embedded into the inner side 328 of the cover 314, for example by being mounted to a body of the cover 314. The optical waveguide 338 may include an inlet 340 (which may be referred to an inlet window) which is located opposite the light source 124 when in the closed configuration. The optical waveguide 338 may include an outlet 342 (which may be referred to as an outlet window) which is located opposite the light sensor 126 when the cover 314 is in the closed configuration. A bridge portion may extend between the inlet window 340 and outlet window 342 to provide an enclosed optical pathway for light to travel between the inlet and outlet.

[0135] The separation of the inlet 340 and the outlet 342 may be the same as the separation between the light source 124 and light sensor 126 so as to provide good alignment when the cover 314 is in the closed position.

[0136] The optical waveguide 338 can be comprised of any suitable material and include any suitable coating. In some examples, the optical waveguide 338 may be a clear plastic material having suitable transmissivity. The optical waveguide 338 may comprise one or more coatings to aid internal reflections. It will be appreciated that reflectivity provided by the surface(s) of the waveguide may be dependent on the angle of incidence of the light from the light source, and as such the reflective surface of the waveguide need not be reflective for all angles of incidence.

[0137] It will be appreciated that the inlet 340 and outlet 342 are shown nominally and the role of each will be dictated by the interaction with the light source 124 and light sensor 126 and the relative locations thereof.

[0138] An advantage of providing a light reflective surface in the cover 114, such as on a reflective channel and/or in an optical waveguide, is that the light sensor 126 is efficiently directed light from the light source 124, so less power is required to the light sensor 124 to deliver the prerequisite amount of light to indicate that the cover is closed.

[0139] An example method of operating the camera units as described above is now provided. The method is described with the embodiment of Figures 2a and 2b in mind, in which the camera unit 110 includes a light sensor 126 and light source 124 which are obscured by the cover 114' when the cover 114' is in a closed position. In some embodiments, a light sensor 126 which is separate from the camera 112 is not employed, and instead the image sensor of the camera 112 acts as the light

sensor. For such cases, the method described below may adapted accordingly to the embodiment of Figures 1a and 1b,

[0140] The camera unit 110 may comprise a processor to carry out the instructions in relation to the measurement, determinations and the activating or deactivating of the light source 124 and light sensor 126. The processor may be housed within the camera housing, or may be remote, or may be distributed to be in part in the housing and in part remote.

[0141] The light sensor 126 may be configured to measure the light level received by the light sensor 126, whilst the light source 124 is off or on. Figure 5, shows a method 500 in which the light sensor 126 is used to measure 510 the amount (e.g. intensity) of light whilst the light source 124 is off. The measurement with the light source off may be used to provide an indication as to whether the cover is open by relying on the detection of ambient light. In particular, if light is detected by the light sensor 126 when the light source is off 124, it is indicative that the cover is fully open 514 and the camera lens 116 is operative (uncovered), since detected light must be ambient light. In this instance, the camera 112 can be configured to capture one or more images as required and/or to provide a confirmatory notification as to the open status of the cover to a controller.

[0142] Hence, at step 512, a determination is made as to whether the light received by the light sensor 126 is sufficient to represent a level of ambient light.

[0143] If no ambient light is detected 516 with the light source 124 off, then there are two possible outcomes. The first is that the cover is at least partially closed and no ambient light can be detected by the light sensor 126 due to it being blocked. The second is that the ambient light levels are too low to be detected. For applications in which the ambient light is controlled or known to exist (e.g. the camera is used outside and it is known to be daytime), then if the measured light is below a threshold it may be concluded by the processor that the cover 114 is at least partially closed. However for applications in which the ambient light is not known then in the event that no light is detected, it may be advantageous to carry out further measurements. The further measurements may comprise measuring an output of the light sensor 126 when the light source 124 is on.

[0144] The determination of whether ambient light is detected 512 may be achieved using a predefined condition. The predefined condition may comprise a predetermined value, for example a threshold value, which is representative of a positive indication of ambient light. The threshold value may be set at a value which is greater than an expected noise floor for the light sensor 126, for example, such that any amount of light received above a background noise level may be representative of ambient light. The background noise may arise as a result of the light sensor, the transmission or processing of the output signal of the light sensor 126, or any other source which may affect the determination of whether there is

ambient light or not. For example such noise may also include parasitic light transmissions through and/or around the cover 114 such that when the cover is closed a non-zero amount of ambient light may be detected by the light sensor 126. For a light sensor having a maximum noise reading when the cover is closed at or below 1 Lux, the threshold may be set to 2 Lux, for example.

[0145] Hence, the threshold value may correspond to a maximum amount of ambient light that may be detected when the cover is in the closed position and/or a representation of the light sensor output which there is no ambient light..

[0146] In another example method 600, of Figure 6, the light sensor 126 is configured to measure 610 the light when the light source 124 is on. The measured output may be compared to a threshold value 612 to identify if the cover is closed 616 and light is received from the light source 124 as reflected by the inside of the cover 114. The cover 114 is configured to efficiently convey light from the light source 124 to the light sensor 126 and the light source 124 is powered such that a first intensity that is minimum intensity of light that it emits, as detected by the light sensor 126 when the cover is closed, is greater than a second intensity maximum intensity of light expected from ambient conditions. Thus, if the measured light is below a threshold that is between the first and second intensity, then the cover is determined to be open 614.

[0147] The method 600 can be achieved with a relatively low power consumption for the light source 124 in circumstances in which the ambient light level is known to be low. For example, the ambient conditions may be measured using a light sensor that is exposed to ambient light.

[0148] Figure 7 shows another method of determining a position of the cover 114. In this example, the light sensor 126 is used to measure 710 the ambient light with the light source 124 deactivated. The measured light is compared with a first threshold 712. If the light level is above the first threshold, then ambient light may be determined to be detected and the cover determined to be open 714. If the light is measured as being below the first threshold then either the cover is closed or the ambient light level is low.

[0149] To determine which is the case, if the level of measured light is below the first threshold, the light source 124 is then activated 718, and the light received by the light sensor 126 is measured 720. The measured light is compared to a second threshold 722 and a determination made as to whether the cover 114 is open or closed. If the level of the detected light is above the second threshold, the cover is determined to be closed 726, on the basis a closed cover 114' results in light from the light source 124 being directed to the light sensor 126. If the light is below the second threshold, the cover 114 is determined to be open 724.

[0150] It will be appreciated that with method 700 it is possible to determine the status of the cover 114 at any

time and with a relatively low power usage.

[0151] The method described in Figure 7 requires the first measurement to be carried out when the light source is deactivated, and the second measurement carried out when the light source is activated. It will be appreciated that the these two stages could be reversed in some examples. However, the measurement made with the light source 124 switched off may make a positive determination that the cover is open when there is sufficient ambient light which removes the need for the measurement in which the light source 124 is powered, and therefore power would be saved in such circumstances.

[0152] As noted above, the methods of Figures 5 to 7 involved the use of a camera unit 110 having a separate light sensor which is independent from the image sensor of the camera 112. However, in some embodiments, the image sensor of the camera 112 may be used in place of an independent light sensor 124 which may or may not be present in the camera unit 110. Thus, although determining cover position based on measurements from a light sensor that is independent of the image sensor advantageously saves power, the methods of Figures 5 to 7 may in other implementations be performed by using the image sensor as the light sensor.

[0153] The first and second thresholds may be set in accordance with expected values and accounting for any noise. As noted above, the first threshold value may be set at a light level which is a noise floor of the sensing system which comprises the light sensor and associated processing devices. The noise sources may be same as in the case of method 500, and so the threshold used in the case of method 500 may be used as the first threshold of the method 700. The second threshold may be set to include a range of values which are indicative of the light levels which are expected to be received from light reflected by the inner side of the cover. However, since when the cover is closed there should be an increase in detected light when the light source 126 is turned on, the second threshold is selected to be greater than the first threshold. In some embodiments, turning on the light source 126 may result in some parasitic light from the light source 126 being detected from by the light sensor even when the cover is open. Such parasitic light may be treated as noise, wherein the second threshold is greater than the maximum noise when the light source 126 is on. Setting the second threshold as low as possible/practical advantageously enables minimal power consumption in determining the cover position according to the described method. The actual first and second thresholds (or any others disclosed herein) may be determined empirically or analytically using known techniques, taking into account the considerations discussed above, and taking into account an expected variance over the lifetime or the camera unit 110 product, and in some embodiments variance from product to product, to attribute appropriate thresholds.

[0154] As well as determining the light levels using the sensor 126, there may be other examples which detect

a light signature from the light source 124, such a spectral content of the light, which can be associated with the output of the light source 24 rather than any ambient light source.

5 **[0155]** As shown in Figure 8, the camera unit 810 having the features of camera units 10 or 110 may comprise a processor 812 and a memory 814. The processor 812 and/or memory 814 may be conventional. The processor 812 and/or or the memory 814 may each be comprised
10 of a single device or a plurality devices. Further, the memory 814 or a part thereof may be integrated into one or more processing devices.

