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(73) Octrooihouder(s):
Unica Groep B.V. te ZWOLLE.

(72) Uitvinder(s):
Henricus Antonius Johannes Maria Jenniskens te BREDA.
Johannes Antonius Catharina Maria Jenniskens te BREDA.

(74) Gemachtigde:
ir. J.M.G. Dohmen c.s. te Eindhoven.

(54) **A method, a test device, a tracing device and a monitoring system for testing a passive infrared motion detection sensor.**

(57) A method, a test device, a tracing device and a monitoring system for testing a passive infrared motion detection sensor having a detection field of view comprised of a plurality of spatially adjacent detection zones. Each detection zone of the sensor has first and second adjacent detection subzones. By determining a respective detection subzone at a position remote from the sensor in the field of view thereof, and arranging the test device at a position for predominantly generating infrared radiation in the determined detection subzone, a reliable response by the sensor can be triggered by generating infrared radiation from the test device in accordance with a radiation profile. The tracing device supports the determination of a subzone for positioning the test device.

Title

A method, a test device, a tracing device and a monitoring system for testing a passive infrared motion detection sensor.

Technical Field

The present disclosure generally relates to passive infrared, PIR, motion detection. More specifically, the present disclosure relates to a method of, a test device and a monitoring system for testing the operation of a PIR sensor. The disclosure further provides a tracing device for tracing detection zones of a PIR sensor.

Background

PIR sensors allow to sense motion by an infrared energy radiating body, such as human body, that moves in or across a detection field of view or detection range of the sensor. PIR motion detection sensors, or also often referred to as pyroelectric or IR motion sensors, are relatively small, low-power and easy to install devices, commonly used in homes, offices and other locations for monitoring and/or alarm applications, for automated operation of lighting equipment, for example, and other control purposes.

The term PIR sensors is used in practice to indicate a complete detection device comprised of the actual detector or sensing part and a beamforming part that determines the detection field of view of the PIR sensor. The majority of present PIR sensors operates with a field of view comprised of adjacently arranged detection zones, either in a sliced type spatial arrangement, wherein the field of view is composed of imaginary adjacently arranged detection slices, or in a three-dimensional arrangement, wherein a detection zone spans a particular solid angle. The number and type of detection zones depends on the type of lens that is used for focussing the infrared energy at the actual detector or sensing part, such as a multiple facetted Fresnel type lens.

PIR sensors nowadays respond based on differential input signals. The detector, i.e. the sensing part of the PIR sensor, has a sensing area comprised of at least two windows. When the detector is idle, i.e. when there is no moving infrared energy source moving in the field of view, all windows detect the same amount of infrared radiation generated in the ambient of the detector, i.e. by the walls and furniture in a room, or outdoors by the sun, for example. When a warm body, like a human or larger animal, at a temperature above the ambient temperature, passes the sensing area of the detector, the radiation energy emitted by the body is captured in a first window and the infrared radiation at the detector increases, which causes a positive differential energy change between this window and a second or any of the other windows, producing a positive going pulse signal. When the body eventually leaves the sensing area the reverse happens, i.e. the infrared energy in the last window decreases, whereby the detector produces a negative differential change pulse signal. The change pulses may trigger a response by the PIR sensor, i.e. by the control electronic thereof processing the pulses.

Most PIR sensors comprise two sensing windows. However sensors comprising detectors having four or even more sensing windows are known in practice. It will be appreciated that in the case of more than two sensing windows, a moving body will cause differential pulses between windows of the detector, such that the number of and the order in which the pulses are produced may also be used for determining whether to respond.

In case of a detector comprising two sensing windows, the detection zones of the PIR sensor are subdivided in a first and a second adjacent detection subzone, either sliced or comprised by solid angle subzones. Likewise, in case of more than two sensing windows, the beamforming part of the PIR sensor divides a detection zone of the PIR sensor in as many as detection subzones as sensing windows, such as consecutive first and second detection subzones, for example.

German patent application DE 199 02 213 discloses a PIR sensor testing arrangement, comprised of a thermal infrared radiation source that is moveable within the field of view of the PIR sensor. In practice, however, in particular for testing a PIR sensor in a room equipped with furniture and the like, such a moving body is impracticable to handle and difficult to control.

International patent application WO03/067203 discloses a device for calibration and control of thermal detectors, such as PIR sensors. The device produces an intensity modulated collimated beam for directing onto a PIR sensor. In particular, it is disclosed to direct the collimated beam at the PIR sensor from a plurality of different positions, and to observe whether the PIR sensor responds. Moving the device to different positions for reliably testing the proper operation of a PIR sensor is cumbersome, relatively expensive, and is not suitable for automated testing procedures.

Summary

It is an object to provide a method and test device for reliably testing PIR sensors, in particular for repeatable, automated testing of PIR sensors in a monitoring system. It is another object to provide a support device for use with the method.

In a first aspect there is disclosed a method of testing a passive infrared motion detection sensor using a test device arranged for generating infrared radiation for exciting the sensor having a detection field of view comprised of a plurality of spatially adjacent detection zones and each detection zone being comprised of first and second adjacent detection subzones. The method comprising the steps of:

- determining a first detection subzone of a detection zone at a position remote from the sensor in the field of view thereof,

- arranging the test device at this position for predominantly generating infrared radiation in the determined first detection subzone, and

- generating infrared radiation by the test device in accordance with a radiation profile, for triggering a response by the sensor.

For provoking a reliable response by the PIR sensor under test, the method involves positioning of the test device in the field of view of the PIR sensor such to substantially radiate infrared radiation in a single detection subzone of the PIR sensor, thereby creating a differential signal between the subzones, for triggering a response by the PIR sensor. That is, after the test device is positioned as indicated and the PIR sensor is in its idle or quiescent state or mode, when generating infrared radiation by the test device in a single subzone, a differential energy change is caused between the first and second detection subzones, and hence the first and second sensing window of the detector in the PIR sensor, thereby producing a differential pulse signal as disclosed above.

A radiation profile may comprise, for example, a pulse type infrared radiation profile, having a predetermined rising or leading edge, a falling or trailing edge and a pulse width during which an amount of infrared energy is radiated by the test device at a level that can be sensed by the PIR sensor taking into account the geographical distance between the test device and the PIR sensor.

The test device, after the correct positioning thereof for testing purposes, may be fixedly and/or permanently installed at this position, such as mounted on a wall in the field of view of the PIR sensor under test. Then, each time by controlling the test device for emitting infrared radiation, the correct operation of the PIR sensor can be tested in an automated manner.

In the case that each detection zone of the sensor is comprised of a plurality of first and second adjacent detection subzones, such as four detection subzones, for example, the step of determining comprises determining, at the position mentioned, a group of first detection subzones of a detection zone, and the step of arranging comprises arranging the test device at the determined position for independently predominantly generating infrared radiation in each determined first detection subzone of the group.

That is infrared radiation can be provided in a first subzone of the group, independently from the other first subzones of the group, thereby creating plural differential pulses for provoking a response by the PIR sensor. To this end, the first detection subzones may be charged with infrared radiation in accordance with a particular radiation profile corresponding to a motion detection profile of a particular sensor under test. That is, the number and sequence of charging the sensing windows of the detector in the PIR sensor may be controlled, for producing differential pulses for reliably triggering a response by the PIR sensor.

It will be appreciated that in the case of charging more than one detection subzone with infrared radiation, the test device has to be suitably equipped therefore or one may install plural test devices, each arranged for charging a single detection subzone.

Among others for automated operation of the test method, the sensor is operatively connected to a monitoring system for monitoring a response by the sensor, wherein the step of generating infrared radiation by the test device is controlled by a control unit of the monitoring system and/or a control circuit of the test device.

The control circuit and/or the control unit may comprise a programmable processor, microcontroller or other programmable control equipment and storage or memory for storing a radiation profile of a sensor under test. The control circuit and/or the control unit may be further arranged for setting the monitoring system in a test mode, implementing a particular delay time for heating up of a thermal infrared radiation device, for example, and for repeating a test once same is not successful, for example, or in accordance with a particular test schedule such as may be required by an insurance company or the like in case of alarm monitoring, for example, and for logging test data in the storage. The control circuit and/or the control unit may have an interface for remote control and communication purposes.

In an embodiment, the step of determining at least one first detection subzone of a detection zone at a position remote from the sensor in the field of view thereof is supported by replacing the sensor under test by a tracing device, arranged for radiating different electromagnetic radiation in a first and second detection subzone of at least one zone in the field of view of the sensor under test, such that a first subzone is determined from detecting the electromagnetic radiation.

