



## Description

**[0001]** The present invention relates to a spot sensor for smoke and/or temperature and/or flame and/or other substances and/or phenomena.

**[0002]** A spot smoke sensor is an electronic device capable of detecting the presence of smoke in the environment in which it is installed and of sending an alarm signal when one or more predefined or in any case programmable thresholds are exceeded.

**[0003]** Detection of the presence of smoke is of the optical type and is based on the "Tyndall effect".

**[0004]** The Tyndall effect is a phenomenon of light diffusion caused by the presence of particles in the air.

**[0005]** Because of the Tyndall effect, therefore, in the presence of smoke particles, incident light is reflected by them.

**[0006]** As mentioned, the spot smoke sensor operates according to the Tyndall effect and therefore detects an increase in the reflection of a beam of light, which can be visible or invisible, in the presence of smoke when the former is reflected by the particles of the latter.

**[0007]** The electro-optical part of the sensor comprises:

- one or more light transmitters,
- one or more light receivers.

**[0008]** Such transmitter and such receiver are axially offset and therefore there is no direct optical contact between the two.

**[0009]** The region composed of the transmitter, the receiver and the smoke detection area is contained in a smoke analysis chamber which is shaped like a labyrinth in order to hinder or minimize the entry of external light.

**[0010]** A protective grille hinders and/or minimizes the entry of:

- insects,
- objects,
- dirt.

**[0011]** The light emitted by the transmitter can be:

- always present, in the case of an always-on transmitter,
- pulsed, in the case of a normally-off transmitter which turns on for a fraction of a second at regular time intervals.

**[0012]** Currently, pulsed-light smoke sensors are the most widespread.

**[0013]** A smoke sensor is normally composed of two parts which are assembled together:

- an electro-optical part, which contains the optical elements, the electronic board and connection elements,

- a base for supporting the electro-optical part, which comprises a containment tray, sliding or interlocking metallic laminas and the appropriate screws for the electrical wiring and the means for association with the electro-optical part.

**[0014]** Generally, the two parts mutually interlock by means of a bayonet coupling.

**[0015]** This allows ease of installation and removal of the electro-optical part even from a distance, by means of a telescopic gripping tool.

**[0016]** Electrical contact by means of sliding and interlocking metallic laminas offers less reliability and durability over time than that offered by an industrial-grade terminal block.

**[0017]** The smoke sensor is installed on the surface of the ceiling of the room to be monitored.

**[0018]** This ceiling can be:

- real, i.e., constituted by masonry elements,
- virtual, i.e., constituted by a false ceiling composed of removable panels and/or plasterboard.

**[0019]** During operation of the sensor, two operating states can be distinguished:

- operation in the absence of smoke,
- operation in the presence of smoke.

**[0020]** In the absence of smoke, only a fraction of the light emitted by the transmitter reaches the receiver.

**[0021]** This allows diagnostics of the smoke sensor for correct operation and for the estimation of the life cycle, which is useful for maintenance planning.

**[0022]** In the presence of smoke, however, a larger amount of light emitted by the transmitter reaches the receiver, by virtue of the reflection on the smoke particles.

**[0023]** This makes it possible to measure the quantity of smoke that is present and to start the fire alarm signal, depending on the preset threshold or thresholds, or according to dynamic thresholds.

**[0024]** However, it should be considered that an increase in reflection, and therefore the exceeding of the alarm threshold, can also be due to the presence of other factors:

- insects,
- objects,
- dirt.

**[0025]** In this case the alarm is actually a false alarm.

**[0026]** Maintenance seeks to minimize false alarms by cleaning the labyrinth-shaped smoke analysis chamber.

**[0027]** In fact, the many blind corners that are present in the labyrinth offer points of accumulation for dust, dirt (which for various reasons can shift into the smoke analysis area and create false alarms) and shelter for insects.

**[0028]** Substantially two constructive types of smoke

sensor are currently widespread.

**[0029]** The first type of smoke sensor is the sensor with an optical smoke analysis chamber of the type that is darkened and labyrinth-shaped, i.e., protected from external light.