[0156] The processor, or at least a part thereof, described herein may be implemented hardware or software and may be implemented as a controller, rather than a processor per se. The processing devices may comprise, for example: control circuitry; and/or processor circuitry; and/or at least one application specific integrated circuit (ASIC); and/or at least one field programmable
15 gate array (FPGA); and/or single or multi-processor architectures; and/or sequential/parallel architectures; and/or at least one programmable logic controllers (PLCs); and/or at least one microprocessor; and/or at least one microcontroller; and/or a central processing unit
20 (CPU); and/or a graphics processing unit (GPU), and/or transceiver(s) to perform the methods described herein.

[0157] The memory devices may store code/instructions that, when read by the processor, causes performance of any of the methods described herein, and/or as illustrated in the drawings. For example, the memory may comprise: volatile memory, for example, one or more dynamic random access (DRAM) modules and/or static random access memory (SRAM) modules; and/or non-volatile memory, for example, one or more read only
25 memory (ROM) modules, which for example may comprise a Flash memory and/or other electrically erasable programmable read-only memory (EEPROM) device. The code may for example be software, firmware, or hardware description language (HDL) or may be any combination of these or any other form of code for one
30 or more processing devices that is known by a person skilled in the art.

[0158] Further, the present disclosure includes a signal processor comprising readable instructions that, when read by a processor, cause performance of one or more of the methods described herein. Such a signal may be generated and transmitted from a central controller to the camera unit, for example.

[0159] The camera units described herein may form part of a security system. The security system may include one or more central controllers 816 (e.g. a control hub) which receive data from and/or transmit commands to the camera unit 810 and in some embodiments to other peripheral devices (e.g. door locks; door/window entry sensors). Hence, the camera unit 810 may transmit data including image, video or audio data to the controller 816. Further, the camera unit 810 may transmit a status of the cover position to the controller 816. The controller 816

may be configured to provide a notification of the cover position to an operator of the security system, such as an occupant of the dwelling.

[0160] It will be appreciated that references to a processor within the camera unit 810 in the present disclosure, may be a distributed processor in which some of the steps are carried out in a processor which is remote to the camera unit 810. For example, some of the steps described as being carried out by the processor 818 may be executed by the central controller 816 and data and instructions may be stored in a memory 820 of the central controller 816. Such a step may include, for example, a comparison of the measured light with a predetermined value.

[0161] The devices comprising camera units, cameras and/or PIRs described herein may be arm aware or arm unaware devices. An arm aware device may be one in which the cameras and/or PIR are configured to receive and be responsive to and/or store an arm or disarm status or command which is issued from the central controller (or other controlling entity) when the system is armed or disarmed by a user or operator.

[0162] Generally, the camera in a camera unit may reside in a powered down state until one or more images are required. This is the case in an arm aware or arm unaware camera unit. Hence, the camera unit and/or a PIR may be in a powered down state when the system is armed or unarmed. In arm aware device, a processor of the device may be temporarily woken by and process an arm request using, for example, known beacon techniques. Once armed, the device may go back to sleep state. A motion detector may be operable to detect motion on an ongoing basis as a motion detecting transducer, such as a PIR transducer, and some electronics that process its signal use very little power. Thus, the camera unit (and/or a separate motion detector of the security system) may be constantly active to detect motion within a field of view, regardless of whether the camera unit is considered to be in a sleep state (e.g. by virtue of a CPU of the camera unit being in a sleep state). A processor (e.g. the CPU of the device) may be woken from the sleep state if the PIR processing electronics indicate a motion has been detected.

[0163] In some embodiments the camera may be controlled by a separate processor to that of the CPU, and may only be woken when the camera needs to capture an image(s). So more the camera unit may comprise more than one processor with each having sleep states that are woken as needed.

[0164] When armed, the camera of an arm aware device may receive and be responsive to a signal or command issued from an integrated security sensor, such as a motion sensor (e.g. a camera PIR), or door or entry sensor, which signals possible activity and/or motion in the camera's field of view. This may prompt the camera unit to record an image (i.e. at least one image), either as one or more stills or video using the camera. Alternatively, or additionally, the camera may receive an image

record command from the central controller. The image record command from the central controller may, in some embodiments, also be made in response to a PIR signal that is not in integrated with the camera and which is received at the central controller, or in response to a request of an operator, for example, a person or system responsible for monitoring the security system and premises.

[0165] In the case of an arm unaware device, the camera unit is normally in a sleep state and woken to be fully power-up and capture an image upon an appropriate signal from the central controller. Thus, a motion detector may send a motion detection notification to the controller which is responsive on the basis of whether the device or system is armed. If armed, the response may be to transmit an image record command to the camera unit. If unarmed, the response may be null, meaning that no action is taken. This may be the case, for example, when an occupant of the premises triggers the motion detector.

[0166] Whether arm aware or arm unaware, a camera in a camera unit may be provided in a sleep state when the system is in an armed state.

[0167] For either of arm aware and arm unaware camera units, a cover position status may be determined upon request from the central controller or at predetermined events or times.

[0168] For example, the camera unit may be configured to determine the cover position upon request from the central controller when the security system is switched from a disarmed to armed state, or when the camera unit is otherwise placed in an active state from an inactive state, such as when it is first installed or commissioned or a power source is connected following a disconnection (e.g. after a change of batteries or power cut). Additionally or alternatively, the camera unit may be configured to determine the cover position status upon receipt of a command to record an image. The command to record an image may be caused by an output signal of one or more sensors in the security system or a controlling entity such as the central controller or other remote device. The one or more sensors may provide an output signal to a processor of the camera unit or central controller which issues an image record command in response.

[0169] As noted previously, the camera unit may include a camera (which may also be referred to as a camera module). The camera may include a lens, an image sensor and, optionally, one or more processors. The camera unit may additionally comprise a PIR. The camera unit may be referred to as a security device and/or a premises security device. It will be appreciated that placing the camera unit in an active state may not require the camera to be placed in an active recording state. The active state may be defined by a processor being configured to be responsive to a motion detection signal issued from a motion detector. Hence, when the camera unit is in the awake/active state, the camera of the camera unit may or may not be active. For example, when the

camera unit is in the awake/active state, the camera module may be on stand-by until activated to be in a state to record one or more images upon receipt of an image record command from a processor of the camera unit or central controller.

[0170] Figures 9 and 10 show methods of determining a cover position status. Figure 9 shows a method 900 for an arm aware system. Figure 10 shows a method 1000 for an arm unaware system.

[0171] With regards to Figure 9, at step 910 an arm command may be received by a controller which is configured to arm the security system. The request to arm the system may be received from a user leaving the premises, for example. Upon receipt of the request from the user, the central controller may be configured to notify the camera unit that the system has been armed. The camera unit may be configured to receive the arm command and determine the cover position status. It may be implicit from the arm command that a cover position status is required, meaning a cover position status request is received by the camera unit by virtue of receiving a command to arm from the controller. However, it will be appreciated that a separate command may alternatively be issued with the arm command as part of the same or a different transmission. As well as determining the cover position in response to the arm command, it will be appreciated that the receipt of the arm command may prompt the camera to carry out additional actions such as preparing a camera for image capture, and/or to configure the camera to automatically perform image capture in response to a motion detected by a motion detector of the camera unit.

[0172] Having the camera unit configured to respond to the arm command by determining the cover position status is advantageous as it reduces the need for a further transmission to determine the cover position status, and the associated power required to receive and process that further transmission. Further, having the camera unit determine the cover position status upon receipt of an arm command allows the cover position status to be determined whilst the camera unit is preparing for service.

[0173] In some embodiments, the determination of the cover position and the camera activation may be carried out in parallel. This is particularly advantageous where the cover position is determined in response to a motion detection where the camera unit may be configured to activate (e.g. power-up) the camera upon receipt of the motion detection signal. Carrying out the camera activation and cover position determination in parallel may shorten the period it takes to acquire an image. Further, where a cover position status is determined to be closed, the camera unit may be configured to cease activating the camera to further save power.

[0174] The activation of the camera and an associated start-up time for the camera may be defined by the time it takes to power up the camera electronics, such as the image sensor, and optically stabilize the camera (e.g. by determining the correct aperture and for the ambient light

conditions, for example, by using a light sensor).

[0175] The camera may be activated from a powered down (e.g. off or stand-by) period. Thus, in an arm aware or an arm unaware camera unit, the camera may be in a powered down in which it is unactive and unable to take images. In one embodiment, the determination of the cover position status is executed whilst the camera is being powered-up following a powered-down period.

[0176] At step 912, the cover position status is determined. As noted immediately above, the cover position status may be determined using one of the methods described herein in which a light sensor and/or camera and/or light emitter is used to determine the cover position status. Alternatively, a different cover position status technique may be employed such as using a mechanical sensor. The mechanical sensor may be in the form of a limit switch for example. In other embodiments an electronic or magnetic sensor may be used. In some examples, the sensor may form part of an actuating mechanism which is described further below. It will be appreciated that the camera unit may not include the light emitting diode 24 and the light sensor 126 as disclosed in connection with Figures 1a, 1b, 2a and 2b when not required for determining the cover position status.