The different electromagnetic radiation may be provided by radio wave type radiation having different frequencies, or radiation at a same frequency but differently modulated, for example. The test device may be provided with a suitable electromagnetic radiation detector, or the radiation may be detected by a separate, auxiliary detecting device, for example.

In an embodiment, the tracing device is arranged for radiating differently coloured visible light and wherein a first detection subzone is visibly determined from a light colour allocated to the first detection zone.

For example, in a first detection subzone, green coloured light may be emitted and in a second detection zone red coloured light. By viewing the light thus projected at wall in the field of view of the PIR sensor, i.e. the radiation field of view of the tracing device, a person can easily determine a particular subzone and corresponding position for installing the test device as outlined above, not requiring particular skills or knowledge of the PIR sensor under test or the test method itself.

In a second aspect, for supporting the determining of at least one first detection subzone of a detection zone of a PIR sensor under test, a tracing device is provided, adapted for radiating different electromagnetic radiation in a first and second detection subzone of at least one zone in a field of view of a passive infrared motion detection sensor to be tested, in particular for radiating differently coloured visible light in a first and second detection subzone.

In an embodiment, the tracing device comprises a housing arranged for mounting in a holder of a PIR sensor to be tested, for replacing a sensor part thereof, the tracing device comprises a radiation module comprising at least two electromagnetic radiation sources arranged for radiating mutually different electromagnetic radiation, and a beamforming device arranged for radiating the mutually different electromagnetic radiation in a first and second detection subzone in at least one zone of a field of view of said beamforming device adapted to a particular sensor to be tested.

In this embodiment, the tracing device comprises a beamforming part equivalent to the beamforming part of the sensor under test, whereas at a position comparable to the position of the sensing windows of the detector part of the PIR sensor, the electromagnetic radiating sources are mounted and arranged for radiating mutually different electromagnetic radiation or energy. In the case of emitting visible light, the radiating components may comprise light emitting diodes, LED, arranged or powered for emitting green and red light, respectively, or any other colours that can be easily distinguished from each other.

In a third aspect there is provided an infrared radiation generating test device arranged for testing a passive infrared motion detection sensor having a detection field of view comprised of a plurality of spatially adjacent detection zones and each detection zone being comprised of first and second adjacent detection subzones, the test device having a housing comprising an infrared radiation generator arranged for generating infrared radiation for exciting the sensor, and a control circuit arranged for controlling emission of infrared radiation by the test device, wherein the control circuit is arranged for controlling emission of infrared radiation by the test device in accordance with a radiation profile for triggering a response by the sensor.

The control circuit may comprise a programmable processor, a microcontroller or other programmable control equipment, such as a field-programmable gate array, FPGA, a programmable application specific integrated circuit, ASIC, and storage or memory devices. Further, the control circuit may be arranged for exchanging control signals with a control unit of a monitoring system for monitoring a response by a sensor under test, for controlling operation of the test device by the monitoring system.

In an embodiment of the test device, the infrared radiation generator is an electrically powered thermal infrared radiation source. For example a temperature controlled resistive radiator, comprised of an array of resistive heating components mounted and distributed at a black plate or disc. It has been found that a plate or disc having dimensions in the range of 8 x 8 cm up to 12 x 12 cm or comparable, may be positioned at a distance from about 2 m up to 20 m and even above, for charging a single detection subzone of a PIR sensor.

The test device may further comprise a temperature sensor for measuring ambient temperature, wherein the control circuit is arranged for powering the thermal infrared radiation source at a temperature differing with a set value above ambient temperature, within a temperature range. To this end the thermal infrared radiation source may be powered by a temperature stabilisation circuit.

In an embodiment of the test device, the housing comprises a closable aperture for external emission of infrared radiation generated by the infrared radiation generator, wherein the control circuit is arranged for controlling opening and closing of the aperture for generating the radiation profile, in particular for generating a pulse type radiation profile, having a predetermined rising or leading edge, a falling or trailing edge and a pulse width.

Generating the radiation profile by controlling the opening and closing of a radiation aperture provides that a particular profile can be created without each time taking into account delay times for heating up and cooling down of a thermal radiator, for example.

In another embodiment of the test device, the control circuit is arranged for partially opening the aperture, for controlling the beam width of the emitted infrared radiation, in particular wherein the aperture can be opened and closed by a plurality of parallel elongated shutters, wherein the control circuit is arranged for operating an opening angle of the shutters for controlling the beam width.

By controlling the opening of the aperture, the predominantly charging of a particular detection subzone by infrared radiation may be effectively controlled.

In particular for operation with an advanced PIR sensor, comprising detection zones having more than two detection subzones, the test device in a further embodiment thereof comprises either one or both of a plurality of infrared radiation generators and a plurality of closable apertures arranged for emitting infrared radiation in a plurality of spatially arranged radiation beams, for independently predominantly radiating infrared radiation in a radiation beam adapted to a first detection subzone of a sensor under test.

In a fourth aspect, there is provided a monitoring system, comprising at least one passive infrared motion detection sensor operatively connected to a control unit of the monitoring system, for monitoring a response by the at least one sensor, and at least one test device as disclosed above, operatively connected to the control unit. The monitoring system may be arranged for testing at least one sensor in accordance with the method disclosed above.

The monitoring system may be any of an alarm system, a motion controlled switching system, or the like.

The above-mentioned and other features and advantages of the disclosure will be best understood from the following description referring to the attached drawings. In the drawings, like reference numerals denote identical parts or parts performing an identical or comparable function or operation.

Brief description of the drawings

Figure 1 shows schematically, perspectively, a typical prior art passive infrared, PIR, motion detection sensor.

Figure 2 shows schematically, not to scale, the detection field of view of the PIR sensor of Figure 1, seen from the top.

Figure 3 shows, schematically, in top view, a prior art detector for use in the PIR sensor of Figure 1, having two sensing windows.

Figure 4 shows, schematically, in top view, a prior art detector for use in a PIR sensor, having four sensing windows.

Figure 5 shows an example of a radiation profile for triggering an PIR sensor in accordance with the present disclosure.

Figure 6 shows, schematically, in top view, a radiation module for use in a tracing device in accordance with the present disclosure.

Figure 7 shows schematically, perspectively, an embodiment of a test device in accordance with the present disclosure.

Figure 8 shows schematically, in front view, a further embodiment of a test device in accordance with the present disclosure.

Figure 9 shows an electric circuit diagram of a test device in accordance with the present disclosure.

Figure 10 shows an electric circuit diagram of a monitoring system in accordance with the present disclosure.

Detailed description

Figure 1 shows a typical embodiment of a prior art passive infrared, PIR, motion detection sensor 1. The PIR sensor 1 is comprised of a detection or sensing part 2 that is removably attached to a holder 3. The holder 3 is typically fixedly mounted at a wall or ceiling in a room to be monitored. The PIR sensor has a detection window 4 for detecting or sensing motion by an infrared energy radiating body, such as human body, that moves along or passes the window 4. Reference numeral 5 designates a control or signal light that typically lights up when movement of an infrared energy radiating body is detected by the PIR sensor 1.

Typically, the window 4 is formed by a beam forming part 6, such as an infrared transparent or transmissive lens, for example a Fresnel type lens, having multiple facets 7 defining a particular detection range or field of view, FOV, of the PIR sensor 1, such as the FOV 8 shown in Figure 2. The beamforming part 6 directs infrared radiation in the FOV 8 at the actual detecting part of the PIR sensor 1, formed by an infrared radiation detector 9.

The multi facetted beam forming part 6 of Figure 1 provides an FOV 8 comprised of imaginary, adjacently arranged, sliced type detection zones 10 - 17, each schematically indicated by a dotted line. Figure 2 shows the FOV 8 in top view, such that the imaginary sliced zones 10 - 17 extend in a direction perpendicular to the plane of the drawing. It will be appreciated that the number and type of detection zones 10 -17 depends on the type of lens that is used for focussing the infrared energy at the detector 9.

In the embodiment shown in Figure 2, each detection zone 10 - 17 is comprised by two adjacent detection subzones, i.e. a first detection subzone A and second detection subzone B.

Figure 3 schematically shows the detector 9 in top view. The detector 9 has two adjacently arranged sensing windows, a first sensing window 18 and a second sensing window 19. By the beamforming part 6, the detection zones 10 - 17 of the PIR sensor 1 are aligned with the detector 9 such that for each detection zone infrared radiation energy in a first detection subzone A is directed at the first sensing window 18, and infrared radiation energy in a second detection subzone B is directed at the second sensing window 19.