**[0030]** This is a dome-shaped smoke sensor which protrudes with respect to the surface to which it is applied, inside which there is a darkened area which is labyrinth-shaped and protects against the entry of external light, and a grille which protects against the entry of objects, dirt and insects.

**[0031]** This type of sensor has a protrusion, with respect to the surface to which it is applied, which can be as much as on the order of 10 centimeters.

**[0032]** This type of sensor offers higher reliability and simplicity of analysis of the signals received by the optical receiver.

**[0033]** However, during periodic, generally annual, maintenance, defined by the standards in each country, cleaning of the internal parts is awkward and labor-intensive, since it is necessary to remove the dome and the electro-optical part from the supporting base, disassemble the plastic parts that make up the labyrinth that contains the smoke analysis area, clean it with appropriate means, and finally reassemble everything.

**[0034]** The second type of smoke sensor is the sensor with optical smoke analysis chamber of the visible type, i.e., exposed to external light.

**[0035]** This is a substantially flat smoke sensor which is slightly in relief with respect to the surface to which it is applied.

**[0036]** This type of sensor has a protrusion, with respect to the surface to which it is applied, of less than 1 centimeter.

**[0037]** This kind of smoke sensor is more recent than the sensor with darkened chamber and utilizes innovative electro-optical elements, algorithms originating from other sectors including touch sensors, and higher-performance processing units with respect to the preceding type of sensor, all of which allow it to support greater software complexity for the analysis of the data received from the optical receiver, for the filtering of (natural or artificial) external light and other (regular or irregular) intermittent optical phenomena impinging on the light emitted by the transmitter.

**[0038]** Periodic maintenance is simpler with respect to the first type of sensor, since it is only necessary to clean the external surface, without having to remove the electro-optical part from the supporting base, an operation which does not require specific equipment.

**[0039]** Furthermore, this type of sensor is subject to fewer false alarms owing to dirt or insects, both of which are linked to the presence of recesses or blind corners.

**[0040]** In both of these types of sensor, the electro-optical part is associated with the supporting base using the bayonet coupling mentioned earlier.

**[0041]** The sensor type with visible optical chamber, while allowing easier and faster maintenance than the

sensor type with darkened optical chamber, has, in the current market, like the latter, the drawback of having to first install the supporting base on the surface of the ceiling and then associate therewith the electro-optical part.

**[0042]** The installation difficulties and the space occupations are substantially the same for both types of sensor.

**[0043]** In this second type of sensor, since the optical chamber does not protrude as it does for darkened optical chamber sensors, the supporting base is deeper, since it has to contain all of the electro-optical part.

**[0044]** Furthermore, since the electro-optical part is more recessed, the size of the base is larger and non-standard with respect to other objects that are usually arranged on a false ceiling, and therefore it may require the use of dedicated tools to provide its seating.

**[0045]** Moreover, not all bases of this type of sensor with visible optical chamber have a standard size.

**[0046]** The aim of the present invention is to provide a spot sensor for smoke and/or temperature and/or flame and/or other substances and/or phenomena that is capable of improving the background art in one or more of the aspects indicated above.

**[0047]** Within this aim, an object of the invention is to provide a spot sensor for smoke and/or temperature and/or flame and/or other substances and/or phenomena that is easier to install with respect to sensors of the known type, while at the same time maintaining the same performance and ease of maintenance of sensors with a visible optical chamber.

**[0048]** Another object of the invention is to provide a spot sensor for smoke and/or temperature and/or flame and/or other substances and/or phenomena that has standard measurements and does not entail the drawback, for the user and/or installer, of having to use specific tools for the installation of the base.

**[0049]** Another object of the invention is to provide a spot sensor for smoke and/or temperature and/or flame and/or other substances and/or phenomena that is compact and has smaller space occupations with respect to similar sensors of the known type.

**[0050]** Furthermore, an object of the present invention is to overcome the drawbacks of the background art in an alternative manner to any existing solutions.