[0177] In some examples, the cover position status may be stored in memory and recalled rather than being determined in every instance. This may occur where the cover position status is determined and stored on an ongoing basis, for example, where the position is determined via an actuation system in which the actuation system records the position either by virtue of operation or otherwise. This is described in more detail below.

[0178] Once the position of the cover is determined (or obtained from memory) 914 as being open or closed, appropriate actions can follow. Where the cover has an 'open' status, the camera may be determined to be operable 916 and an image may be obtained at an appropriate time. The time at which an image is obtained may be triggered by a motion detection or upon request from the central controller. The motion detection may be provided by a PIR which may be part of the camera unit, as noted above.

[0179] In the alternative, where the cover position is determined to be 'closed', the status may be transmitted 918 to the central controller. In response to receiving a 'closed' status, the central controller may be configured to either deactivate the camera of the camera unit or flag the camera of the camera unit as being ineffective (e.g. inoperable) so that it does not form any part of the security surveillance. The motion detector of the camera unit, however, can still provide useful information for security so may continue to operate under such conditions. Another option may be to undertake a confirmatory test to reaffirm the position of the cover. For example, where the position has been determined using the light sensor, it may be that the central controller instructs the camera to carry out a further determination using, for example, the camera output. The use of the camera to determine

the cover position may be avoided in preference of the light sensor in the first instance to avoid the associated increased power consumption.

[0180] As indicated by the dashed line in Figure 9, an optional step 920 is for the central controller (or some other entity) to send a notification to a user device to inform the user of the cover position status and/or camera status. The user may be one or more of a supervising entity who is responsible for supervising the premises when the security system is in an armed state, a property owner, or the person who has set the system from disarm to arm, for example.

[0181] Upon receiving the closed notification, the user may consider taking action 922 in response to the notification. Where the user requires the camera to be uncovered, they may disarm the security system (or in other embodiments, the initial arm attempt may have been aborted as a result of the camera being covered), and they may then return to open the cover and re-arm the system 924 accordingly. This will result in the process, 900, restarting at 910 and the cover position status being determined once again.

[0182] Where the user does not wish for the camera to be opened or it would be inconvenient for the user to return to open the camera cover, the user may ignore the notification such that the system remains armed but with the camera unit disabled.

[0183] The notification may take any suitable form and may include one or more predetermined selectable options. For example, the notification may inform the user of the cover status and location of the camera. It may also provide selectable options such as 'disarm', 'accept', 'confirm', 'ignore' or 'open app', for example. The 'disarm' command may result in the security system being disarmed to allow a person to re-enter the premises to open the cover without trigger an alarm; the 'accept' command may inform the central controller that the user accepts the camera being covered; 'confirm' may result in the central controller carrying out a further test to confirm cover position (for example, where a user believes the cover is open already); 'ignore' may allow a user to pause the notification and possibly receive a follow-up reminder to check the cover position at a later time, for example when the security system is disarmed; and 'open app' may relate to opening an application on the user device to allow the user to interface with the security system, e.g. the central controller, if required. It will be appreciated that other actions are possible. Where no response is received following the notification, the system may default to disabling the camera as noted above such that it plays no role in the surveillance. In some examples, the notification may not provide selectable options for response but may simply inform the user that the camera is inoperable.

[0184] The way the notification is delivered to the user may be user specific and dependant on the user device in question. For an end user, such as the person who has armed the system and/or the property owner, the

notification may be delivered to a user device in the form of a mobile phone or other mobile device carried by user and may be a push notification. The push notification may be presented as a pop-up box or drop-down menu providing the selectable options. Alternatively, the push notification may result in an app being started on the mobile device such that the user can fully interact with the security system, if required. The advantage of using a push notification is that it allows a quick response time from the user such that they may return to the property more conveniently, rather than continuing to travel away from the premises whilst the app opens.

[0185] Where a notification is provided to a central supervisor of the system, it may be presented on an operator's screen, for example. It will be appreciated, that several notifications may be issued, for example, to the person arming the system, the property owner, or the supervising service.

[0186] The push notification may be transmitted from a remote device such as a server which is responsible for monitoring several premises, or the central controller.

[0187] In the example of Figure 9, the status of the cover position is only requested when the system is switched from a disarmed status to an armed status and the status update may only be provided when the cover is closed. Hence, the central controller may be configured to proceed on the basis of the camera being uncovered in the event of no response from camera unit.

[0188] The central controller may be configured to additionally (or in other embodiments, alternatively) determine the cover position status on an ad hoc basis and/or in response to an operator request. An operator may request a cover position status where one or more images taken with the camera indicates that the camera lens is obscured in some way. This may be advantageous, for example, where an infiltrator has managed to obscure the camera lens.

[0189] The status of the cover may be recorded in the central controller during or shortly after an installation process. During the installation process the camera may be registered with the central controller when the cover position is set to a default condition, such as the cover being open. This may be useful for preventing a cover position status being required, thereby saving power, or may help with configuring the camera, LED, light sensor or some other sensor used to determine the position of the cover. The status of the cover may also be recorded in the central controller when a power supply for the camera, such as a battery, is replaced. The status of the cover may be recorded in central controller using an associated piece of software such as an app which is usable from a user's mobile device or other computing device which is used to configure or control the system in some way.

[0190] In Figure 10, there is shown a method 1000 for determining the position of a cover in an arm unaware system. Here, as with Figure 9, the command to arm the security system 1010 is received by the central controller. The central controller may then, instead of sending an

arm command to the camera, simply send a request 1012 to determine the cover position status. From thereon, the remaining tasks may be the same as those described in relation to Figure 9 which share similar reference numerals incremented by 100.

[0191] As described above, the image capture in an arm unaware camera unit will typically be carried out following the central controller being notified of a motion detection from a motion detector, which in some embodiments is integrated into the camera unit. However, it will be appreciated that, in an arm unaware system, the camera unit may, in some embodiments, always capture images in response to motion detection. However, this results in a potential waste of energy when the system is unarmed and occupants of the premises cause a lot of unnecessary images to be captured. Therefore, in preferred embodiments, a camera unit in an arm unaware system may only capture an image in response to a request from the controller. In some embodiments, the camera units may not comprise an integrated motion detector/sensor or be configured to communicate with an external motion detector, and so the only option is to capture an image if told to do so by the controller. Hence, a cover position status may be determined at the request of the controller at the time of the controller is armed such that the controller knows whether the camera is covered or uncovered at the time of arming.

[0192] The cover position status updates for an arm aware of arm unaware system may be provided in response to a request received from the central controller or when the security system is armed. The status update may be provided as a dedicated transmission, or maybe part of a multipurpose transmission which conveys other information to the central controller. Such additional information may include: a status for the camera; information relating to the operating status of the camera and/or one or more PIR's; a status for one more sensors used within the camera and/or a battery status; an acknowledgement of or other communication in response to a request from the controller. The acknowledgment may be in response of receiving an arm command. Such information may be required by the central controller in order to determine the operating status of the system at any particular time. Such transmissions may be sent at regular intervals whilst the system is armed or at particular events such as a request for an image or when powering up a camera.

[0193] Returning briefly to Figure 1a, it will be recalled that the cover 14 may be movable between a closed position, in which the camera lens 16 is obscured, and an open position, in which the camera lens 16 is unobscured, using various mechanisms such as a linear sliding mechanism or a hinged mechanism. In Figure 1a, the cover 14 is shown as being slidable between an open and a closed position on runners 20 which are attached to the housing 18.

[0194] In some embodiments, cover 14 may be movable between open and closed positions using an actu-

ator, controlled by processor 812. The actuator may be any suitable device which is operable to cause a movement of the cover 14 relative to the housing 18. Thus, the actuator may move the cover 14 from the open position towards the closed position and, additionally or alternatively, from the closed position to the open position. The actuator may, for example, be mechanical, electromagnetic, hydraulic and/or pneumatic. The actuator may comprise a rotary drive or a linear drive.

[0195] In Figures 11a,b and 12a,b there are shown two examples of different actuation mechanisms for a cover. Figure 11a shows a closed configuration of a cover 1114 from inside the cover along line A-A facing outwards on the left hand side, and section B-B on the right hand side. Figure 11b shows the corresponding cover 1114 in an open configuration. The actuation system includes an electromagnetic actuator 1144 in the form of a rotary drive which engages with a corresponding linear drive member on the cover 1114. As shown, the rotary drive may comprise an electric motor 1146 having a rotatable gear 1148 which engages with elongate toothed member 1150 on the cover to form a rack and pinion drive. The reference numerals are not repeated in Figure 11b, but the various parts correspond with those of Figure 11a, with the exception that the cover is in a lower, open position. It will be appreciated that the reference to open and closed is arbitrary and the actuator can be considered to be moving the cover between a first position and second position, either of which could be the open or closed positions.

[0196] In more detail, Figure 11a shows a cover 1114 having an outwardly facing external surface (or outer side) 1134 and an inwardly facing internal surface (or inner side) 1128, in which the internal surface faces the exterior of the camera unit housing 1118. Mounted on the internal surface 1128 is the elongate tooth member 1150 which engages with the rotatable drive gear 1148 attached to the motor 1146 via a drive shaft 1152. The motor 1146 is located within the camera unit housing 1118 with the drive gear 1146 being located on the exterior with a connecting drive shaft 1152 extending therebetween and passing through an appropriate aperture in a camera housing wall.