When the detector 9 is in its idle or quiescent state, i.e. when there is no moving infrared energy source in the FOV 8, both windows 18, 19 sense the same amount of infrared radiation generated in the ambient of the PIR sensor 1. Such as infrared radiation energy radiated by the walls and furniture in a room, or outdoors by the sun. The detector 9, i.e. the processing or control electronics connected at the output of the detector 9, are arranged such that when both subzones A, B of a detection zone 10 - 17 substantially receive a same amount of infrared radiation energy at the same time, no response signal is provided.

However, when a thermal radiation source, such as a warm body like a human or larger animal at a temperature above ambient temperature moves in the FOV 8 of the IR sensor, from one detection zone to the other, the detection subzones A, B are sequentially charged with infrared radiation energy from the body (not shown).

Suppose that the body is moving from detection zone 12 to detection zone 15 in the FOV 8. Then the radiation energy emitted by the body is first captured by subzone 12A and directed at the first sensing window 18 of the detector 9, such that the infrared radiation energy at the detector 9 increases. This causes a positive differential infrared energy change between the first window 18 and the second window 19, producing for example a positive going pulse signal, as indicated by the order of the + and - signs next to the first sensing window 18. When the body moves further and eventually leaves the subzone 12B, the detector 9 experiences a decrease in infrared radiation energy, producing a negative going pulse signal, as indicated by the order of the - and + signs next to the second sensing window 19. Accordingly, the detector 9 produces differential pulse signals. The changing pulses may trigger a response by the PIR sensor, i.e. by the control electronics thereof processing the pulses.

It will be appreciated that when the body moves further in the FOV 8, to detection zone 13, and so on, a sequence of differential pulses will be generated by the detector. From the order of the pulses and the time between the pulses of different detection zones the control electronics of the PIR sensor 1 may derive the direction and speed by which the body moves through the FOV 8.

Most PIR sensors comprise two sensing windows. However PIR sensors comprising detectors having four or even more sensing windows, such as the detector shown 20 shown in Figure 4 are also known in practice. It will be appreciated that in the case of more than two sensing windows, such as the four sensing windows 21 - 24, movement of a body in three dimensions can be established.

The moving body will cause differential pulses between adjacent windows of the detector 20, as schematically indicated by the + and - signs next to the windows 21 - 24. Likewise as with the detector 9 of Figure 3, the sensing windows 21 - 24 may be aligned by a beamforming part of a PIR sensor such that each detection zone consists of four subzones, which may be designated first and second detection subzones A, B such that the windows 21 and 23 form first subzones A and the windows 22, 24 form second subzones B. To this end one may think of a beamforming part such that each subzone spans a particular solid angle. A PIR sensor of this type is, for example, suitable for being mounted at the ceiling in the middle of a room.

The number of and the order and speed by which differential pulses are produced by the detector 20 may be used for determining whether to respond, that is determine a particular detection or response profile at which the PIR sensor provides a response, such as an alarm or, for example, switches lights in particular order in a room.

The present disclosure is based on the insight that, for testing purposes, a reliable response of a PIR sensor can be provoked or triggered, by charging a respective single detection subzone of a detection zone of the PIR sensor under test with infrared radiation, thereby creating a differential signal between the subzones of the PIR sensor. That is, by charging the single subzone in accordance with a particular radiation profile, corresponding to a response profile for which the PIR sensor provides a response. Thus, a test device emitting infrared radiation for exciting the detector of a PIR sensor is to be installed at a position in the FOV of the PIR sensor for predominantly generating infrared radiation in a single first detection subzone A, for example.

Accordingly, in a first step, at the position at which the test device is to be arranged, such a first detection subzone in the FOV of the PIR sensor under test thereof has to be established. Once positioned, a reliable response by the PIR sensor, such as the PIR sensor 1, can be provided by generating infrared radiation by the test device.

A radiation profile may comprise, for example, a pulse type infrared radiation profile 25 as schematically indicated in Figure 5. The profile 25 is characterized by a rising or leading edge 26, a falling or trailing edge 27 and a pulse width 28 during which an amount of infrared energy is radiated by the test device at a level H that can be sensed by the PIR sensor under test, taking into account the geographical distance between the test device and the PIR sensor.

The leading edge 26 may be characterized by a particular rise time t_r, the trailing edge may be characterized by a particular fall time t_f and the pulse width may be characterized by the time t_w, for example, as shown in Figure 5. In an example, the rise time t_r and the fall time t_f both amount 150 ms, and the pulse width t_w has a length of 3000 ms.

In case of a detector having more than two sensing windows, such as the detector 20 discussed above, dependent on a particular detection or response profile of the detector, it may be required to charge two or even more subzones A thereof, either at the same time or in a particular order. For example charging the respective subzones by a pulse type charging as shown in Figure 5.

In general, charging a single subzone A or B of a PIR sensor will reliably provoke a response signal for testing purposes, that is to test whether the PIR sensor is alive and not tampered with, for example.

The test device, after the correct positioning thereof, for testing purposes, may be fixedly and/or permanently installed at the position determined. For example, mounted on a wall in the FOV of the PIR sensor under test. Then, each time by controlling the test device for emitting infrared radiation, the correct operation of the PIR sensor can be tested in an automated manner.

It will be appreciated that in the case of charging more than one detection subzone with infrared radiation, the test device has to be suitably equipped therefore or one may install plural test devices, each arranged for charging a single detection subzone.

For determining a particular detection subzone at a position remote from the PIR sensor under test a tracing support device is provided. This tracing device is arranged such that, for example in case of a PIR sensor 1 a s shown in Figure 1, in the sensing or detection part 2 thereof the detector 9 is replaced by a radiation module 30, as shown in top view in Figure 6.

In the case of a detector 9 having two sensing windows, the radiation module 30 likewise comprises two radiation components 31, 32, arranged for radiating mutually different electromagnetic radiation in a first A and second B detection subzone of each zone 10 - 17 in the field of view 8 of the PIR sensor 1.

Accordingly, by detecting the particular electromagnetic radiation at the position at which the test device is to be installed, a particular subzone of the PIR sensor under test can be determined. That is, the sensing part 2 of the PIR sensor 1 under test has to be detached from the holder 3 and replaced by an identical sensing part 2, however in which the detector 9 is replaced by the radiation module 30. Power for the radiation module 30 may be extracted for the monitoring system to which the PIR sensor 1 connects and/or the tracing device may have an own on-board battery power supple, for example.

The different electromagnetic radiation of the radiation components 31, 32 may be provided by a radio wave type radiation having different frequencies, or radiation at a same frequency but differently modulated, for example. For detection of a particular subzone, the test device may be provided with a suitable electromagnetic radiation detector, or the radiation may be detected by a separate, auxiliary detecting device, for example manually.

In an embodiment, the radiation module 30 comprises light emitting diodes as radiation components 31, 32 for radiating differently coloured visible light. The first (or second) detection subzone may then be visibly determined from a particular light colour allocated to the first (or second) detection zone. For example, in a first detection subzone A, green coloured light may be emitted and in a second detection zone B red coloured light. By viewing the light thus projected at wall in the field of view of the PIR sensor under test, i.e. the radiation field of view of the tracing device, a person can easily determine a particular subzone A and B form its colour, and hence a corresponding position for installing the test device as outlined above.

Dependent on the type and design of a PIR sensor under test, the tracing device comprises a housing arranged for mounting in a holder of a particular PIR sensor to be tested. The beam forming part of the tracing device may, for example, be made replaceable for adapting same to the beamforming part of a particular PIR sensor.

It will be appreciated that in case of a detector 20 having a plurality of sensing windows 21 - 24, the radiation module has to comprise a same number of radiation components, designed such that the subzones of a particular detection zone can be distinguished.

Figure 7 shows an embodiment of an infrared radiation generating test device 40 in accordance with the present disclosure, arranged for testing a PIR sensor as discussed above, such as the PIR sensor 1. The test device 40 has a housing 41 and comprises an infrared radiation generator 42 arranged inside the housing 41, and designed for generating infrared radiation for exciting a PIR sensor.

The housing 41, at the front part 43 thereof, comprises a closable aperture for external emission of infrared radiation generated by the infrared radiation generator 42. The aperture can be opened and closed by a plurality of parallel elongated shutters 44, that can swing around a hinge shaft, and may be operated in concert or individually by suitable driving means, for example a single electromotor 54, such as a stepper motor, and mechanical drive means, such as a hingedly connected linkage 55 indicated by dashed lines, by which the shutters 44 connect, or individual motors each operating at a particular shutter 44, for operating an opening angle of the shutters for controlling the beam width of the infrared radiation beam emitted by the test device 40.