**[0051]** Another object of the invention is to provide a spot sensor for smoke and/or temperature and/or flame and/or other substances and/or phenomena that is highly reliable, easy to provide and low cost.

**[0052]** This aim, as well as these and other objects which will become better apparent hereinafter, are achieved by a sensor for smoke and/or temperature and/or flame and/or other substances and/or phenomena, comprising an electronic board which comprises:

- an optical chamber containing one or more light transmitters and one or more light receivers for smoke detection,
- a microprocessor and/or another programmable de-

vice for the management of said sensor which is connected to said one or more transmitters and to said one or more receivers,

- one or more terminal blocks, for connection to data link and electric power supply cables,

said sensor being characterized in that said electronic board is contained within a substantially flat shell.

**[0053]** Further characteristics and advantages of the invention will become better apparent from the description of a preferred but not exclusive embodiment of the spot sensor for smoke and/or temperature and/or flame and/or other substances and/or phenomena according to the invention, which is illustrated by way of non-limiting example in the accompanying drawings, wherein:

Figure 1 is a general view of a spot sensor for smoke and/or temperature and/or flame and/or other substances and/or phenomena according to the invention;

Figure 2 is an exploded view of the sensor of Figure 1; Figures 3 and 4 are two cross-sectional views of two different applications of the sensor according to the invention.

**[0054]** With reference to the figures, a spot sensor for smoke and/or temperature and/or flame and/or other substances and/or phenomena according to the invention is generally designated by the reference numeral 10.

**[0055]** The spot sensor 10 for smoke and/or temperature and/or flame and/or other substances and/or phenomena comprises an electronic board 12.

**[0056]** The electronic board 12 comprises:

- an optical chamber 13 of the visible type, containing one or more light transmitters 1 and one or more light receivers 2,
- a microprocessor 14 and/or another programmable element for the management of the sensor 10, which is connected to the transmitter 1 and to the receiver 2,
- one or more terminal blocks 15, for connection to the data link and electric power supply cables 16.

**[0057]** The terminal block 15 can be fixed or extractable:

- fixed, if the electrical wires are fixed to the terminal block 15 which is soldered directly onto the electronic board 12, therefore monolithic,
- removable, if the terminal block 15 is composed of two parts, one soldered directly onto the electronic board 12 and the other fixed to the electrical wires; in this case, the association occurs by means of an interlocking coupling between the pins of the part soldered onto the electronic board 12 and the receptacles of the part that is fixed to the electrical wires.

**[0058]** Preferably, the terminal block 15 is of the ex-

tractable type.

**[0059]** The optical chamber 13 is arranged in the surface of the electronic board 12, which can be opposite from the surface in which the microprocessor 14 is present.

**[0060]** One of the peculiarities of the sensor 10 consists in that the electronic board 12 is contained within a substantially flat shell 17 having a circular profile.

**[0061]** The electronic board 12 can be treated with protective coatings such as adhesives or resins for higher protection against the environment and for better sealing within the shell 17.

**[0062]** In the embodiment shown in the figures, the shell 17 has a circular profile, but in other embodiments, not shown, the shell 17 can also have a different profile, for example quadrangular, or another shape that is such as to be inserted into the base of a spotlight holder of the standard type.

**[0063]** The expression "spotlight holder of the standard type" in the present description is understood to refer to an interlocking adapter support for (civil, residential and industrial) lighting spotlights for flush mounting in a false ceiling. This support enables easy installation due to simplicity of assembly and disassembly and by virtue of the measurements which are coded on the market and are well-known to the person skilled in the art.

**[0064]** A spotlight holder of the standard type is constituted by an annular element, which is contoured for aesthetic reasons and which:

- can be accommodated easily in a hole provided in the false ceiling and subsequently locked in place by virtue of appropriate systems with springs or tabs or other solutions;
- can contain a lighting spotlight, which is accommodated axially inside it and subsequently locked in place by virtue of appropriate systems with springs or tabs or other solutions.

