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(54) **IMPROVED SENSOR ASSEMBLY**

(57) A sensor assembly for a luminaire comprising:-  
 (i) a sensor array;  
 (ii) a sensor array housing (11) further comprising an engagement means suitable for attaching the sensor array housing to a luminaire chassis;

wherein the sensor array housing engagement means is so sized and shaped such that the sensor array housing is slideably mounted with respect to the luminaire chassis.

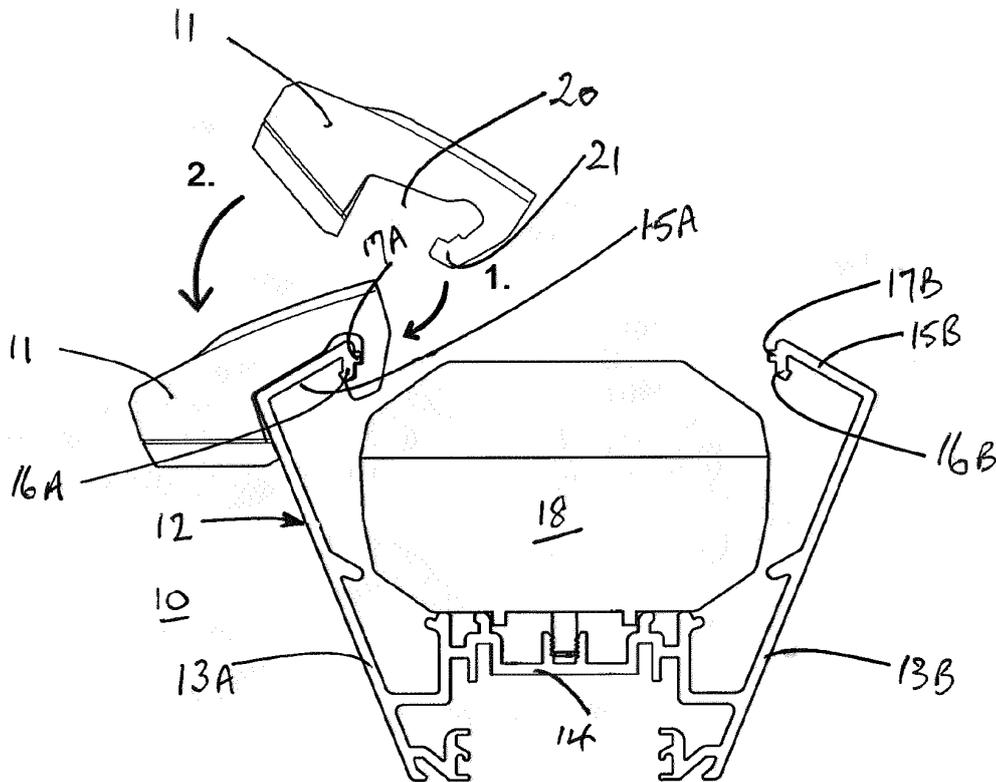


FIG 1

## Description

### Field of the Invention

**[0001]** The present invention relates to a sensor assembly suitable for a linear light fitting. It is particularly applicable, but in no way limited, to a clip on, slidable sensor assembly that is moveable freely along part or all of a linear light fitting in use, enabling flexibility in locating a sensor array.

### Background to the invention

**[0002]** Luminaires or light fixtures which include or are connected to a sensor or a sensor array, such as a motion sensor, are known. In the case of a motion sensor, these are particularly useful for causing a lamp in the luminaire to illuminate when a person is present in the area illuminated by that luminaire. This is a convenient way of saving energy when an area is unoccupied, for eliminating light switches inside buildings, and for lighting pathways etc outside at night.

**[0003]** Luminaires that contain detectors that sense information about their local environment and which communicate this information to a processor are also known, for example as described in WO2015/177762 (Goove Limited). These new luminaires offer a way of collecting a variety of data about the environment in which they are situated. However, known sensor arrays in luminaires, once installed, are generally fixed in a particular location, mainly because of the power and communication connections required within the luminaire to allow the sensors to operate and relay the information gathered. The sensor location, whilst suitable initially, may not remain optimum as space utilisation under a particular luminaire changes over time. In addition, as sensor technology advances, more sophisticated and more accurate sensors and sensor arrays will become available that can detect more information and/or provide more accurate information about the environment in which they are situated. When this happens, this currently requires complete replacement of the existing luminaire with one incorporating the new, advanced type of sensor array. This is both expensive, because it requires a whole new luminaire, and disruptive because the luminaire(s) have to be isolated electrically for Health & Safety reasons. It is also a waste of valuable materials and resources, since the old luminaire(s) generally have to be scrapped.