Generating the radiation profile by controlling the opening and closing of the radiation aperture provides that a particular radiation profile can be created without each time taking into account delay times for heating up and cooling down of the thermal radiator 42, for example. Further, by controlling the opening of the aperture, the amount of infrared radiation for charging a particular detection subzone with infrared radiation may be effectively controlled.

The test device 40 comprises control logic (not shown), for controlling operation of the device and powering and signal input/output connectors 45.

Instead of parallel shutters 44, the radiation aperture may also be opened and closed by, for example, so-called photo shutters 47, 48 as schematically shown with another embodiment of a test device 46 in accordance with the present disclosure. The test device 46 comprise two independently controllable shutter 47, 48, for example for charging two detection subzones of PIR sensor under test, or for charging a first subzone A of different detection zones for simulating a walking body in the FOV of a PIR sensor under test, for example.

The electric circuit diagram shown in Figure 9 is an example of the control electronics of the test device 40. The infrared radiation generator 42 is an electrically powered thermal infrared radiation source, comprised of an array of resistive heating components 49 mounted and distributed at a black plate or disc 50. It has been found that a plate or disc having dimensions in the range of 8 x 8 cm up to 12 x 12 cm or comparable, may be positioned at a distance from about 2 m up to 20 m and even above, for charging a single detection subzone of a PIR sensor.

In operation, the infrared radiation generator 42 produces infrared radiation in the so-called long wavelength infrared, LWIR, transmission band that runs from 8000 to 14,000 nm. This type of radiation is related to the temperature of an object, such as a human or animal body, that produce energy peaks around 10,000 nm.

The infrared radiation generator 42 is powered by a temperature stabilisation circuit 51, under control of a control circuit 53 to which a temperature sensor 56 connects, for measuring ambient temperature T. The temperature stabilisation circuit 51 comprises an input 52 for powering. The control circuit 53 is arranged for controlling the thermal infrared radiation generator 42 through the temperature stabilisation circuit 51 at a temperature that differs with a set value above ambient temperature, among others for reducing power consumption at low ambient temperatures. The set value is, for example, a value above the human body temperature. An operating range of the test device 40 ranges from an ambient temperature of about -20 °C up to about 70 °C, for example. In this way, the test device 40 may be used for testing both inside and outside mounted PIR devices.

The control circuit 53 is arranged for controlling opening and closing of the aperture of the test device for generating a radiation profile for triggering a response by the sensor under test, such as profile shown in Figure 5. For example, by controlling a single or plural shutter motors, generally designated by reference numeral 54.

Among others for automated test operation, the control circuit 53 may be operatively connected to a monitoring system 60, for monitoring a response by a PIR sensor, as schematically shown in Figure 10. The monitoring system 60 comprises a control unit 58 to which a plurality of PIR sensors 1 and test devices 40 connect, for example. The test devices 40 are installed and positioned for triggering a response by an associated PIR sensor 1.

The control circuit 53 and/or the control unit 58 may comprise a programmable processor, microcontroller or other programmable control equipment such as a field-programmable gate array, FPGA, or a programmable application specific integrated circuit, ASIC, and storage or memory (not shown) for storing a radiation profile of a sensor under test. The control circuit 53 and/or control unit 58 may be further arranged for setting the monitoring system 60 in a test mode, implementing a particular delay time for heating up of a thermal infrared radiation test device 40, for example, and for repeating a test once same is not successful, for example, or to operate in accordance with a particular test schedule such as may be required by an insurance company or the like in case of alarm monitoring, for example, and for logging test data in the storage. The control circuit 53 and/or the control unit 58 may have an interface 57, 59 for remote control and communication purposes.

In particular for operation with an advanced PIR sensor, comprising detection zones having more than two detection subzones, the test device 40, 46 may comprise a plurality of infrared radiation generators 42 for emitting infrared radiation in a plurality of spatially arranged radiation beams, for example.

The present disclosure is not limited to the embodiments as disclosed above, and can be modified and enhanced by those skilled in the art beyond the scope of the present disclosure as disclosed in the appended claims without having to apply inventive skills.

Those skilled in the art will appreciate other variations to the disclosed embodiments but comprised by the appended claims from practicing the claimed disclosure and /or from a study of the description, drawings and claims. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. A single processor or other digital processing unit may fulfil the functions of several items recited in the claims and features recited in mutually different dependent claims may be combined. Reference signs in the claims, if any, are provided for illustrative purposes only.

CONCLUSIES

1. Werkwijze voor het testen van een passieve infrarood bewegingsdetectiesensor gebruikmakend van een testinrichting ingericht voor het voortbrengen van infraroodstraling voor het exciteren van de sensor, welke sensor een detectiezichtveld heeft omvattende een veelheid ruimtelijk aangrenzende detectiezones en waarbij elke detectiezone eerste en tweede aangrenzende detectiedeelzones omvat, welke werkwijze de stappen omvat van het:

- bepalen van een eerste detectiedeelzone van een detectiezone op een positie op afstand van de sensor in het zichtveld hiervan,
- opstellen van de testinrichting op de positie voor het in hoofdzaak voortbrengen van infraroodstraling in de bepaalde eerste detectiedeelzone, en
- voortbrengen van infraroodstraling door de testinrichting in overeenstemming met een stralingsprofiel voor het activeren van een reactie door de sensor.

2. Werkwijze volgens conclusie 1, waarin elke detectiezone van de sensor een veelheid eerste en tweede aangrenzende detectiedeelzones omvat, waarin de stap van het bepalen omvat het op de positie bepalen van een groep van eerste detectiedeelzones van een detectiezone en de stap van het opstellen omvat het opstellen van de testinrichting op de positie voor het onafhankelijk in hoofdzaak voortbrengen van infraroodstraling in elke bepaalde eerste detectiedeelzone van de groep.

3. Werkwijze volgens conclusie 2, waarin de stap van het voortbrengen van infraroodstraling omvat het voortbrengen van infraroodstraling in de eerste detectiedeelzones van de groep in overeenstemming met een bewegingsdetectieprofiel van de sensor.

4. Werkwijze volgens een van de voorgaande conclusies, waarin het stralingsprofiel een stralingsprofiel van het pulstype omvat, met een vooraf bepaalde opgaande flank of voorflank, een neergaande flank of achterflank en een pulsbreedte.

5. Werkwijze volgens een van de voorgaande conclusies, waarin de sensor werkzaam is verbonden met een bewakingssysteem voor het bewaken van een reactie door de sensor, waarin de stap van het door de testinrichting voortbrengen van infraroodstraling wordt gestuurd door ten minste een van een stuureenheid van het bewakingssysteem en een stuurschakeling van de testinrichting.

6. Werkwijze volgens een van de voorgaande conclusies, waarin de stap van het bepalen van ten minste één eerste detectiedeelzone van een detectiezone op een positie op afstand van de sensor in het zichtveld hiervan omvat het vervangen van de sensor door een traceerinrichting ingericht voor het in een eerste en een tweede detectiedeelzone van ten minste één zone in het zichtveld van de sensor uitstralen van verschillende elektromagnetische straling en waarin een eerste deelzone wordt bepaald uit het detecteren van de elektromagnetische straling.

7. Werkwijze volgens conclusie 6, waarin de traceerinrichting is ingericht voor het uitstralen van zichtbaar verschillend gekleurd licht en waarin een eerste detectiedeelzone wordt bepaald uit een aan de eerste detectiezone toegekende lichtkleur.

8. Infraroodstraling voortbrengende testinrichting ingericht voor het testen van een passieve infrarood bewegingsdetectiesensor welke een detectiezichtveld heeft omvattende een veelheid ruimtelijk aangrenzende detectiezones en waarbij elke detectiezone eerste en tweede aangrenzende detectiedeelzones omvat, welke testinrichting een behuizing heeft omvattende een infraroodstralingsgenerator ingericht voor het voortbrengen van infraroodstraling voor het exciteren van de sensor en een stuureenheid ingericht voor het sturen van emissie van infraroodstraling door de testinrichting, waarin de stuureenheid is ingericht voor het sturen van emissie van infraroodstraling door de testinrichting in overeenstemming met een stralingsprofiel voor het activeren van een reactie door de sensor.

9. Testinrichting volgens conclusie 8, waarin de behuizing een sluitbare apertuur omvat voor externe emissie van infraroodstraling voortgebracht door de infraroodstralingsgenerator, waarin de stuureenheid is ingericht voor het sturen van het openen en sluiten van de apertuur voor het voortbrengen van het stralingsprofiel, in het bijzonder voor het voortbrengen van een stralingsprofiel van het pulstype, met een vooraf bepaalde opgaande flank of voorflank, een neergaande flank of achterflank en een pulsbreedte.

