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(71) Applicants: **POLITECNICO DI MILANO** [IT/IT]; Piazza Leonardo da Vinci 32, 20133 Milano (IT). **EXCEN S.R.L.** [IT/IT]; Via Marcora 61/69, 20097 San Donato Milanese MI (IT).

(72) Inventors: **FARANDA, Roberto Sebastiano**; c/o Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milano (IT). **FUMAGALLI, Kim**; c/o Excen S.r.l., Via Marcora 61/69, 20097 San Donato Milanese MI (IT). **PACETTI, Antonio**; c/o Excen S.r.l., Via Marcora 61/69, 20097 San Donato Milanese MI (IT).

(74) Agent: **CICERI, Fabio** et al.; c/o Perani & Partners, Piazza Armando Diaz 7, 20123 Milan (IT).

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(54) **Title:** AN ELECTRIC DEVICE FOR SUPPLYING POWER TO ELECTRIC LOADS IN EXPLOSION RISK ENVIRONMENTS

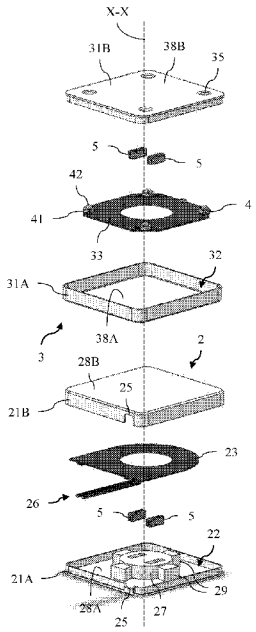

Fig. 3

(57) **Abstract:** The present invention relates to an electric device for supplying power to electric loads (1) in explosion risk environments comprising a mutually sealed first module (2) and second module (3). In the first module (2) a first circuit (23) is housed with a primary portion adapted to be connected to an electric network. A second circuit (33) is housed in the second module (3) with a secondary portion connected to an electric load (4). The second module (3) can be removably associated with the first module (2) in an active position in which the primary portion and the secondary portion define a power supply system adapted to convert the electrical energy of the network making it available to the electric load (4). The first module (2) and the second module (3) comprise pairs of magnets (5), appropriately oriented and magnetically polarized so as to be attracted to each other and orient the second module (3) in the active position, magnetically locking the second module (3) to the first module (2).

WO 2020/016711 A1

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TITLE: "An electric device for supplying power to electric loads in explosion risk environments"

DESCRIPTION

Field of application

The invention relates to an electric device for supplying power to electric loads in explosion risk environments, according to the preamble of claim 1.

In particular, but not exclusively, the invention can be applied to an electric load such as LED lamps, smoke detectors, gas detectors or sirens.

Description of the state of the art

In some industrial environments, because of the substances used in production cycles or in the processes themselves, there may be a risk of explosion due to the presence of an explosive atmosphere. An explosive atmosphere is a mixture of flammable substances in the gas, mist, vapour or dust state with air, in certain atmospheric conditions in which, after being triggered, the combustion is propagated to the flammable mixture. For an explosion to take place the presence of three main factors is necessary: a combustible material, represented by gases and hazardous dust, a combustive agent (e.g. oxygen) which assists the combustion reaction and a trigger source, represented for example by electrical equipment that can generate sparks or overheating.

Any solid combustible material, finely subdivided and dispersed in air in the form of dust, can cause an explosion, if triggered; this potential explosion characteristic can be found both in substances classified as hazardous (e.g. aluminium dust or of other metals, pharmaceutical preparations, etc...) and in other non-hazardous substances (flour, grains, powdered milk, sugar, wood dust, etc...). Some examples of hazardous gases may be: methane, ethane, hydrogen, acetylene, etc...

Therefore, environments that are particularly at risk are mines,

chemical/pharmaceutical or oil industries, and grain or paper storage plants.

Electrical systems and the respective electrical equipment constitute a possible trigger factor, in particular in the case of overheating, electric arc or electrostatic discharge. European Directives 2014/34/EU and 99/92/EC therefore indicate the relative protection measures that must be taken in explosive environments. An example is the electrical components being housed in explosion-proof enclosures, which are designed to contain any explosion of the electrical components within them without transferring it to the outside and therefore without triggering the external atmosphere.

Therefore the connection of loads to the electric network is particularly critical, as at the time of contact or separation of a plug from a socket, sparks can be produced. Therefore, dedicated and expensive construction measures are provided for ensuring that the plugs are isolated from the explosive atmosphere and well connected to the sockets, such that accidental separation therefrom may not occur.

Furthermore, when the electric load is to be disconnected, e.g. for maintenance, the environment must be made safe and the processing systems, which are the cause of the explosive atmosphere and/or possible trigger, must be stopped, implying significant costs.

Document US 9512993 describes an example of a lamp for explosion risk environments. In such lamp there are two supports on which there is a series of LED lighting elements arranged in a row. Electric power supply systems provided with magnetic cores and coils are provided for every lighting element both inside the supports and in every LED lighting element.