[0197] When the electric motor 1146 is energised, the drive gear 1148 engages with and drives the elongate toothed member 1150 so as to lower the cover 1114 from a closed position (Fig. 11a) to an open position (Fig. 11b). It will be appreciated that the camera lens is not shown in Figures 11a and 11b but would be located above the motor 1146 so as to be obscured in Figure 11a and unobscured in Figure 11b.

[0198] When it is desirable to close the cover 1114, the actuator may be controlled to drive the cover 1114 from the open position to the closed position.

[0199] The actuator may include a sensor for sensing the position of the drive and/or the cover. In the example shown in Figure 11a the motor 1146 includes a position sensor 1154. The position sensor 1154 may take any suitable form and may be an integral part of the electric

motor 1146 required for controlling the motor 1146.

[0200] The motor 1146 may be any suitable motor which can be controlled to provide the necessary drive. Examples may include a brushed or brushless DC motor, for example. Where the motor is a DC motor 1146, it may include an encoder such as a rotary encoder on the rotor or drive shaft, or a linear encoder on or associated with the slidable cover 1114. The encoder may be used to provide control of the motor with the encoder output being indicative of, or usable to determine, the cover position. In other examples, a brushless DC, or stepper motor, may be employed and the position of the rotor may be acquired from the motor controller to determine the position of the cover 1114. It will be appreciated that the position sensor 1154 may be provided by other means which may or may not be connected with the operation of the motor 1146 and may not form part of the motor 1146.

[0201] The actuator controller may be provided by a processor and memory within the camera unit or central controller as described in connection with Figure 8. The camera unit may be configured to receive a command, such as an arm command which prompts the camera unit to determine the cover position status as described herein. In some examples, the cover position status may be already stored in memory as a result of a previous actuation or requirement of the actuator controller. Thus, the determination of the cover position status may be achieved by obtaining the cover position from a memory associated with an actuator controller.

[0202] The control of the motor 1146 (or other actuator) may be 'closed-loop' in which the position of the motor 1146 and/or cover 1114 is monitored as part of a feedback signal. Alternatively, the control of the motor 1146 (or other actuator) may be open-loop in which the motor 1146 records a cover position status rather than providing a feedback signal relating to the cover position in any one instance.

[0203] The actuator may additionally be controlled using one or more sensors to determine the position of the cover 1118. For example, the sensor may be in the form of a limit switch which has the effect of cutting power to the motor when triggered.

[0204] The memory used to store the position of either the actuator and/or the cover may be that of the camera unit or the central controller. It will be appreciated that storing the position within the camera unit memory will generally be more energy efficient as it will not be necessary to transmit the position back to the central controller except for predefined events such as the system becoming armed.

[0205] Figures 12a and 12b show an alternative arrangement comprising a linear actuator 1244. Figure 12a shows a closed configuration of a cover 1214 from outside the cover along line C-C facing inwards, and section D-D. Figure 12b shows the corresponding cover in an open configuration. The actuation system includes an electromagnetic actuator 1244 in the form of a linear drive

which is drivably connected to the cover 1214. The linear actuator 1244 may comprise an electric solenoid 1246 having an elongate linearly translatable drive arm 1252 which connects to the inside surface of the cover 1228 such that energising the solenoid causes the drive arm 1252 to move and a corresponding translation of the cover 1214 between the open and closed positions, or vice versa. The camera lens 1216 is shown above the actuator, but this is not a limitation.

[0206] The reference numerals used in Figure 12a are not repeated in Figure 12b, but the various parts correspond with those of Figure 12a, with the exception that the cover 1214 is in a lower, open position. It will be appreciated that the reference to open and closed is arbitrary and the actuator can be considered to be moving the cover between a first position and second position, either of which could be the open or closed positions.

[0207] In more detail, Figure 12 shows a cover 1214 having an outwardly facing external surface (or outer side) 1234 and an inwardly facing internal surface (or inner side) 1228, in which the internal surface faces the exterior of the camera unit housing 1218. Mounted on the internal surface 1228 is linear drive arm connection 1256 which extends inwardly from the inner side through an aperture 1258 in the housing wall. The linear drive arm connection 1256 is attached to the linear drive arm 1252 which is in turn received by the solenoid.

[0208] The aperture 1258 is in the form of an elongate slot which extends longitudinally in the direction of motion of the cover 1218. The aperture 1258 is located so as to be concealed by the cover 1218 when in the open or closed positions, however, this is not essential.

[0209] Although not shown in Figures 12a and 12b, a second solenoid may be used to drive movement of the cover 1218 in the opposite direction to that caused by solenoid 1246, rather than relying on gravity. In such embodiments, to save power, a detent (not shown) may be included to keep the cover in the elevated position shown in Figure 12a, wherein the powering of the solenoid 1246 and the other solenoid overcomes a holding power of the detent. Alternatively the two solenoids may be positioned and configured to control movement of the cover along a horizontal axis instead of a vertical axis.

[0210] As with Figures 11a and 11b, the linear actuator shown in Figures 12a and 12b may incorporate a sensor which can be used to determine the position of the cover 1214. Such sensors are known in the art and may be used for controlling the actuator. Similarly, the control of the actuator and storage of the position, where applicable, may be achieved using the camera unit processor and memory, and/or that of the central controller, as per the arrangement described for Figures 11a and 11b.

[0211] In both of Figures 11a and 12a the covers 1114, 1214 are shown in isolation of any of the guide features. However, it will be appreciated that the housing units 1118, 1218 and/or cover 1114, 1214 may include one or more guide features such as the runners shown in Figures 1a and 1b.

[0212] It will also be appreciated that other actuation mechanisms may be possible. For example the rotary actuator may comprise a worm gear as opposed to a rack and pinion. The solenoid may be replaced by a linear motor or hydraulic or pneumatic ram, for example.

[0213] In some embodiments, the opening of the cover with the solenoid or other actuation mechanism may be carried out in parallel to determining the cover status position and/or powering up the camera of the camera unit.

[0214] As described above, the sensor(s) used to determine the position of the cover and/or actuator may include a passive sensor such as a discrete limit switch which could be located at a predetermined position in relation to the cover 1114, 1214 and camera unit housing. Thus, when the limit switch is engaged by the cover when moving from an open to a close position, or vice versa, it will be possible to determine the position of the cover to the extent required. The limit switch may be a mechanical device, in which a switch is mechanically connected to via the cover. Alternatively, the limit switch may comprise a non-contact device such as a magnetic switch in which, for example, a magnet is mounted to the cover and a reed switch is activated at the predetermined position (or vice versa).

[0215] The covers 1114, 1214 shown in Figures 11a and 12a do not include the light directing channel and/or waveguide of Figures 3a and 4a. However, it will be appreciated that such features may be incorporated with the actuation mechanisms described herein. This may be achieved by moving the position of the cover 1114, 1214 in relation to the camera and/or drive mechanism features. The location of the actuators relative to the cover, housing, camera, camera lens, light-emitting diode, and light sensor may be variably arranged to suit a particular configuration. In some examples, the covers 1114, 1214 may be mounted asymmetrically in relation to the camera lens, or the drive mechanism may be mounted to one side of the cover to accommodate a centrally mounted camera.

[0216] In some embodiments the camera units are PIR cameras. The camera functionality of the unit need not be its primary function. For example, the unit may operate as a PIR for the security system, with the camera functionality only being used at select instances, for example when the unit is security system is armed or if instructed to capture images by the controller. Further, the unit may have other functionalities too. Thus, the present disclosure is not limited to devices that, as an entire device, is necessarily termed a camera unit. For example, it may more generally apply to a security device, in some embodiments. Thus the term "camera unit" as used herein may refer to a device, more particularly any security device in some embodiments, which may comprise additional features, for example other security sensors, and/or perform additional functions, unrelated to the use of the camera.

[0217] Reference to any prior art in this specification is not an acknowledgement or suggestion that this prior

art forms part of the common general knowledge in any jurisdiction, or globally, or that this prior art could reasonably be expected to be understood, regarded as relevant/or combined with other pieces of prior art by a person skilled in the art.

[0218] As used herein, except where the context requires otherwise, the terms "comprises", "includes", "has", and grammatical variants of these terms, are not intended to be exhaustive. They are intended to allow for the possibility of further additives, components, integers or steps.

[0219] The skilled person will appreciate that except where mutually exclusive, a feature described in relation to any one of the aspects, examples or embodiments described herein may be applied to any other aspect, example, embodiment or feature. Further, the description of any aspect, example or feature may form part of the entirety of an embodiment of the invention as defined by the claims. Any of the examples described herein may be an example which embodies the invention defined by the claims and thus an embodiment of the invention.

[0220] It will be understood that the invention is not limited to the examples and embodiments above-described and various modifications and improvements can be made without departing from the concepts described herein. Except where mutually exclusive, any of the features may be employed separately or in combination with any other features and the disclosure extends to and includes all combinations and sub-combinations of one or more features described herein.