10. Testinrichting volgens conclusie 9, waarin de stuureenheid is ingericht voor het gedeeltelijk openen van de apertuur, voor het sturen van een bundelbreedte van de geëmitteerde infraroodstraling, in het bijzonder waarin de apertuur kan worden geopend en gesloten door een veelheid evenwijdige langwerpige lamellen, waarin de stuureenheid is ingericht voor het sturen van een openingshoek van de lamellen voor het sturen van de bundelbreedte.

11. Testinrichting volgens conclusie 8, 9 of 10, waarin de infraroodstralingsgenerator een elektrisch bekrachtigde thermische infraroodstralingsbron is, welke inrichting verder een temperatuursensor omvat voor het meten van omgevingstemperatuur, waarin de stuureenheid is ingericht voor het bekrachtigen van de thermische infraroodstralingsbron op een temperatuur welke verschilt met een ingestelde waarde boven de omgevingstemperatuur, in een temperatuurbereik.

12. Testinrichting volgens conclusie 8, 9, 10 of 11, omvattende ten minste één van een veelheid infraroodstralingsgeneratoren en een veelheid sluitbare aperturen ingericht voor het emitteren van infraroodstraling in een veelheid ruimtelijk gerangschikte stralingsbundels, voor het onafhankelijk in hoofdzaak uitstralen van infraroodstraling in een stralingsbundel afgestemd op een eerste detectiedeelzone van een te testen sensor.

13. Traceerinrichting, ingericht voor het in een eerste en tweede detectiedeelzone van ten minste één zone in een zichtveld van een te testen passieve infrarood bewegingsdetectiesensor uitstralen van verschillende elektromagnetische straling, in het bijzonder voor het in een eerste en tweede detectiedeelzone uitstralen van zichtbaar verschillend gekleurd licht.

14. Traceerinrichting volgens conclusie 13, omvattende een behuizing ingericht voor montage in een houder van een passieve infrarood bewegingsdetectiesensor voor het vervangen van een sensordeel hiervan, welke traceerinrichting een stralingsmodule omvat welke ten minste twee elektromagnetische stralingsbronnen omvat ingericht voor het onderling uitstralen van verschillende elektromagnetische straling en een bundelvormingsinrichting ingericht voor het uitstralen van de onderling verschillende elektromagnetische straling in een eerste en tweede detectiedeelzone in ten minste één zone in een zichtveld van de bundelvormingsinrichting, afgestemd op een betreffende te testen sensor.

15. Bewakingssysteem, omvattende ten minste één passieve infrarood bewegingsdetectiesensor werkzaam verbonden met een stuureenheid van het bewakingssysteem voor het bewaken van een reactie door de ten minste ene sensor en ten minste één testinrichting in overeenstemming met een van de conclusies 8 - 12, werkzaam verbonden met de stuureenheid en ingericht voor het testen van de ten minste ene sensor in overeenstemming met een werkwijze volgens een van de conclusies 1 - 7.