**[0065]** The outside diameter of the hole for accommodation in the false ceiling can have different values which are defined and standard in the market.

**[0066]** Likewise, the outside diameter of the spotlight holder can have various values which are defined and standard in the market.

**[0067]** In this manner, both the lighting spotlight and the spotlight holder are components that are standardized on the market and allow easy installation and maintenance.

**[0068]** This brings a clear economic saving in production and during transport, since the sensor is much smaller with respect to the current background art.

**[0069]** This allows the sensor 10 to be compact and have a smaller space occupation than smoke sensors of the known type.

**[0070]** The shell 17 comprises two half-shells:

- a first half-shell 18a, to be directed toward the false

ceiling 19 or the ceiling 20, and adapted to be hidden from view after the installation of the sensor 10,

- a second half-shell 18b, to be directed toward the environment in which the sensor 10 is applied and which is visible after its installation.

**[0071]** The sensor 10 comprises a support 21, which is constituted by a spotlight holder of a type that is known per se, inside which the shell 17 is recessed.

**[0072]** The dimensions and the shape of the shell 17 are such that it can be installed inside a flush-mount spotlight holder for a false ceiling.

**[0073]** The support 21 is provided with a hole 22 for the flush mounting of the shell 17.

**[0074]** The hole 22 for the flush mounting of the shell 17 has a diameter comprised in a range of values from 3 cm to 20 cm.

**[0075]** The support 21 comprises means 35 for removable engagement with the element to which the sensor 10 is applied.

**[0076]** Such means 35 for removable engagement are for example snap-acting springs.

**[0077]** These are torsion springs which comprise a spiral 40 at the ends of which a wing 41 protrudes.

**[0078]** Operation is as follows:

- the wings 41 are raised in order to be able to insert the support 21 into a hole 34 of the false ceiling 19,
- as a result of elastic return, owing to the torsion of the spirals 40, the wings 41 are lowered onto the upper surface of the false ceiling 19, thus ensuring the support 21 thereon.

**[0079]** In this manner it is not necessary to provide a receptacle and dedicated electrical connections for the sensor 10, and one or more terminal blocks 15 are sufficient.

**[0080]** The two half-shells 18a and 18b are integrally associated by virtue of methods that are known per se, such as for example pins and protrusions for interlocking, not shown in the figures, or by virtue of fixing screws.

**[0081]** The first half-shell 18a has:

- a first through opening/hole 23, for the passage of the cables 16 and/or of a portion of the terminal block 15,
- a second through hole 24, into which a screw 25 for locking the half-shells 18a and 18b is inserted.

**[0082]** The second half-shell 18b has:

- a circular opening 26 for the exposure of the optical chamber 13, located at the center of the circular cross-section of the second half-shell 18b,
- two protrusions 27, which extend from the surface 28 of the second half-shell 18b that is internal to the shell 17 and is directed toward the first half-shell 18a.

**[0083]** The opening 26 can optionally be protected by a thin transparent glass screen with a thickness of the order of 1 mm, fixed to the shell 17 by way of rubbers and/or resins and/or adhesives, for better stability and protection from the environment.

**[0084]** As an alternative to glass it is possible to use a layer of polymethyl methacrylate.

**[0085]** The exposure of the optical chamber 13 from the shell 17 makes it possible to maintain a similar ease of maintenance as for sensors with visible optical chamber of the known type.

**[0086]** The protrusions 27 have a substantially cylindrical body, with a dead hole 33, on the surface directed toward the first half-shell 18a.

**[0087]** The dead hole 23 of one of the protrusions 27 corresponds to the through hole 24 of the first half-shell 18a and therefore the screw 25 is inserted therein.

**[0088]** In particular, these protrusions 27 are identical and opposite with respect to a plane of symmetry that is perpendicular to the surface 28 of the second half-shell 18b.

**[0089]** The electronic board 12 has, in the example shown in the figures, a circular profile and two through holes 29, into which the protrusions 27 are inserted.