**[0004]** It is an object of the present invention to overcome or mitigate some or all of the problems outlined above.

### Summary of the Invention

**[0005]** According to a first aspect of the present invention there is provided a sensor assembly for a luminaire according to Claim 1. For example, a sensor assembly for a luminaire is provided comprising:-

(i) a sensor array;

(ii) a sensor array housing further comprising an engagement means suitable for attaching the sensor array housing to a luminaire chassis;

5 wherein the sensor array housing engagement means is so sized and shaped such that the sensor array housing is slideably mounted with respect to the luminaire chassis. For the first time it is possible to locate a sensor array  
10 in an adjustable position along the body of a luminaire, especially a linear luminaire. The sensor array can thus be placed in the optimum location by the user to sense the local environment, and repositioned as the user requirements change.

15 **[0006]** Preferably the sensor array housing engagement means is a 'clip on'-push off fit on the luminaire chassis, requiring no tools to fit or remove the sensor array housing from the luminaire chassis, and without the need for a qualified electrician to attend. This is an  
20 important feature because it means that a sensor array can be fitted to a luminaire very quickly and easily. It also means that a sensor array can be moved from luminaire to luminaire as required by the user.

25 **[0007]** Preferably the sensor assembly further comprises a connection means attached to the sensor array and adapted to convey data from the sensor array and convey electrical power to the sensor array and more preferably the connection means comprises a substantially flexible cable. Preferably the flexible connection  
30 cable is of sufficient length such that the sensor assembly housing can slide along substantially the entire length of the luminaire chassis. Using a flexible cable of sufficient length means that the sensor array can be slid to any desired position on the luminaire.

35 **[0008]** Preferably the sensor assembly further comprises a wireless interface module (WIM) adapted to transmit data wirelessly from the sensor array to a remote repository and preferably the wireless interface module is housed within the luminaire chassis.

40 **[0009]** Preferably the connection means connects the sensor array to the wireless interface module.

45 **[0010]** Preferably the sensor array includes one or more sensors from the group of sensors comprising: proximity sensors, including capacitive, capacitive-displacement, conductive, magnetic, optical, thermal, and sonar sensors; motion sensors, including passive infrared ("PIR") motion detectors, ultrasonic, microwave, and tomographic motion detectors; acoustic sensors including microphones; charge-coupled detectors; digital cameras including low-resolution digital cameras; thermopiles; thermocouples; carbon dioxide sensors; water-vapour detectors; flow meters; pressure sensors, field-strength sensors for magnetic and electrical fields.

55 **[0011]** In summary, the present invention provides a sensor array housing design which enables the sensor to be hooked onto the chassis of a luminaire such as a linear luminaire that is preferably able to slide freely along the length of the luminaire. The sensor module is 'hooked'

onto the body of the linear luminaire with just one operation without the need for any tools. The sensor module can be moved freely along substantially the entire length of the luminaire simply by sliding it into the desired position. Most retro-fit sensor modules for lighting luminaires currently on the market require some sort of wiring and/or fixing methods to install the sensor onto the luminaire. Sometimes this requires cutting holes on the luminaire to mount a sensor module, which is both time consuming and requires tools to complete the job. Furthermore it is often difficult or impossible to change the position of a sensor module once it is installed. Most retro-fit sensor modules on the market are permanently fixed onto the luminaire. The position of the sensor module is often determined by the layout and spacing of components within the luminaire, and therefore adjusting the location of the sensor module is very difficult once initial installation has been completed.

**[0012]** The design of the sensor clip module of the present invention enables the sensor to be installed onto a luminaire with just one simple clipping motion - no hard wiring and tools are required. In addition, re-positioning of the sensor module is incredibly easy by just sliding it along the entire length of the luminaire chassis.