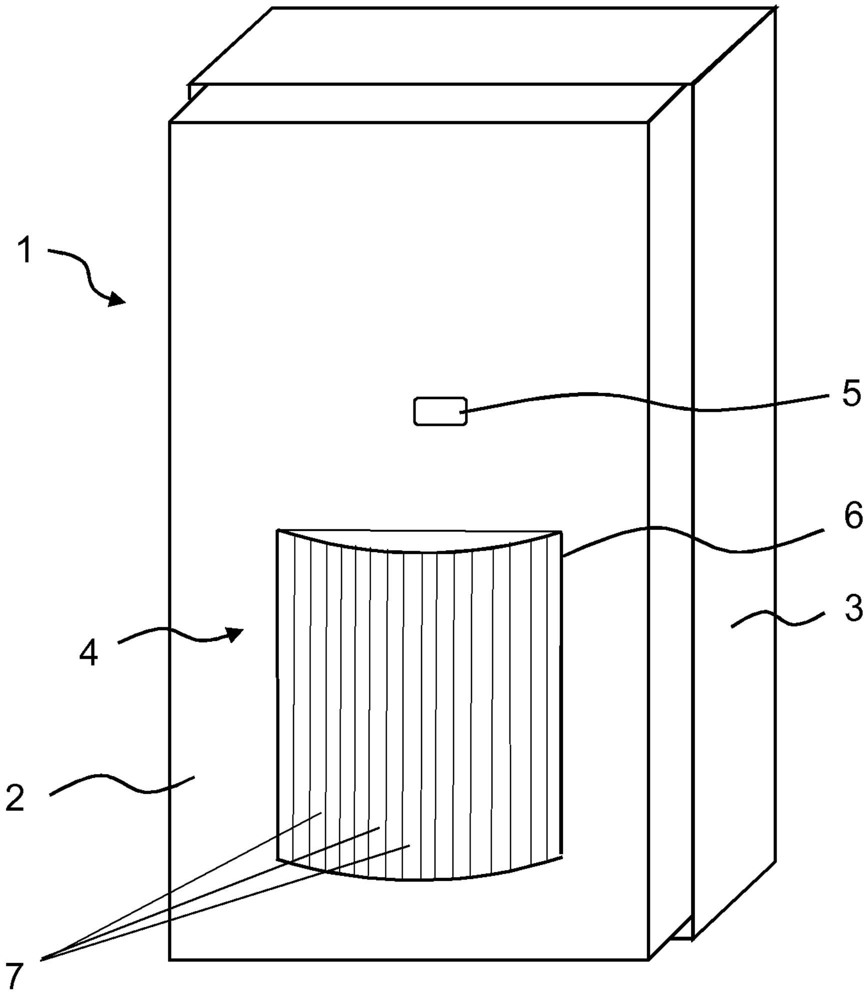

Fig. 1

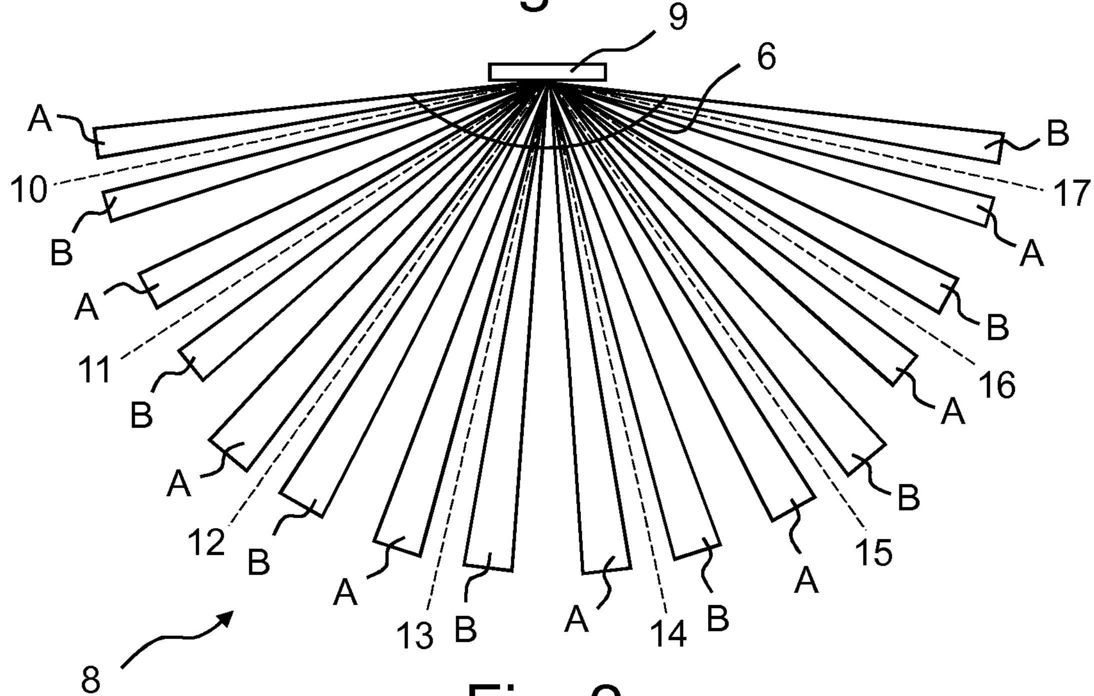

Fig. 2

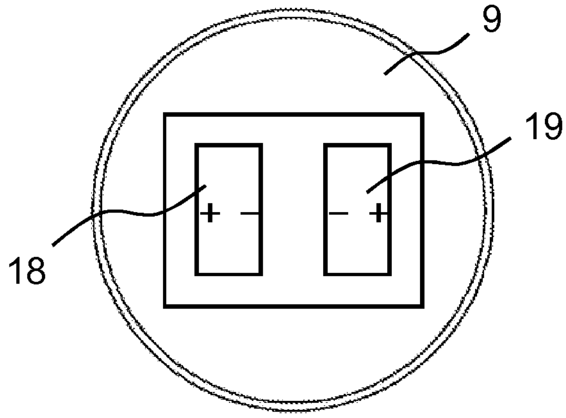

Fig. 3

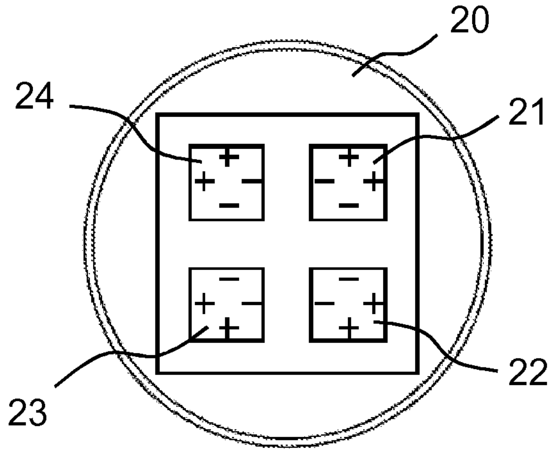

Fig. 4

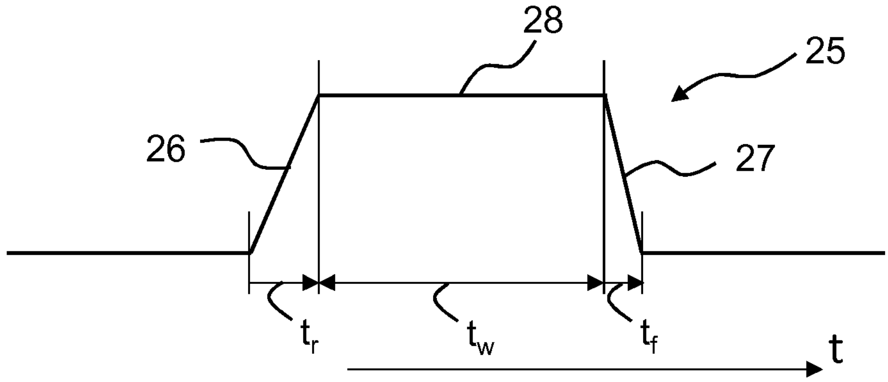

Fig. 5

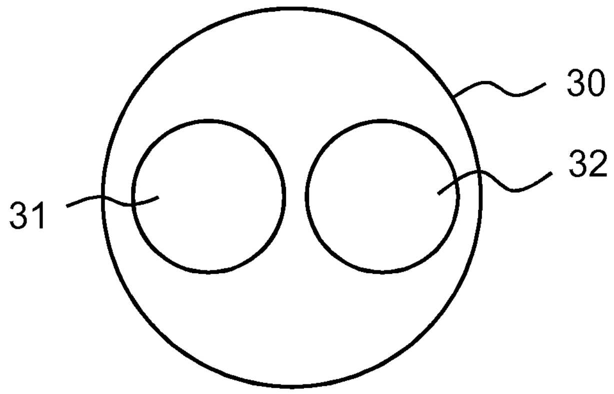

Fig. 6

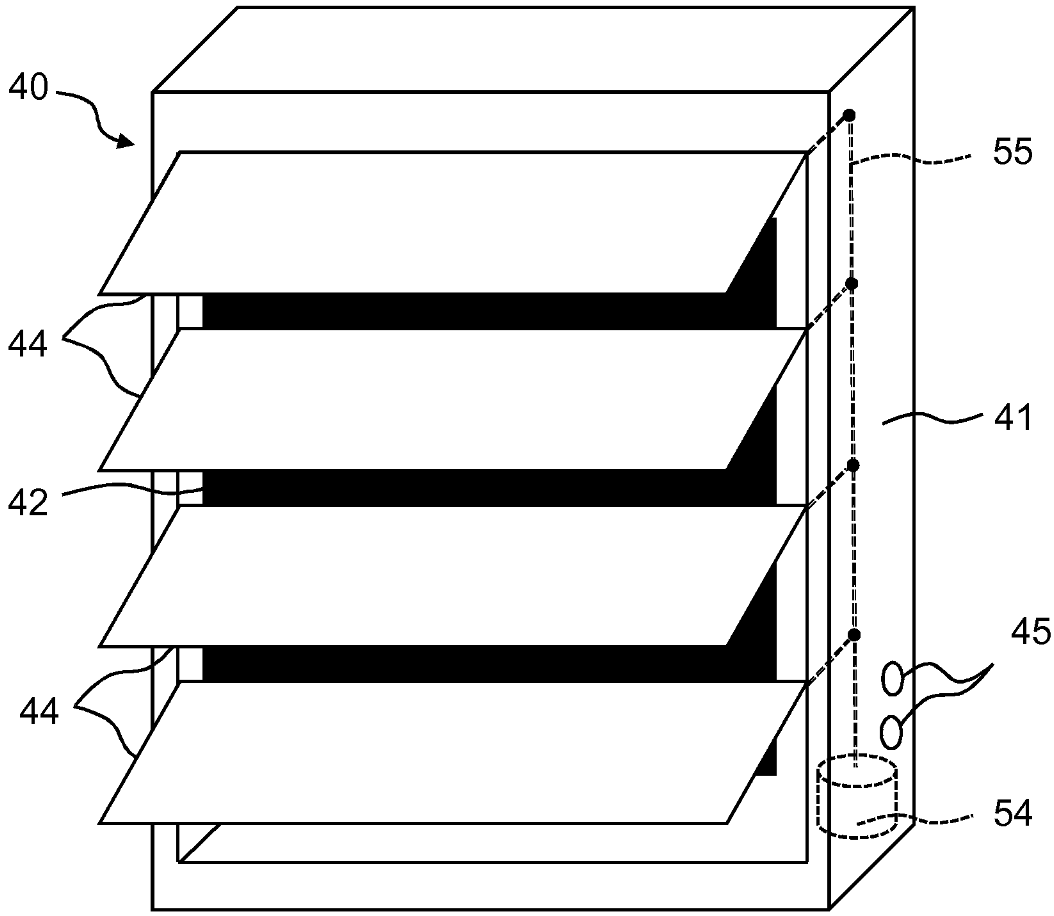

Fig. 7

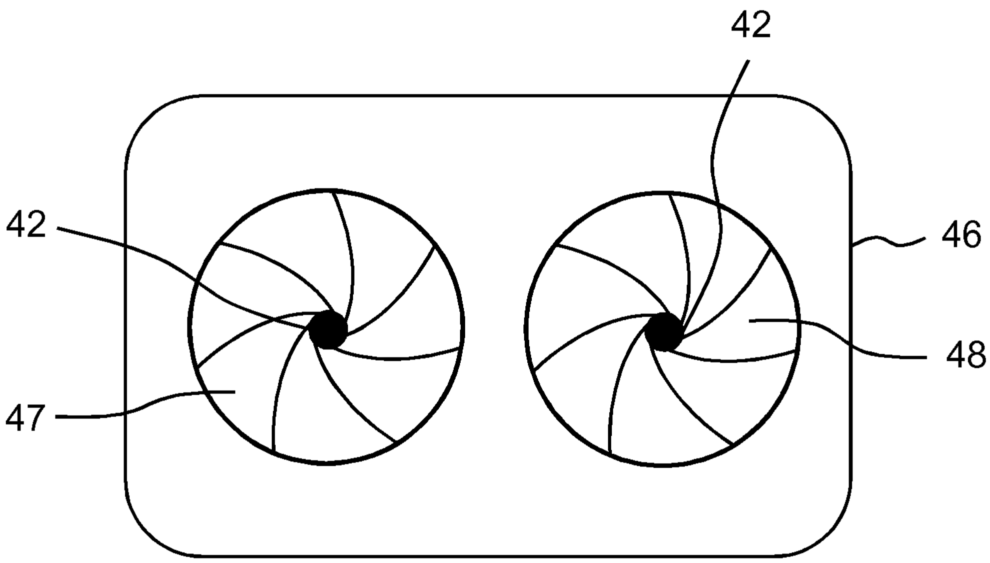

Fig. 8

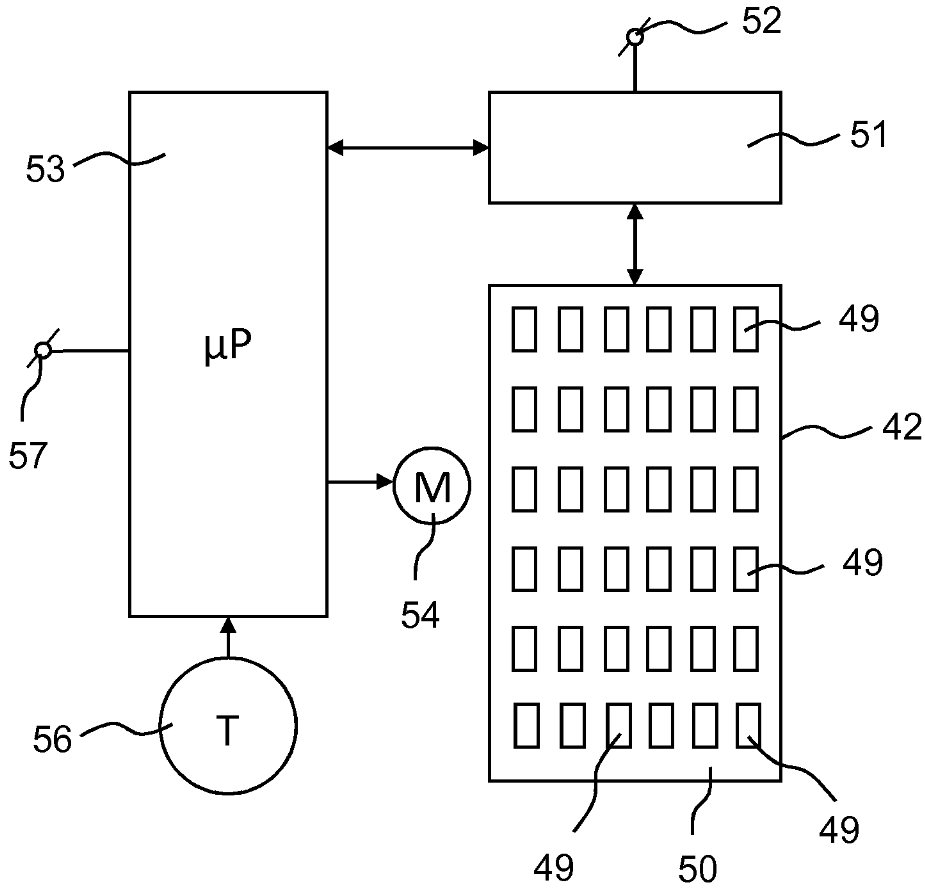

Fig. 9

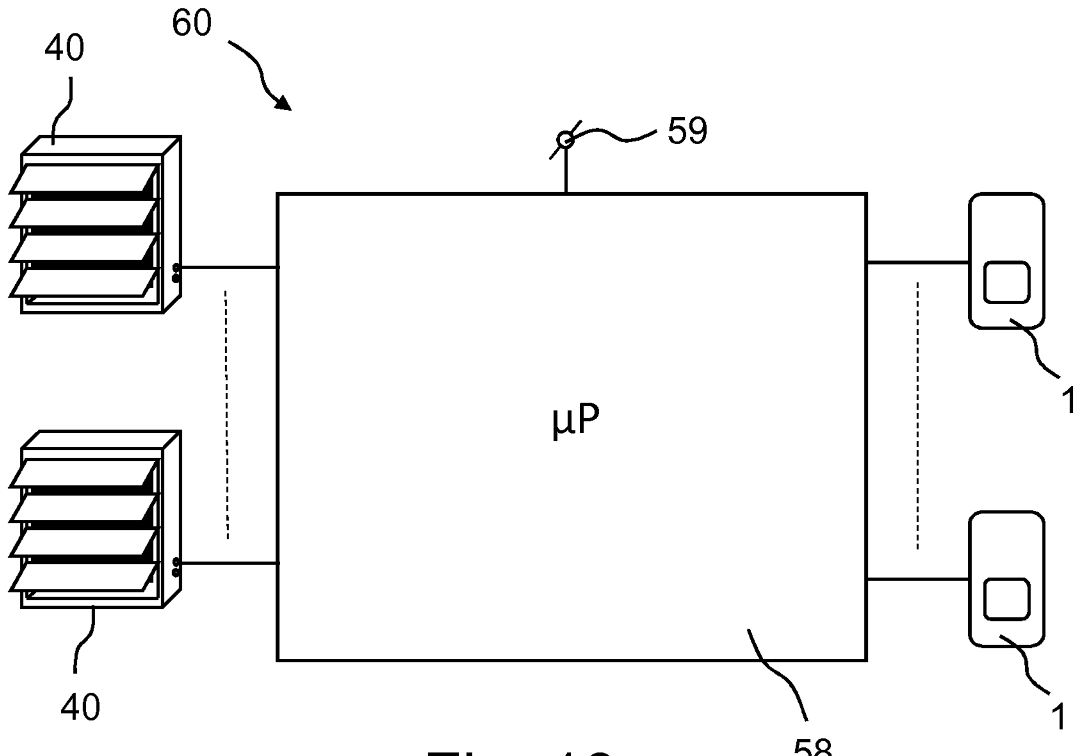

Fig. 10

ABSTRACT

A method, a test device, a tracing device and a monitoring system for testing a passive infrared motion detection sensor having a detection field of view comprised of a plurality of spatially adjacent detection zones. Each detection zone of the sensor has first and second adjacent detection subzones. By determining a respective detection subzone at a position remote from the sensor in the field of view thereof, and arranging the test device at a position for predominantly generating infrared radiation in the determined detection subzone, a reliable response by the sensor can be triggered by generating infrared radiation from the test device in accordance with a radiation profile. The tracing device supports the determination of a subzone for positioning the test device.

Rijksdienst voor Ondernemend Nederland

RAPPORT BETREFFENDE HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK

Octrooiaanvrage 2017644

Classificatie van het onderwerp[1]: G08B 13/19; G08B 29/22	Onderzochte gebieden van de techniek[1]: G08B; G01J; G05J; G01P
Computerbestanden: EPODOC, WPI	Omvang van het onderzoek: Volledig
Datum van de onderzochte conclusies: 11 november 2016	Niet onderzochte conclusies: –

Van belang zijnde literatuur