**[0090]** The profile of the electronic board 12 substantially duplicates the profile of the shell 17.

**[0091]** The through holes 29 of the electronic board 12 and the protrusions 27 of the second half-shell 18b facilitate the insertion and placement of the electronic board 12 inside the second half-shell 18b, speeding up assembly of the sensor 10.

**[0092]** The shell 17, once recessed in the support 21, is kept inside it by way of removable retention means 30, which are constituted for example by a spring that extends perimetrically within the flush-mounting hole 22 of the support 21 and has contoured portions 31 which are removably inserted into corresponding openings 32 of the support 21.

**[0093]** Figure 3 shows a first application of the sensor 10 according to the invention.

**[0094]** In the first application, the sensor 10 is applied to a false ceiling 19.

**[0095]** In this application, the support 21 is recessed in a hole 34 of the false ceiling 19 which is designed to accommodate a flush-mounted spotlight holder.

**[0096]** The support 21 is associated with the hole 34 of the false ceiling 19 by way of the removable engagement means 35.

**[0097]** In turn, the shell 17 is flush-mounted in the support 21 and is associated therewith by way of the removable retention means 30.

**[0098]** Figure 4 on the other hand schematically shows the application of a sensor 10 to a ceiling 20.

**[0099]** In this case there is no receptacle for the support 21 but it is still possible to install the sensor 10 by fixing to the ceiling 20 an appropriate container 36 which can be likened, in terms of shape and dimensions, to the hole 34 of the false ceiling 19 of the example of Figure 3.

[0100] The sensor 10 therefore comprises a container 36, inside which the support 21 is flush-mounted, which is associated with the container 36 by way of the removable engagement means 35.

[0101] As in the previous application, the shell 17 is flush-mounted in the support 21 and is associated therewith by way of the removable retention means 30.

[0102] The container 36 is fixed to the ceiling 20 by way of fixing means of known type, such as for example screws.

[0103] The container 36 can already include spring-type fixing systems which simulate the flush-mount spotlight holder, thus avoiding its use, containing costs and reducing fixing times.

[0104] Operation of the sensor 10 is similar to that of a smoke sensor with visible optical chamber of the known type.

[0105] In practice it has been found that the invention achieves the intended aim and objects, by providing a spot sensor for smoke and/or temperature and/or flame and/or other substances and/or phenomena that is easier to install with respect to sensors of the known type, while at the same time maintaining the same performance and ease of maintenance of sensors with a visible optical chamber.

[0106] With the invention a spot sensor for smoke and/or temperature and/or flame and/or other substances and/or phenomena has been devised which has standard measurements and does not entail the drawback for the user and/or installer of using specific tools for installation.

[0107] It should be noted that a sensor according to the invention is easier to provide industrially and at competitive costs with respect to similar sensors of the known type by virtue of the absence of bayonet-type interlocking mechanical parts in the supporting base, thus avoiding electrical contacts with sliding or interlocking metallic laminas, since the electrical connection is entrusted to a terminal block for industrial use.

[0108] Finally, with the invention a spot sensor for smoke and/or temperature and/or flame and/or other substances and/or phenomena is provided that is compact and has smaller space occupations than similar sensors of the known type.

[0109] The invention thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the appended claims; all the details may furthermore be replaced with other, technically equivalent elements.

[0110] In practice, the materials used, so long as they are compatible with the specific use, as well as the contingent shapes and dimensions, may be any according to the requirements and the state of the art.

[0111] The disclosures in Italian Patent Application No. 102019000014484 from which this application claims priority are incorporated herein by reference.