#### **Brief description of the drawings**

**[0013]** The invention will now be described, by way of example only, in relation to the accompanying figures wherein:

Figure 1 illustrates a cross-sectional view of a luminaire chassis member with a sensor assembly clipped and unclipped to the chassis member;

Figure 2 illustrates a perspective view from the rear of the sensor assembly when it is clipped to the chassis member;

Figure 3 illustrates a perspective view of part of a luminaire chassis member with a sensor assembly clipped to it, showing how the sensor assembly can be slid backwards and forwards along the chassis member;

Figures 4A to 4E illustrate a side view, a front view, a view from the rear, an underneath view from the front showing the sensor array, and a top view of a sensor array housing.

#### **Description of the Preferred Embodiments**

**[0014]** The present invention will now be described by way of example only. These are the best ways currently known to the applicant of putting the invention into practice, but they are not the only ways. Although the examples given are based on a sensor assembly for use on a linear luminaire, it will be understood that the sensor apparatus or assembly described is applicable to other types of luminaires having a luminaire chassis or body onto which a sensor assembly can be clipped. The sensor

assembly described is also suitable for attachment to other items that are not luminaires, provided the item has some sort of chassis for the sensor assembly to clip or attach onto.

**[0015]** Referring to Figure 1, this shows as 10 a sensor array housing 11 clipped onto a chassis member 12 of a linear luminaire. The chassis member 12 in this example consists of a base or bottom portion 14 with two opposing side portions 13A, 13B. The angle of these side portions with respect to the base portion is important in that the side portions form an obtuse angle with the base. That is to say the sides splay out away from the base such that the chassis chamber becomes narrower towards the base. Thus in this example the chassis chamber or member is substantially frustoconical in cross-section, that is to say it is shaped like an inverted frustum of a cone when viewed in the cross-section shown. This shape or cross-section of chassis member gives a number of advantages, including the advantage that when a sensor assembly is clipped in place the sensor(s) has a relatively unobstructed view of the environment below the luminaire. But it will be appreciated that this is only one possible shape for a chassis member, and other shapes and cross-sections are equally possible.

**[0016]** The top edge of each side portion of the chassis chamber is bent inwards to create an inwardly directed flange 15A, 15B and a downstand 16A, 16B at the end of each flange creates what are in effect two channels, one on each top inside edge of the chassis chamber. The chambers can be formed by extrusion and as a result the flanges 15A, 15B and associated channels extend for substantially the whole linear length of the chamber. Nibs or small lugs 17A, 17B are formed on the external faces of the respective downstands 16A and 16B. Electrical or electronic components such as a wireless interface module (WIM) e.g. 18 can be accommodated within the body of the chassis member (see details below).

**[0017]** The sensor array housing 11 attaches to a top edge of the chassis member by means of a specially shaped recess or cavity 20 in the underside of the sensor array housing. This recess acts as an engagement means and is shaped to correspond closely to the shape of the upper region of the side of the chassis member. In particular, there is space within the recess corresponding to and adapted to accommodate the downstand 16A and the lug or nib 17A. That part of the recess can, for example, be formed by two legs or feet as shown as 21A and 21B in Figure 2. These legs can be resiliently deformable to assist in the engagement and disengagement of the sensor array housing to and from the chassis member 12. The engaged and disengaged configurations are shown as in Figure 1. This shows that in order to engage the sensor array housing with the chassis member, the legs 21 are first hooked under the downstand 16A and the sensor array housing then forced into the engaged configuration, where it is in contact with both the side portion 13A and the flange 15a of the chassis member, using gentle finger pressure. No tools are re-

quired for this procedure. Likewise, the sensor array housing can be disengaged from the chassis member by upward finger pressure in a reverse of the engagement movement.

**[0018]** It will be appreciated that because of the symmetry of the chassis member the sensor array housing can be attached to the other side portion 13B of the luminaire by engagement with flange 15B and a downstand 16B in a similar way to that described above.

**[0019]** In a preferred embodiment, the sensor array housing is slideably mounted with respect to the chassis member 12 and this is shown more clearly in Figure 3. This shows a section of a linear luminaire chassis member 12 similar in design to that shown in Figure 1. A sensor array housing 11 is clipped onto the side of the chassis member in the same manner as shown in Figure 1 and, in this example, is connected by a connection cable to a data communication device such as a wireless interface module (WIM) 30 housed inside the body of the chassis member. A sensor array, not shown in these figures, in the sensor array housing 11 is connected to the WIM by means of a flexible connection cable 31. This cable is of sufficient length that the sensor array housing 11 can be positioned anywhere along the length, or part of the length, of the luminaire as required by the user. The connection cable is designed to carry electrical power to the sensor array and convey data from the sensor array to the WIM. Any excess cable can be stored in the body of the chassis member.