Categorie[2]	Vermelding van literatuur met aanduiding, voor zover nodig, van speciaal van belang zijnde tekstgedeelten of figuren.	Van belang voor conclusie(s)
A, D	DE 19902213 A (ABB PATENT GMBH) 27 juli 2000 * gehele document * – – –	1 – 7
X, D	WO 03/067203 A (QINETIQ LTD) 14 augustus 2003 * figuren; samenvatting; bladzijde 3, regels 20 – 26; bladzijde 5, regels 7 – 9 * – – –	8 – 12
X	US 5438233 A (BHK INC) 1 augustus 1995 * figuren 1 en 4; samenvatting; kolom 2, regel 65 – kolom 3, regel 2; kolom 4, regels 27 – 33 * – – –	8 – 10, 12
A	FR 2901394 A (EURO PROT SURVEILLANCE SOC PAR) 23 november 2007 * figuren 5 en 6; samenvatting; bladzijde 1, regels 24 – 30; bladzijde 5, regels 7 – 11 * – – –	13, 14
A	EP 0234312 A (CERBERUS AG) 2 september 1987 * figuren 2 en 4; samenvatting; bladzijde 10, regel 8 – bladzijde 11, regel 27 * – – – – –	13, 14

Datum waarop het onderzoek werd voltooid: 22 juni 2017	De bevoegde ambtenaar: W. Boek **Octrooicentrum Nederland,** **onderdeel van Rijksdienst voor Ondernemend Nederland**

1 Gedefinieerd volgens International Patent Classification (IPC).
2 Verklaring van de categorie-aanduiding: zie apart blad.

Categorie van de vermelde literatuur:

X: op zichzelf van bijzonder belang zijnde stand van de techniek

Y: in samenhang met andere geciteerde literatuur van bijzonder belang zijnde stand van de techniek

A: niet tot de categorie X of Y behorende van belang zijnde stand van de techniek

O: verwijzend naar niet op schrift gestelde stand van de techniek

P: literatuur gepubliceerd tussen voorrangs- en indieningsdatum

T: niet tijdig gepubliceerde literatuur over theorie of principe ten grondslag liggend aan de uitvinding

E: octrooiliteratuur gepubliceerd op of na de indieningsdatum van de onderhavige aanvrage en waarvan de indieningsdatum of de voorrangsdatum ligt voor de indieningsdatum van de onderhavige aanvrage.