[0112] Where technical features mentioned in any claim are followed by reference signs, those reference

signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

## Claims

1. A sensor (10) for smoke and/or temperature and/or flame and/or other substances and/or phenomena, comprising an electronic board (12) which comprises:
  - an optical chamber (13) containing one or more light transmitters (1) and one or more light receivers (2) for smoke detection,
  - a microprocessor (14) and/or another programmable device for the management of said sensor (10) which is connected to said one or more transmitters (1) and to said one or more receivers (2),
  - one or more terminal blocks (15), for connection to data link and electric power supply cables (16),
 said sensor (10) being **characterized in that** said electronic board (12) is contained within a substantially flat shell (17).
2. The sensor (10) according to claim 1, **characterized in that** said shell (17) has a shape and dimensions that are such that it can be installed within a standard flush-mounted spotlight holder for a false ceiling.
3. The sensor (10) according to one or more of the preceding claims, **characterized in that** said shell (17) comprises two half-shells:
  - a first half-shell (18a),
  - a second half-shell (18b).
4. The sensor (10) according to one or more of the preceding claims, **characterized in that** it comprises a support (21) for said shell (17), said support (21) being provided with a hole (22) inside which said shell (17) is flush-mounted.
5. The sensor (10) according to one or more of the preceding claims, **characterized in that** said support (21) is constituted by a standard spotlight holder and comprises removable engagement means (35) for engagement with an element to which said smoke sensor (10) is applied.
6. The sensor (10) according to claim 5, **characterized in that** said removable engagement means (35) are snap-acting springs.

7. The sensor (10) according to claim 3, **characterized in that** said first half-shell (18a) has:

- a first through opening/hole (23), for the passage of said cables (16) and/or of a portion of said terminal block (15), 5
- one or more second through holes (24) into which one or more locking screws (25) of said half-shells (18a, 18b) are inserted. 10

8. The sensor (10) according to claim 3, **characterized in that** said second half-shell (18b) has:

- an opening (26) for the exposure of said optical chamber (13), 15
- one or more protrusions (27), which extend from a surface (28) of said second half-shell (18b) that is internal to said shell (17) and is directed toward said first half-shell (18a). 20

9. The sensor (10) according to claims 7 and 8, **characterized in that** said protrusions (27) have a dead hole (33) on a surface directed toward said first half-shell (18a), said dead hole (33) of one of said protrusions (27) corresponding to one of said one or more second through holes (24) of said first half-shell (18a). 25

10. The sensor (10) according to one or more of the preceding claims, **characterized in that** it comprises retention means (30) for retaining said shell (17) in said support (21), said retention means (30) being removable. 30