**[0020]** Using a wired connection is not the only means by which the sensor array can relay data and/or receive electrical power. For example, the sensor array can be powered by a battery for example, the battery being housed within the sensor array housing or separately from it. In a further example the sensor array can be powered by induction, or Wireless Power Transfer (WPT) technology. Data collected by the sensor array can be transmitted wirelessly using a wireless communication module using known or yet to be developed wireless protocols such as WIFI (RTM), ZigBee (RTM), Bluetooth (RTM), or DALI (RTM) to give but a few examples of known protocols. The wireless communication module can also be housed within the sensor array housing or separately from it. Where the WIM is housed in the chassis of the luminaire can take the form of a plug and play unit that requires no tools and no qualified electrician to install it. Thus the entire installation of a sensor assembly housing and its associated WIM according to the present invention can be done by hand, without the use tools, and without the need for a qualified electrician.

**[0021]** Wireless Interface Modules and other data communication devices suitable for this purpose are known per se, such as those described in GB 2524664 (Aurora Limited). The exact location or positioning of the WIM is not critical to this invention. The purpose of this WIM is to collect and store data gathered by the sensor array and to transmit that data wirelessly to a local hub, gateway or other repository. The data collected can then

either be used and analysed locally or transmitted to a remote location such as the Cloud for storage and/or analysis, where it can be accessed by authorised users as required. Thus the data collected by the sensor array can be used, amongst other things, to control the light output from the luminaire, including both the brightness of light and the colour temperature of that light, for example. Control can be operated wirelessly by either authorised users, or automatically by programmed algorithms based on the information gathered from the sensor array.

**[0022]** Figure 4 shows various views of the sensor array housing as illustrated in Figure 1. Figure 4D shows a view from below the sensor array housing when oriented as in Figure 4A. This shows a sensor array 40 mounted on the downward facing surface of the sensor array housing and which, in use, collects data about the environment in the vicinity of that luminaire. The sensor array can include a lens, preferably a convex lens, in front of the sensor array in order to spread the sensor detection angle. A wide variety of sensors and sensor arrays are already known, and sensor technology is advancing all the time. It is intended that the present invention should include all types of sensors known at the time of making this application, as well as those sensors yet to be developed. Known types of sensors that can be included in the sensor array include, but is in no way limited to, proximity sensors, including capacitive, capacitive-displacement, conductive, magnetic, optical, thermal, and sonar sensors, motion sensors, including passive infrared ("PIR") motion detectors, ultrasonic, microwave, and tomographic motion detectors, acoustic sensors including microphones; charge-coupled detectors, digital cameras including low-resolution digital cameras, thermopiles; thermocouples, carbon dioxide sensors, water-vapour detectors, flow meters, pressure sensors, and field-strength sensors for magnetic and electrical fields. This list is not intended to be exhaustive but serves only to give an idea of the wide range of sensor types that could be included in a sensor array.

**[0023]** In summary, a sensor module assembly is provided that is an add-on component that can be retro-fitted onto a luminaire and thus turn the luminaire into a connected node within a network of luminaires. The sensor is used to capture data from the environment around the luminaire and feed this data back to a remote repository and thus to the customer, in the form of usable information.

**[0024]** Currently, most sensor modules are mounted in a fixed location within or near a luminaire. The process of retrofitting a sensor into a luminaire generally requires cutting holes/slots in the luminaire and fixing an add-on sensor module to the luminaire using screws or other fixings. Even when the sensor module does not require cutting or drilling the luminaire, the position of the sensor module is generally substantially fixed.

**[0025]** The longer installation times required to fit existing add-on sensor modules means more costs to the

customer. Additionally and importantly the inability to easily change the position of a sensor after the initial installation means less flexibility and ultimately more cost to the customer. This is particularly a disadvantage to retail customers when they change a store layout to suit different product seasons, or to customers with a commercial building where there is a change of furniture or working area layout.