Claims

1. A method of determining a cover position of a camera unit in a security system, the security system comprising one or more control hubs which receive data from and/or transmit commands to the camera unit, the camera unit comprising:

a camera having a lens for receiving light from a field of view, FOV;

a cover which is movable from an open position in which the lens is exposed, to a closed position in which the lens is covered, the method comprising:

receiving, at the camera unit, a cover position status request from the control hub;

and,

determining the cover position status in response to receiving the cover position status request.

2. The method of claim 1, wherein the cover position status request comprises an arm command, wherein the camera unit is configured to be placed in an armed state in which the camera is responsive to a

motion detection signal from a motion detector in response to the arm command.

- 3. The method of claims 1 or 2, further comprising: determining that the cover position status is either open or closed, and transmitting the cover position status from the camera unit to the control hub only when the cover position status is closed and/or wherein when the cover is determined to be closed, transmitting a cover status notification to a user. 5
- 4. The method of any preceding claim, further comprising: receiving a second cover position status request at the camera unit in response to a re-arming command received by the control hub. 10
- 5. The method of any preceding claim, further comprising: obtaining one or more images with the camera in response to a security sensor or upon receiving an image capture command from the control hub and, optionally, wherein the security sensor comprises at least one: of a motion sensor or an entry sensor. 15
- 6. The method of any preceding claim, further comprising determining the cover position status in response to connecting the camera unit to a power source, and, optionally, wherein the connection to a power source follows an installation of the camera unit, a change of the power source or re-connection of the power source following a disconnection, and/or wherein the determination of the cover position status is carried out prior to or during the camera being activated for image capture, and, optionally, wherein the determination of the cover position status is executed whilst the camera is being powered-up following a powered-down period. 20
- 7. The method of claims 3 to 6, wherein the cover position status is transmitted as part of another transmission. 25
- 8. The method of any preceding claim, wherein determining the cover position status comprises obtaining the cover position status from a position sensor, and, optionally, wherein the position sensor comprises: a light sensor which is covered by the cover when in the closed position and exposed when the cover is in the open position, or, an actuator position sensor configured to provide positional information to an actuator. 30
- 9. A method of determining the cover position of a camera unit in a security system, the security system comprising one or more control hubs which receive data from and/or transmit commands to the camera unit, the camera unit comprising: 35

a camera having a lens for receiving light from a field of view, FOV;
 a cover which is movable from an open position in which the lens is exposed, to a closed position in which the lens is covered, the method comprising:

transmitting, from the control hub, a cover position status request to the camera unit;
 and,
 in the event of receiving a closed cover position status from the camera unit in response to the request, determining that the camera is ineffective.

- 10. The method of claim 9, wherein in the event of not receiving a cover position status from the camera unit in response to the request, determining that the cover is in the open position. 40
- 11. The method of claim 10, wherein the cover position status is transmitted in response to an arm command. 45
- 12. The method of claims 9 to 11, wherein when the cover position status is closed, sending a notification to a user or a server to inform the user or server of the cover position status and, optionally, wherein the notification comprises one or more selectable response options for the user to select in response to the cover position status. 50
- 13. A method of confirming a security system configuration in a security system, the security system comprising one or more control hubs which receive data from and/or transmit commands to the camera unit, the camera unit, comprising: 55
 - receiving, by a user device, a cover position status of a camera cover when the cover is in a closed position;
 - displaying a notification for a user of the user device in response to receiving the cover position status, wherein the notification comprises an indication that the cover position is closed.
- 14. The method of claim 13, wherein the receiving of the cover position status is in response to an arm request transmitted from the user device and/or further comprising providing one or more user selectable options for a user to select in response to the notification of the cover position status, wherein, optionally, the user selectable options comprise one or more of: a disarm command for disarming the security system; an accept command for accepting the cover position status; or an open application command for opening an application for interfacing with the security system on the user device.

15. A camera unit comprising:

a camera comprising a lens for receiving light
 from a field of view, FOV;
 a cover which is movable from an open position 5
 in which the lens is exposed, to a closed position
 in which the lens is covered, and,
 at least one processor configured to carry out
 the method according to any of claims 1 to 8.

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16. A security system control hub comprising at least
 one processor and at least one memory, wherein the
 processor is configured to carry out the method of
 any of claims 9 to 12 or a user device comprising at
 least one processor and at least one memory, where- 15
 in the processor is configured to carry out the method
 of any of claims 13 and 14.

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17. A non-transitory storage medium comprising elec-
 tronic-processor readable code that, when read by 20
 one or more electronic processors, cause perform-
 ance of the method as claimed in any of claims 1 to
 12 or a non-transitory storage medium comprising
 electronic-processor readable code that, when read
 one or more electronic processors of a user device, 25
 configure the user device to carry out the method
 according to any of claims 13 and 14.

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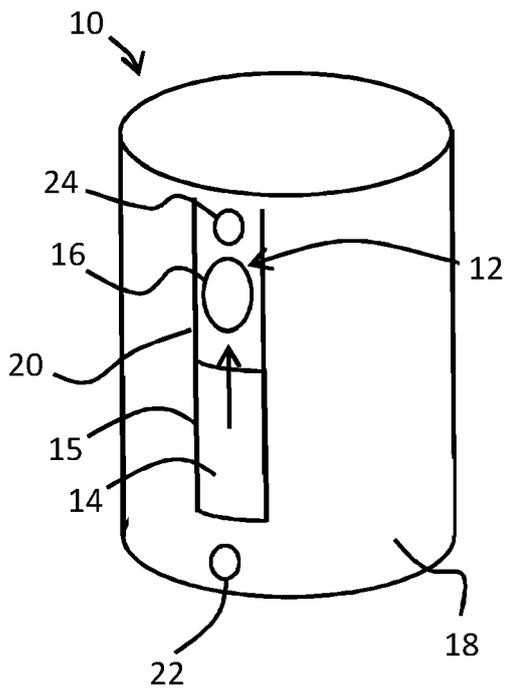