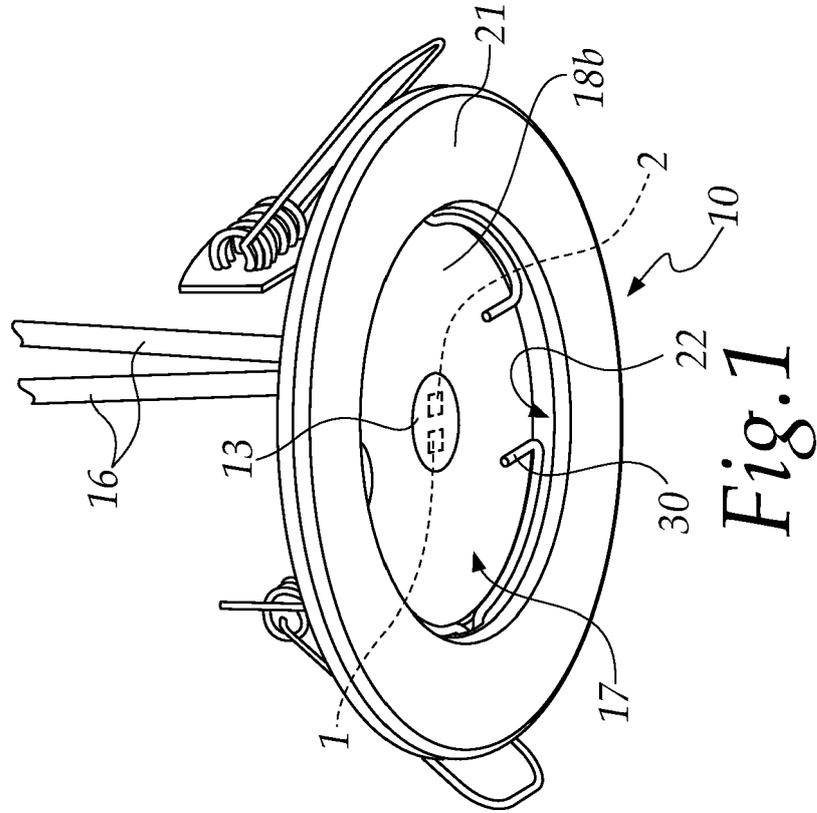
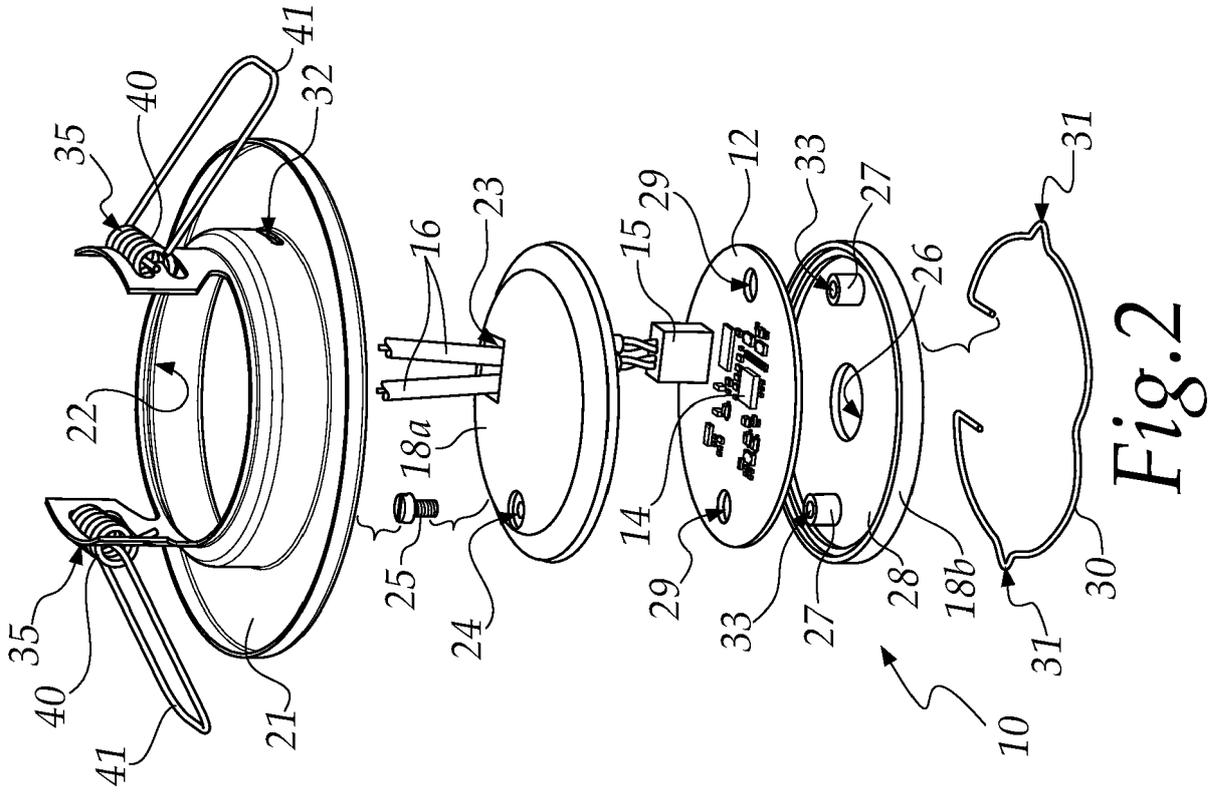
11. The sensor (10) according to one or more of the preceding claims, **characterized in that** it comprises a container (36) which can be fixed to a ceiling (20), said support (21) being flush-mounted within said container (36). 35