**[0026]** The design of the present sensor assembly allows it to be easily mounted onto a light fitting by clipping the 'legs' of the module onto the top part of the chassis - the design of the sensor array housing follows the internal and external geometry of the luminaire chassis extrusion, hence once clipped on, the sensor stays securely on the light fixture and its position can be adjusted freely by sliding up or down substantially the entire length of the luminaire. This design provides a much shorter installation time, requires no tools, does not require a qualified electrician to attend, and gives great flexibility of sensor positioning. It will be appreciated that the size and shape of the sensor array housing may vary depending on various factors, such as the size of the sensor array being used, and whether the WIM is accommodated within the sensor array housing or outside it.

**[0027]** In summary there is disclosed a sensor assembly suitable for use with a luminaire comprising a luminaire chassis, the sensor assembly comprising: (i) a sensor array: and (ii) a sensor array housing. The sensor array housing comprises an engagement means and the sensor array housing engagement means is a 'clip on' - 'push off' fit on the luminaire chassis.

**[0028]** The sensor assembly is attachable to and detachable from the luminaire chassis by hand, without the use of tools.

**[0029]** The sensor array housing includes a recess or cavity in the underside of the housing that engages in use with the luminaire chassis. Part of the recess or cavity is formed by two legs or feet. The legs or feet are resiliently deformable to assist in the engagement and disengagement of the sensor array housing to and from the chassis member.

**[0030]** The sensor array housing engagement means is so sized and shaped such that the sensor array housing is slideably mounted with respect to the luminaire chassis in use.

**[0031]** The sensor assembly further comprises a wireless interface module (WIM) adapted to transmit data wirelessly from the sensor array to a remote repository. The wireless interface module is housed within the luminaire chassis. The sensor assembly further comprises a connection means adapted to attach the sensor array to the wireless interface module (WIM) and adapted to convey data from the sensor array to the WIM. The connection means comprises a substantially flexible connection cable. The flexible connection cable is of sufficient length such that the sensor assembly housing can slide along substantially the entire length of the luminaire chassis. The sensor assembly can be installed on a luminaire by

hand, without the use of tools.

**[0032]** The sensor array includes one or more sensors from the group of sensors comprising: proximity sensors, including capacitive, capacitive-displacement, conductive, magnetic, optical, thermal, and sonar sensors; motion sensors, including passive infrared ("PIR") motion detectors, ultrasonic, microwave, and tomographic motion detectors; acoustic sensors including microphones, charge-coupled detectors, digital cameras including low-resolution digital cameras, thermopiles, thermocouples, carbon dioxide sensors, water-vapour detectors, flow meters, pressure sensors, field-strength sensors for magnetic and electrical fields.

## Claims

1. A sensor assembly suitable for use with a luminaire comprising a luminaire chassis, said sensor assembly comprising:-

- (i) a sensor array;
- (ii) a sensor array housing;

wherein the sensor array housing comprises an engagement means and wherein the sensor array housing engagement means is a 'clip on' - 'push off' fit on the luminaire chassis.

2. A sensor assembly according to Claim 1 wherein the sensor assembly is attachable to and detachable from the luminaire chassis by hand, without the use of tools.

3. A sensor assembly according to Claim 1 or Claim 2 wherein the sensor array housing includes a recess or cavity in the underside of the housing that engages in use with the luminaire chassis.

4. A sensor assembly according to Claim 3 wherein part of the recess or cavity is formed by two legs or feet.

5. A sensor assembly according to Claim 4 wherein the legs or feet are resiliently deformable to assist in the engagement and disengagement of the sensor array housing to and from the chassis member.

6. A sensor assembly according to any preceding claim wherein the sensor array housing engagement means is so sized and shaped such that the sensor array housing is slideably mounted with respect to the luminaire chassis in use.

7. A sensor assembly according to any preceding Claim wherein the sensor assembly further comprises a wireless interface module (WIM) adapted to transmit data wirelessly from the sensor array to a