Fig. 1a

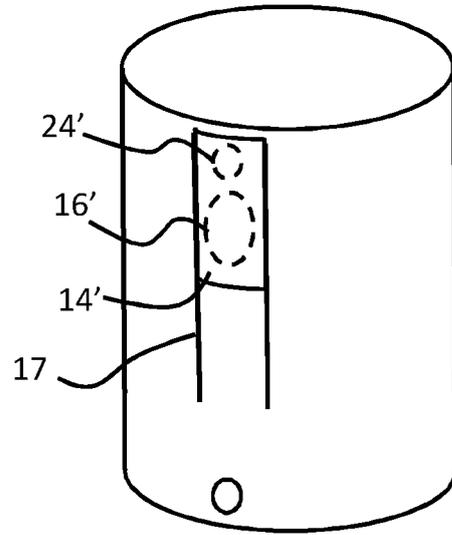


Fig. 1b

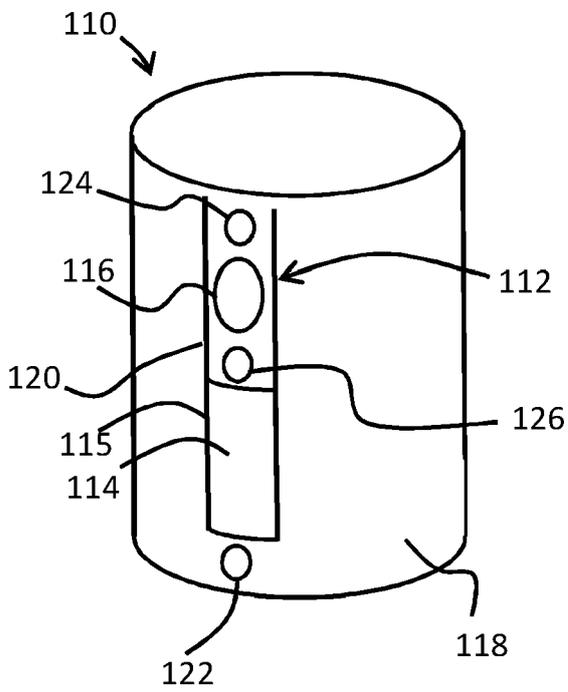


Fig. 2a

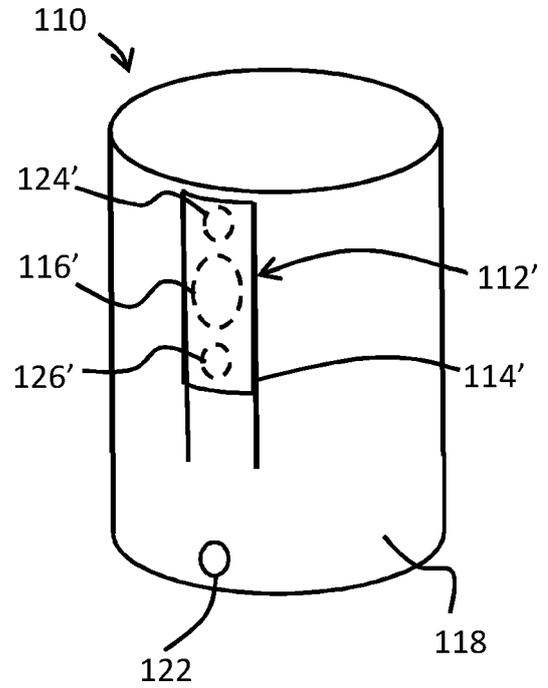


Fig. 2b

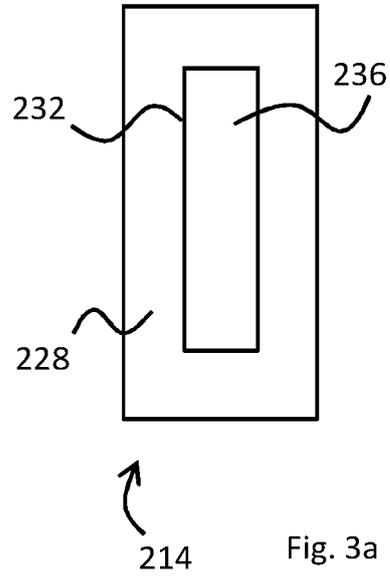


Fig. 3a

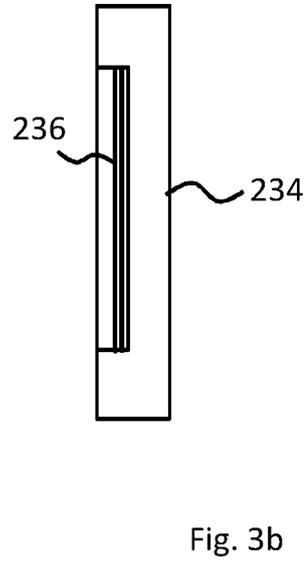


Fig. 3b

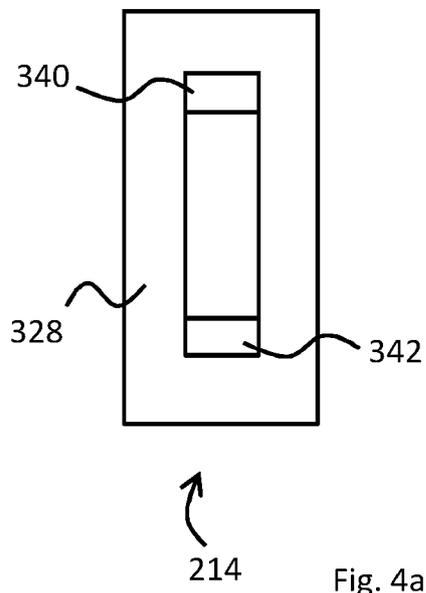


Fig. 4a

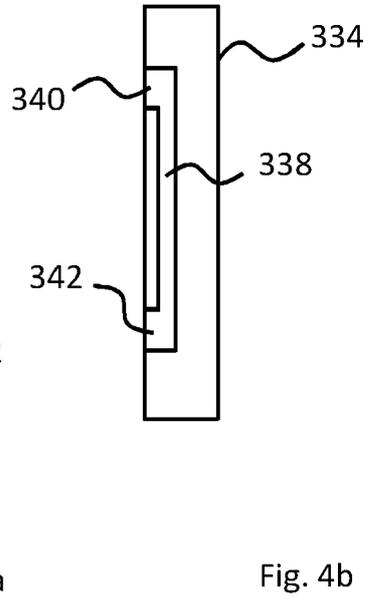
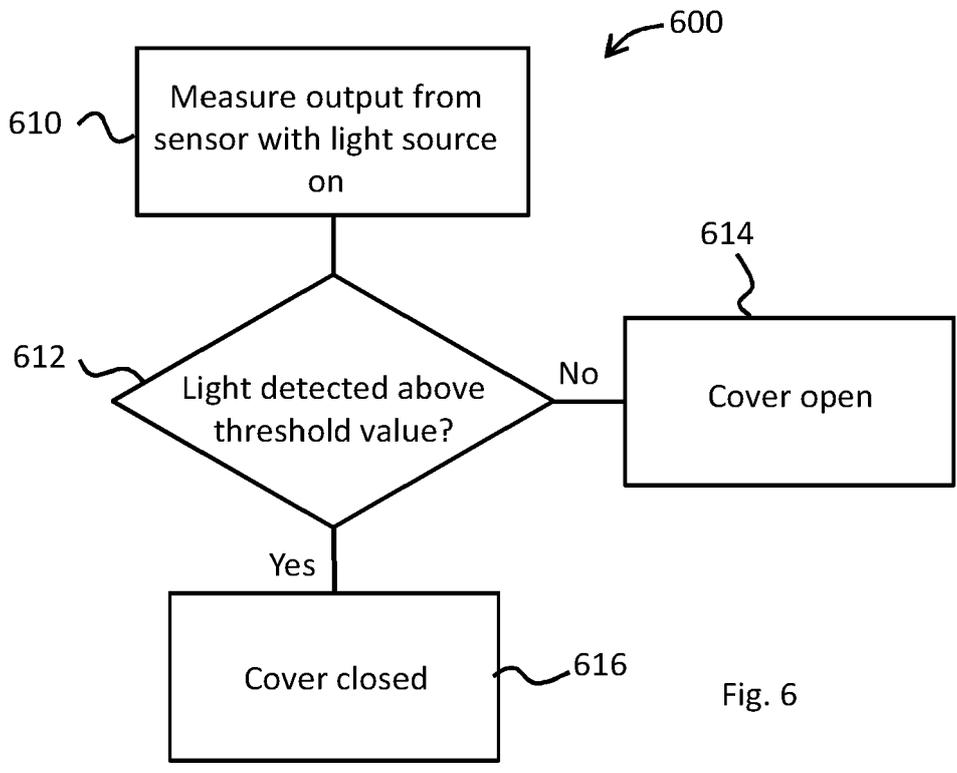
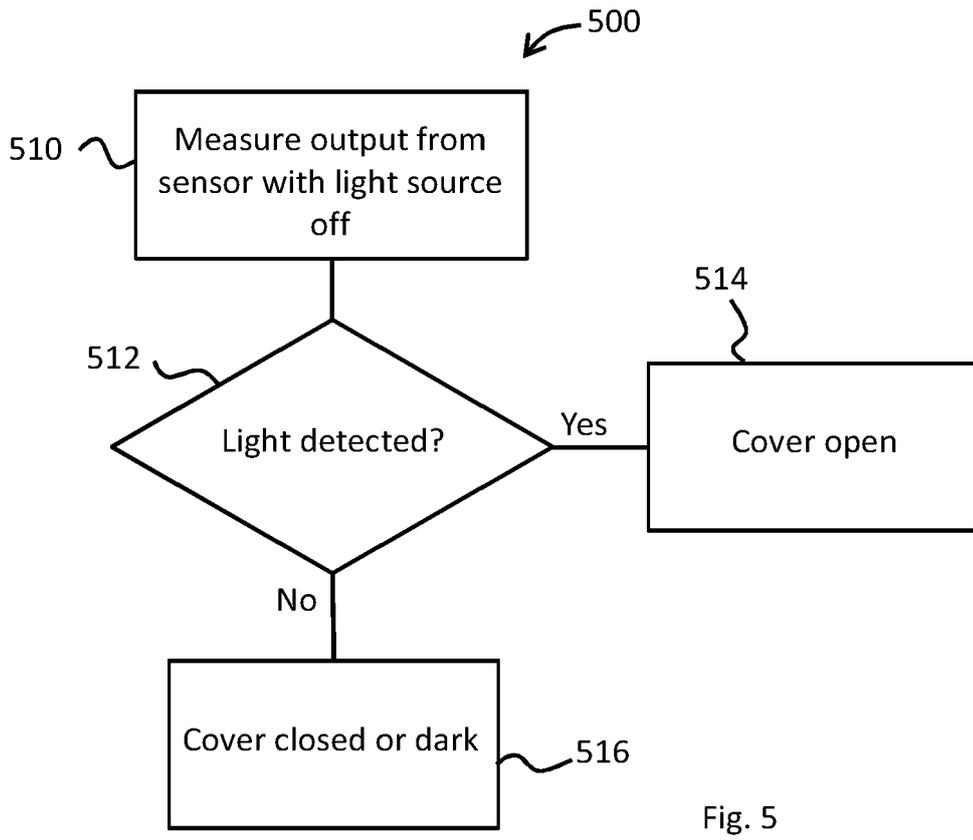