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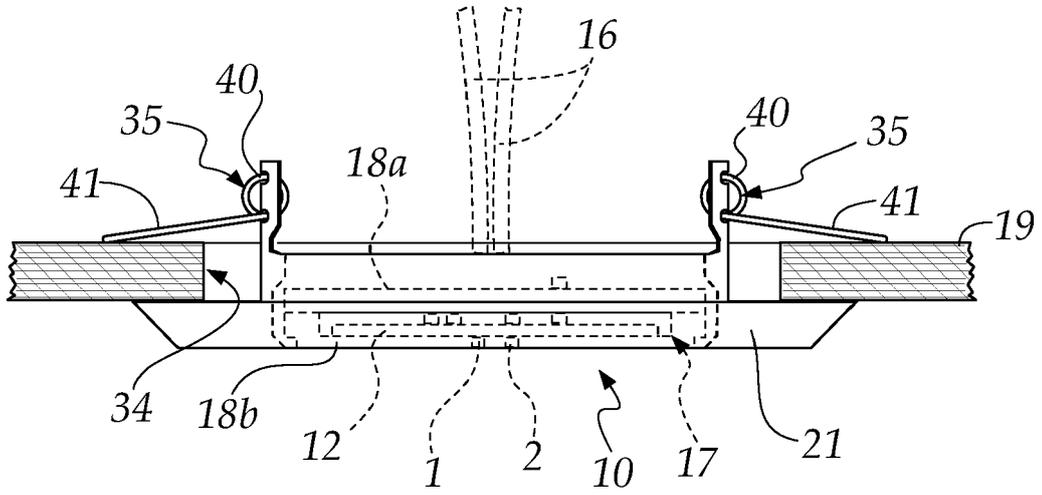


Fig.3

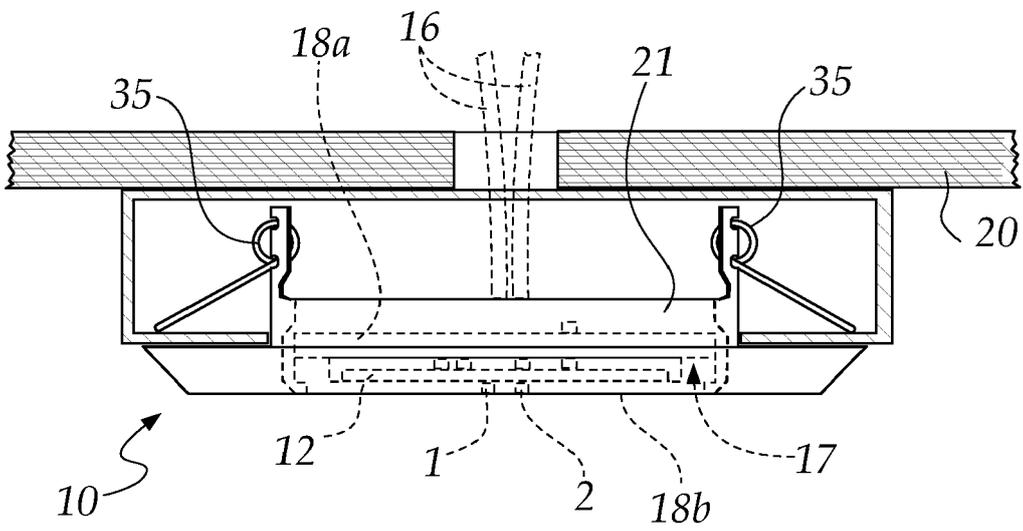


Fig.4



EUROPEAN SEARCH REPORT

Application Number  
EP 20 18 9938

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DOCUMENTS CONSIDERED TO BE RELEVANT			
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A	WO 2006/093803 A2 (ROSENBLATT JASON R [US]) 8 September 2006 (2006-09-08) * figure 5 *	11	
			TECHNICAL FIELDS SEARCHED (IPC)
			G08B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 18 September 2020	Examiner Meister, Mark
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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

EP 20 18 9938

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
The members are as contained in the European Patent Office EDP file on  
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18-09-2020

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**REFERENCES CITED IN THE DESCRIPTION**

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