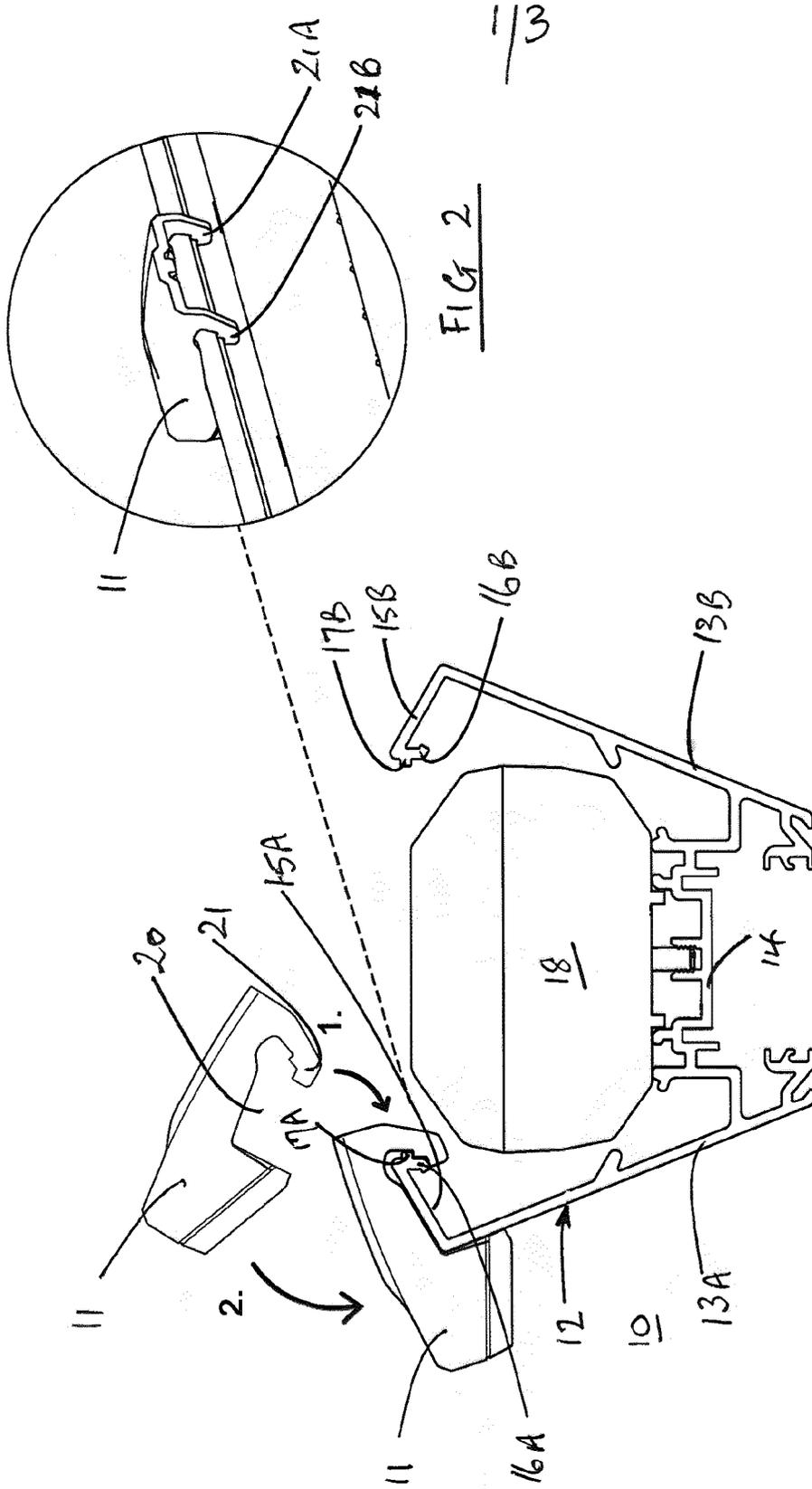
remote repository.