Fig. 4b



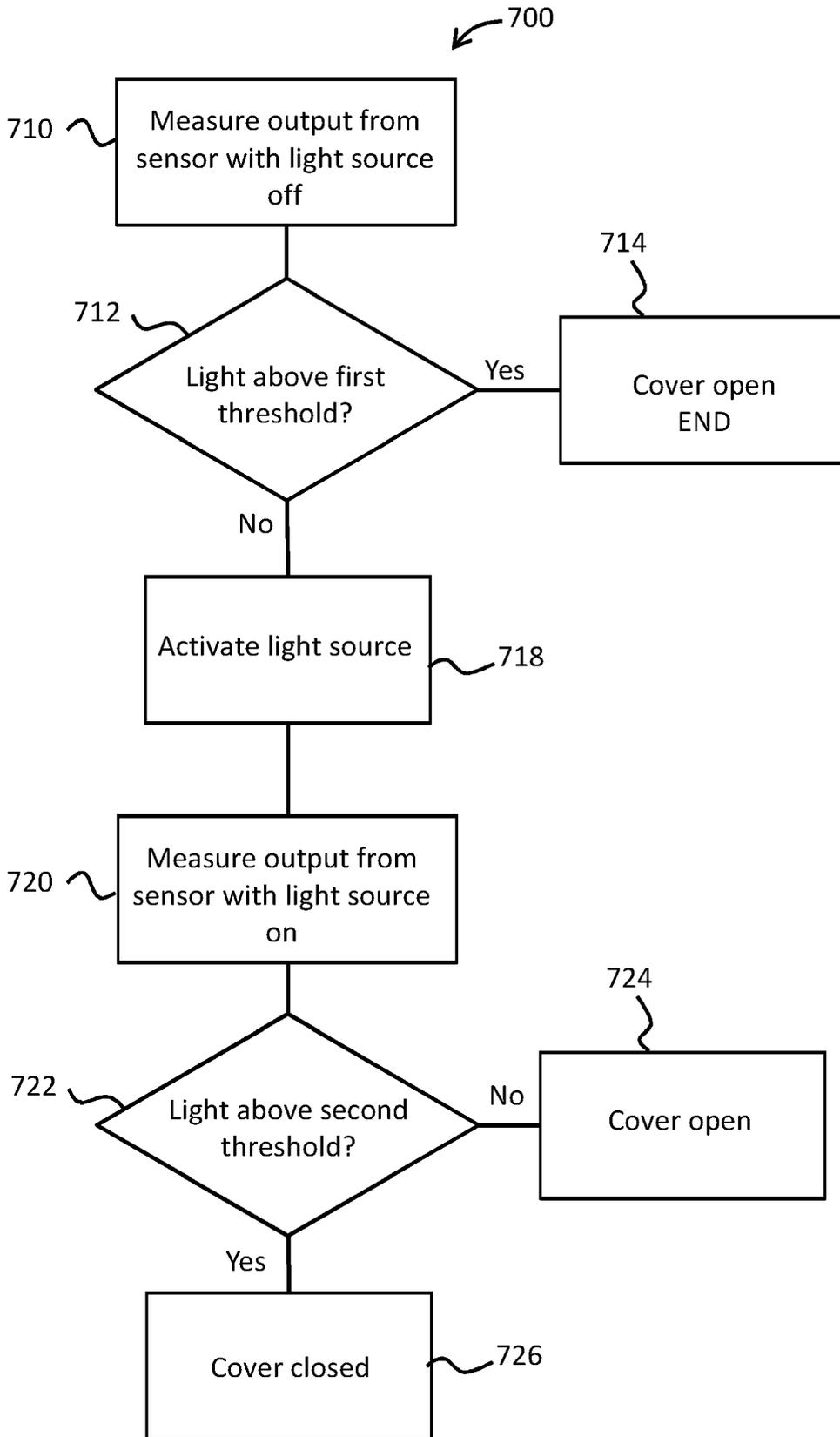


Fig. 7

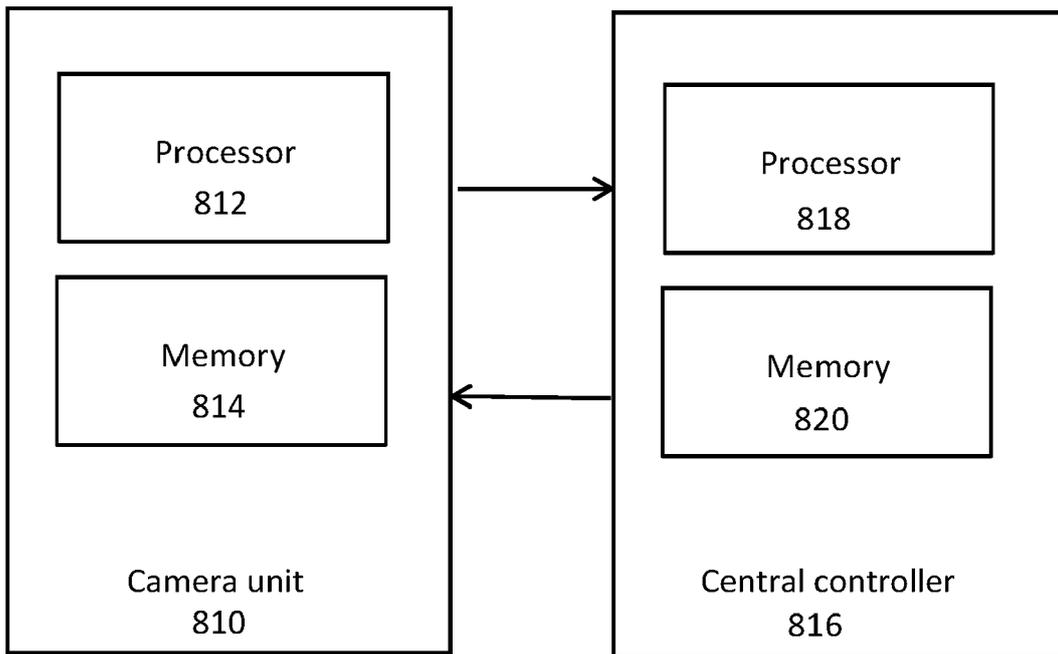


Fig. 8

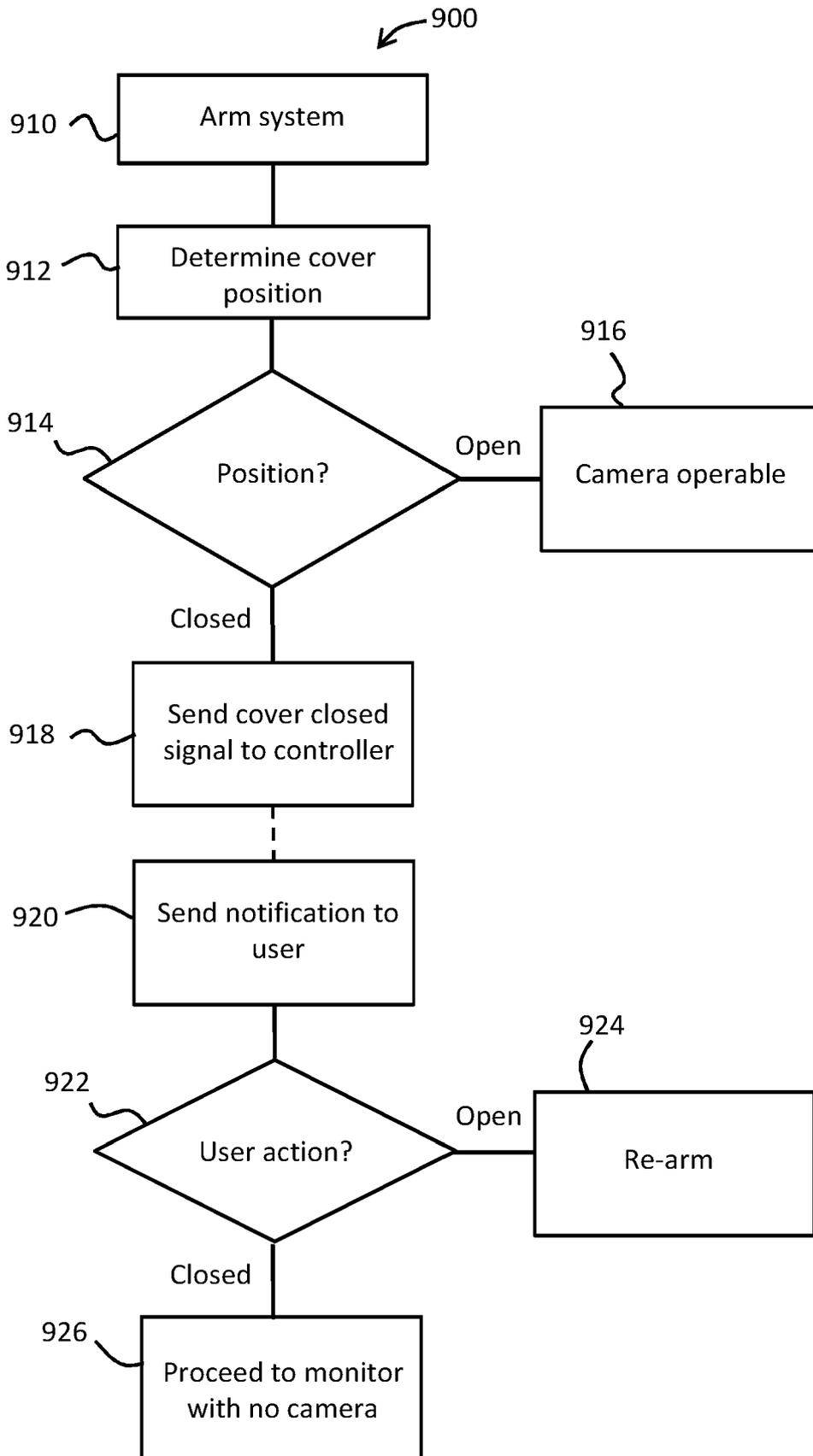


Fig. 9

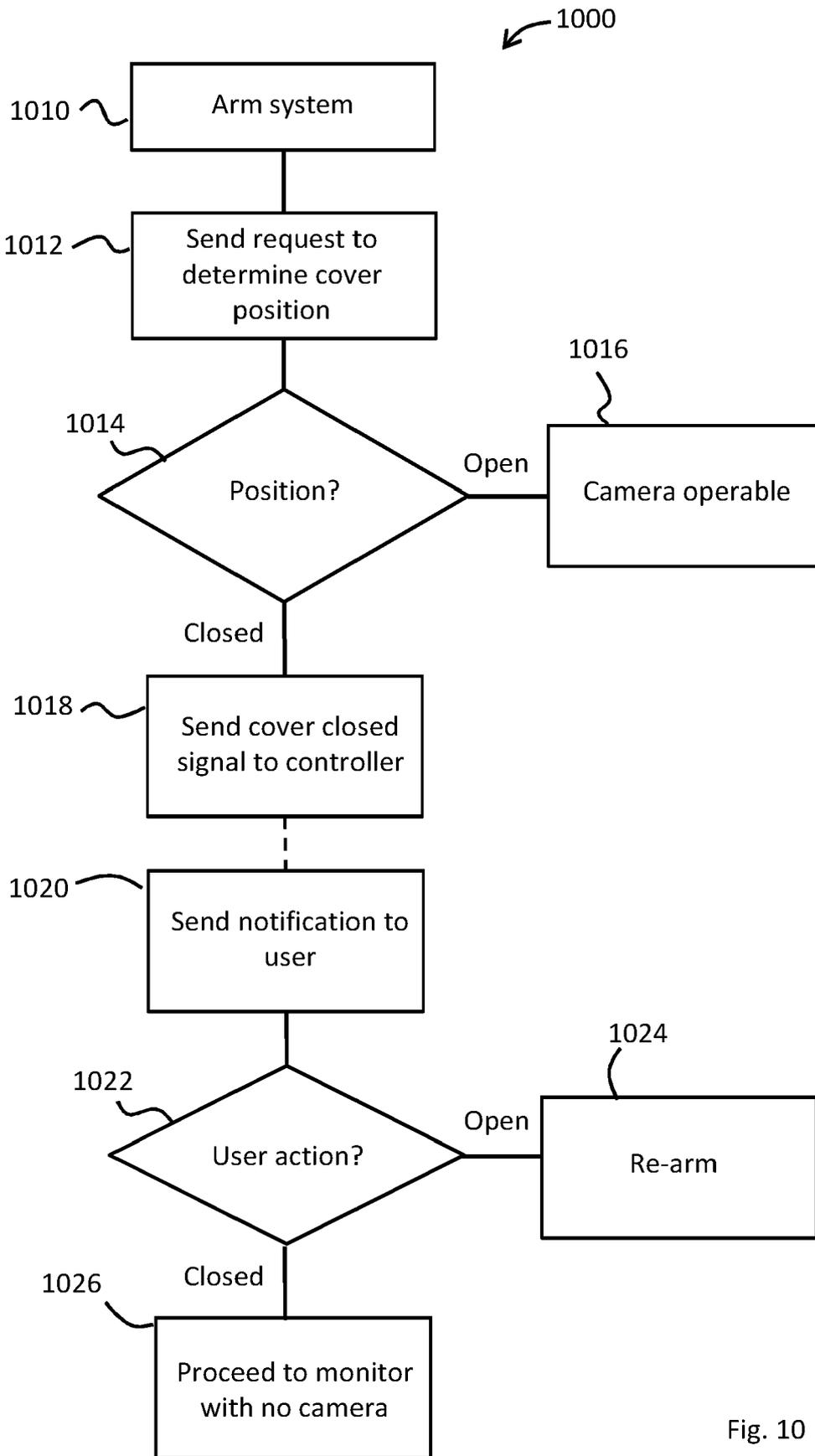


Fig. 10

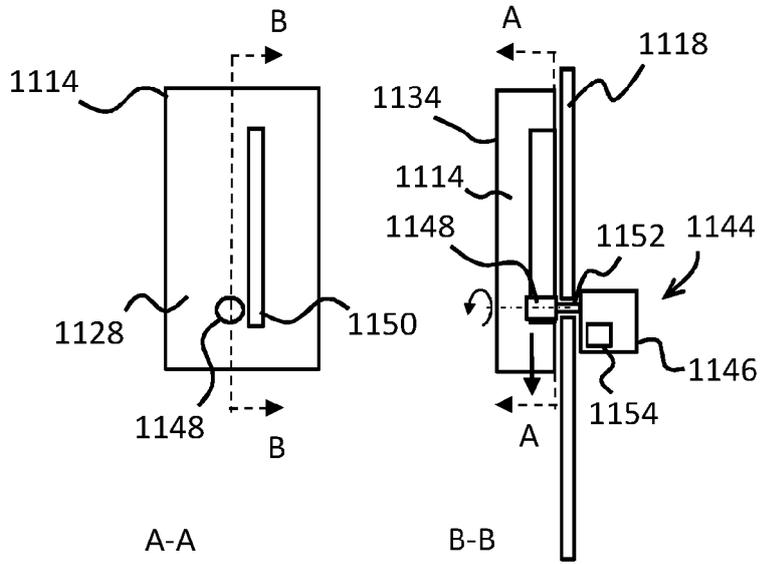


Fig. 11a

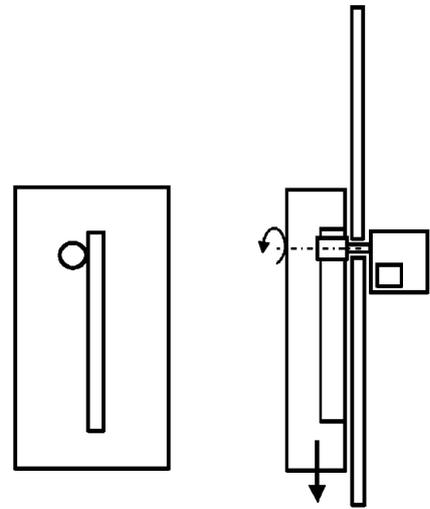


Fig. 11b

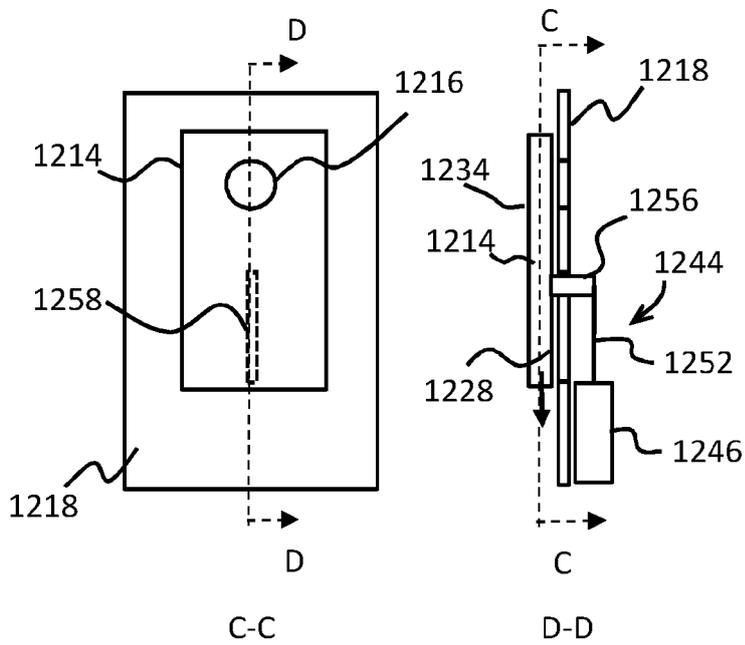


Fig. 12a

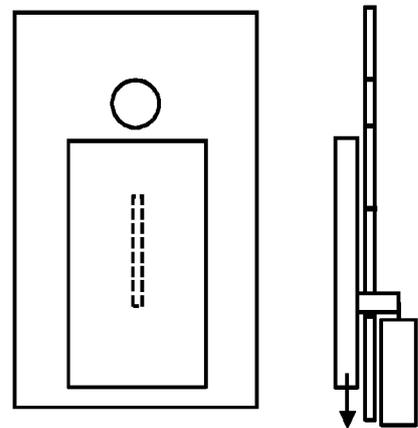


Fig. 12b



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Application Number
EP 20 21 7627

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Y	EP 3 540 704 A1 (VERISURE SARL [CH]) 18 September 2019 (2019-09-18) * paragraphs [0011], [0019] *	5,14	
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The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			H04L
Place of search		Date of completion of the search	Examiner
Munich		21 May 2021	Coffa, Andrew
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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