D: in de aanvrage genoemd

L: om andere redenen vermelde literatuur

&: lid van dezelfde octrooifamilie; corresponderende literatuur

AANHANGSEL

**Behorende bij het Rapport betreffende het Onderzoek naar
de Stand van de Techniek, Octrooiaanvrage 2017644**

Het aanhangsel bevat een opgave van elders gepubliceerde octrooiaanvragen of octrooien (zogenaamde leden van dezelfde octrooifamilie), die overeenkomen met octrooigeschriften genoemd in het rapport. De opgave is samengesteld aan de hand van gegevens uit het computerbestand van het Europees Octrooibureau per 22 juni 2017. De juistheid en volledigheid van deze opgave wordt noch door het Europees Octrooibureau, noch door Octrooicentrum Nederland gegarandeerd; de gegevens worden verstrekt voor informatiedoeleinden.

In het rapport genoemd octrooigeschrift		Datum van publicatie	Overeenkomende octrooigeschriften		Datum van publicatie
DE 19902213	A1	27-07-2000	(geen)		
WO 03067203	A2	14-08-2003	US 2005116168	A1	02-06-2005
			US 7858941	B2	28-12-2010
			EP 1470402	A2	27-10-2004
			AU 2003205843	A1	02-09-2003
US 5438233	A	01-08-1995	(geen)		
FR 2901394	A1	23-11-2007	(geen)		
EP 0234312	A1	02-09-1987	US 4757204	A	12-07-1988
			CA 1259389	A	12-09-1989

Rijksdienst voor Ondernemend Nederland

SCHRIFTELIJKE OPINIE

Octrooiaanvrage 2017644

Indieningsdatum: 20 oktober 2016	Voorrangsdatum:
Classificatie van het onderwerp[1]: G08B 13/19; G08B 29/22	Aanvrager: Unica Groep B.V.

Deze schriftelijke opinie bevat een toelichting op de volgende onderdelen:

☒ Onderdeel I	Basis van de schriftelijke opinie
☐ Onderdeel II	Voorrang
☐ Onderdeel III	Vaststelling nieuwheid, inventiviteit en industriële toepasbaarheid niet mogelijk
☐ Onderdeel IV	De aanvraag heeft betrekking op meer dan één uitvinding
☒ Onderdeel V	Gemotiveerde verklaring ten aanzien van nieuwheid, inventiviteit en industriële toepasbaarheid
☐ Onderdeel VI	Andere geciteerde documenten
☐ Onderdeel VII	Overige gebreken
☐ Onderdeel VIII	Overige opmerkingen

	De bevoegde ambtenaar: W. Boek **Octrooicentrum Nederland,** **onderdeel van Rijksdienst voor Ondernemend Nederland**

1 Gedefinieerd volgens International Patent Classification (IPC).

Schriftelijke Opinie

Octrooiaanvrage 2017644

Onderdeel I **Basis van de schriftelijke opinie**

Deze schriftelijke opinie is opgesteld op basis van de op 11 november 2016 ingediende conclusies.

Onderdeel V **Gemotiveerde verklaring ten aanzien van nieuwheid, inventiviteit en industriële toepasbaarheid**

1. Verklaring

Nieuwheid	Ja: Conclusie(s)	1 – 7, 11 – 15
	Nee: Conclusie(s)	8 – 10
Inventiviteit	Ja: Conclusie(s)	1 – 7, 13 – 15
	Nee: Conclusie(s)	11, 12
Industriële toepasbaarheid	Ja: Conclusie(s)	1 – 15
	Nee: Conclusie(s)	

2. Literatuur en toelichting

In het rapport betreffende het onderzoek naar de stand van de techniek worden de volgende publicaties genoemd:

D1: DE 19902213 A (ABB PATENT GMBH) 27 juli 2000
D2: WO 03/067203 A (QINETIQ LTD) 14 augustus 2003
D3: US 5438233 A (BHK INC) 1 augustus 1995
D4: FR 2901394 A (EURO PROT SURVEILLANCE SOC PAR) 23 november 2007
D5: EP 0234312 A (CERBERUS AG) 2 september 1987

Conclusies 1 – 7 en 15

Publicatie D1 wordt gezien als de meest nabij gelegen stand van de techniek. Uit deze publicatie is een werkwijze bekend voor het testen van een passieve infrarood bewegingsdetectiesensor (zie samenvatting).

De in D1 beschreven werkwijze maakt gebruik van een testinrichting ('Testobjekt 1'), ingericht voor het voortbrengen van infraroodstraling (zie kolom 1, regel 54: 'Wärmestrahler') voor het exciteren van de sensor. De sensor heeft een detectiezichtveld (kolom 1, regel 12: 'Erfassungsbereich'), dat zoals bekend een veelheid ruimtelijk aangrenzende detectiezones omvat (zie o.a. ook D4 en D5).

De werkwijze volgens D1 omvat de stappen van:

– het opstellen van de testinrichting op verschillende posities voor het voortbrengen van infraroodstraling in een detectiezone (zie kolom 1, regels 52 – kolom 2, regel 2); en
– het voortbrengen van infraroodstraling door de testinrichting in overeenstemming met een stralingsprofiel voor het activeren van een reactie door de sensor (zie kolom 2, regels 3 – 16).

De maatregel volgens conclusie 1 van de onderhavige aanvrage, dat de werkwijze tevens de stap omvat van het bepalen van een eerste detectie*deelzone* van een detectiezone op een positie op afstand van de sensor in het zichtveld hiervan, is niet bekend uit publicatie D1. Conclusie 1 is dus nieuw.

Voorts wordt in de onderzochte stand van de techniek geen aanwijzing gevonden voor een dergelijke maatregel, die gericht is op het gebruik van nauwkeurig geselecteerde detectiedeelzones bij het testen van een bewegingsdetectiesensor onder pratijkomstandigheden. Daarom wordt conclusie 1 tevens inventief geoordeeld.
In afhankelijkheid van conclusie 1 dienen ook conclusies 2 – 7, alsmede conclusie 15, zowel nieuw als inventief te worden beoordeeld.

Conclusies 8 – 12
Uit elk van de publicaties D2 en D3 is een infraroodstraling voortbrengende inrichting bekend, omvattende een behuizing met een infraroodstralingsgenerator en een stuureenheid, alsmede een sluitbare apertuur (zie de in het rapport vermelde passages). Met een dergelijke inrichting is het mogelijk om een infraroodbewegingsdetectiesensor te testen (zie o.a. D2, bladzijde 1, 'calibrating'). Hoewel in conclusie 8 van de onderhavige aanvrage wordt beschreven dat de inrichting geschikt dient te zijn voor het testen van een passieve infraroodbewegingsdetectiesensor met een detectiezichtveld bestaande uit detectiezones met detectie*deelzones*, wordt geoordeeld dat een dergelijke geschiktheid slechts ligt in het (nauwkeurig) positioneren van de testinrichting. De uit D2 en D3 bekende testinrichtingen *als zodanig* worden hiertoe geschikt geacht.
Op grond van het voorgaande worden de (beperkende) maatregelen volgens conclusies 8 – 10 bekend geoordeeld uit publicaties D2 en D3. Beide publicaties zijn daarom nieuwheidsbezwarend voor conclusies 8 – 10.

De maatregelen volgens conclusies 11 en 12, gericht op het gebruik van een temperatuursensor (conclusie 11), of het toepassen van meerdere infraroodstralingsgeneratoren (conclusie 12), worden gezien als logische uitbreidingen zonder inventiviteitswaarde. Conclusies 11 en 12 worden daaom niet inventief geoordeeld ten opzichte van D2 of D3 in combinatie met de algemene kennis van de vakman.

Conclusies 13 en 14
Ten slotte is uit elk van de publicaties D4 en D5 een traceerinrichting bekend voor het in een of meer detectiezones uitzenden van elektromagnetische straling, om zo de detectiezones zichtbaar te maken (zie de in het rapport vermelde passages). Daarenboven is uit D4 bekend, dat voor het zichtbaar maken van meerdere detectiezones, gebruik kan worden gemaakt van verschillende kleuren licht (zie D4, bladzijde 5, regels 7 – 11).

Uit geen van de publicaties D4 of D5 is echter de maatregel volgens conclusie 13 bekend, dat de inrichting ook geschikt is voor het uitzenden van verschillende elektromagnetische straling in verschillende detectie*deelzones.* Ook wordt geen aanleiding gevonden voor een dergelijke maatregel. Daarom worden ook conclusies 13 en 14 zowel nieuw als inventief geoordeeld.