8. A sensor assembly according to Claim 7 wherein the wireless interface module is housed within the luminaire chassis. 5
9. A sensor assembly according to Claim 7 or Claim 8 wherein the sensor assembly further comprises a connection means adapted to attach the sensor array to the wireless interface module (WIM) and adapted to convey data from the sensor array to the WIM. 10
10. A sensor assembly according to Claim 9 wherein the connection means comprises a substantially flexible connection cable. 15
11. A sensor assembly according to Claim 10 when dependent on Claim 6 wherein the flexible connection cable is of sufficient length such that the sensor assembly housing can slide along substantially the entire length of the luminaire chassis. 20
12. A sensor assembly according to any of Claims 7 to 11 inclusive wherein the sensor assembly can be installed on a luminaire by hand, without the use of tools. 25
13. A sensor assembly according to any preceding Claim wherein the sensor array includes one or more sensors from the group of sensors comprising: proximity sensors, including capacitive, capacitive-displacement, conductive, magnetic, optical, thermal, and sonar sensors; motion sensors, including passive infrared ("PIR") motion detectors, ultrasonic, microwave, and tomographic motion detectors; acoustic sensors including microphones, charge-coupled detectors, digital cameras including low-resolution digital cameras, thermopiles, thermocouples, carbon dioxide sensors, water-vapour detectors, flow meters, pressure sensors, field-strength sensors for magnetic and electrical fields. 30  
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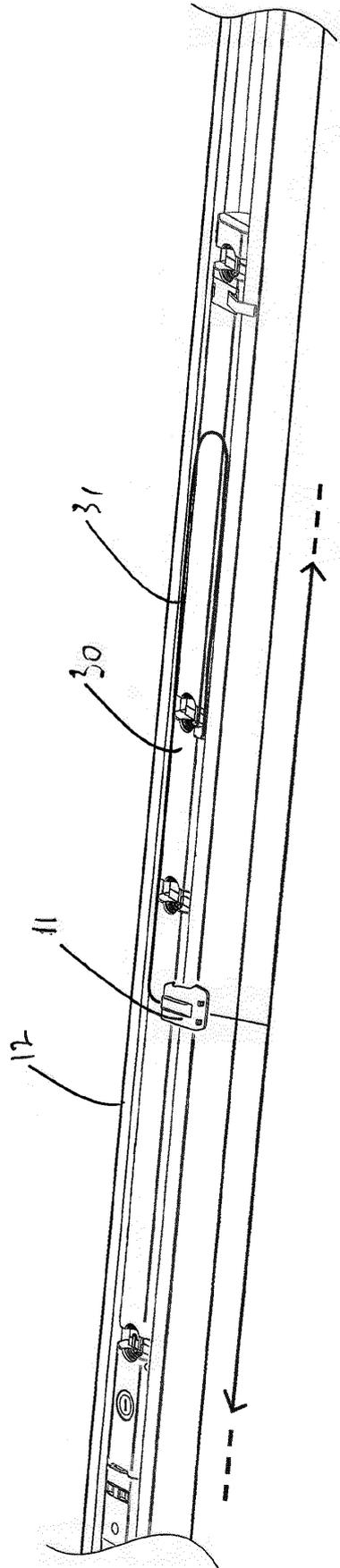


FIG 3

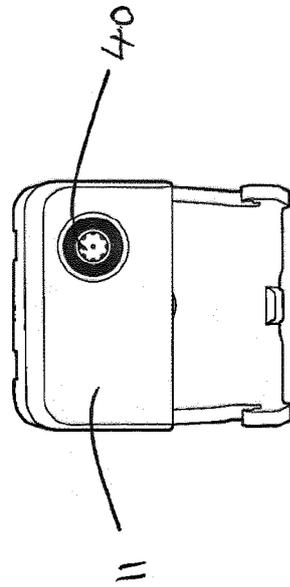
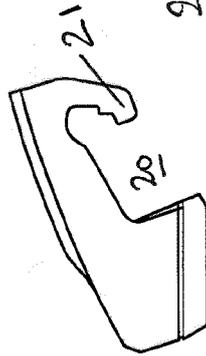
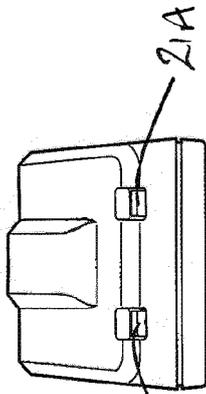
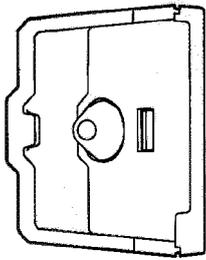
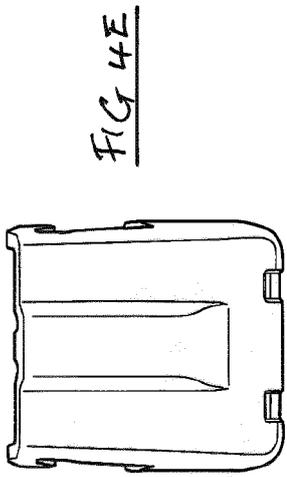


FIG 4



EUROPEAN SEARCH REPORT

Application Number  
EP 19 15 5048

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Place of search		Date of completion of the search	Examiner
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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  
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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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