The LED lighting elements are attached individually like clips to the supports so as to align the related coils to the coils of the support, creating an electromagnetic coupling between them. Furthermore, the LED lighting elements and the related support are conformed to co-penetrate each other.

The co-penetration between LED lighting elements and support has a dual aim: the first is to create a power supply system adapted to convert the electrical energy of the network making it available to the electric load thanks to the vicinity of the magnetic cores of the LED lighting element and the support, whereas the second is to keep the LED lighting element in a certain position with respect to the support.

Yet, it is best to specify that cavities or sharp elements are provided to obtain co-penetration. However, such cavities may be deposit points of hazardous substances or however causes of problems in the maintenance and replacement stages. Furthermore, any imprecisions or deformations of the cavities, for example due to time and/or wear can lead to misalignments between the LED lighting element and the support, creating inefficiencies in energy conversion.

Document DE 102012212254 shows a pair of connectors for signal transmission, with an inductive type coupling between circuits and individual magnets for the locking of the connectors.

Summary of the invention

The aim of the present invention is to provide an electric power supply device for supplying an electric load adapted to explosion risk environments having a simplified structure, simple assembly and reliable operation.

This and other aims are achieved through an electric device according to any one of the appended claims. In such electric device a first module houses a circuit adapted to be connected to the electric network. In a second module a second circuit is housed that supplies an electric load, receiving energy from the first module. In fact, by correctly positioning the second module, the circuit inside the first module and the circuit inside the second module define a power supply system adapted to convert the electrical energy of the network making it available to the electric load. In this way, the presence of electric

connectors that could potentially trigger an explosion is prevented.

The first module and the second module can be magnetically locked to each other in their active position by means of pairs of magnets arranged appropriately in the first module and in the second module. The polarization of such magnets is such as to correctly orient the second module with respect to the first module.

The use of a magnetic locking system further allows the first module and the second module to be firmly locked only in the active condition, and preferably with the use of a single surface for each element and therefore only the resting surface of the second module onto the first module.

In particular, when observing from the first module the pairs of magnets of the second module, they are arranged along a circumference and all direct the same magnetic polarity towards the centre. The same happens observing the pairs of magnets of the first module from the second module, where however for the two modules the polarities directed towards the centre thus observed are opposite each other.

Advantages of the invention

Thanks to the use of the pairs of permanent magnets it is possible to realize simple and secure fixing between the first module and the second module.

Furthermore, the pairs of magnets lead the second module to automatically assume the active position, wherein the alignment is correct between the circuit inside the first module and the circuit inside the second module, without the need to see the circuits inside the modules or have any reference points for obtaining the necessary alignment.

The installation operation is simplified as it is sufficient to place the two modules alongside each other (the fixed one and the removable one) and follow the forces of attraction of the pairs of magnets. In fact, thanks to the magnetic forces the second module is exactly positioned in the active position at the first module.

In doing so, it is also possible to exploit a single coupling surface and therefore eliminate all cavities or pointed elements, thus removing all possible deposit points for hazardous substances and simplifying the equipment maintenance operations.

BRIEF DESCRIPTION OF THE DRAWINGS

The characteristics and advantages of the present invention will become clear from the following detailed description of a possible practical embodiment, illustrated by way of non-limiting example in the set of drawings, wherein:

- Figure 1 shows a perspective view of an electric device according to the invention in the active position,

- Figure 2 shows the device of Figure 1 in a misaligned position,

- Figures 3 and 4 show exploded perspective views of the device of Figure 1,

- Figure 5 shows a partial perspective view of an electrically powered device according to an alternative embodiment, and

- Figure 6 shows two different views of the same pair of permanent magnets.

DETAILED DESCRIPTION

With reference to the appended figures, an electric device for supplying power to electric loads in explosion risk environments is indicated by number 1.

The device 1 comprises a first module 2 and a second module 3.

The first module 2 is configured to be fixed or associated in an irremovable way with a building element (not illustrated), such as for example a wall of a room, or a ceiling or a fixed structure of movable equipment.

The second module 3 is removable with respect to the first module 2.

For descriptive simplicity in the following, but without thereby forgoing the generality of the invention, the first module 2 will be indicated as a fixed module whereas the second module 3 will be indicated as a removable module.

The fixed first module 2 and the removable second module 3 respectively comprise a first and a second sealed (preferably resined) enclosure 21, 31. In particular, the first and the second enclosure 21, 31 each delimit a respective internal cavity 22, 32, and are configured to prevent the entry of explosive mixtures into the respective internal cavities 22, 32.

The first and the second module are described below with reference to the specific embodiment illustrated in the figures but such first and second module can assume different dimensions, such as for example regular polygonal or irregular polygonal shapes.

Preferably, each enclosure 21, 31 has a rear wall 28A, 38A and a front wall 28B, 38B spaced from the rear wall 28A, 38A along a longitudinal direction X-X. The internal cavity 22, 32 of each enclosure 21, 31 is delimited by the respective front and rear walls 28A, 28B, 38A, 38B, and by side walls that extend between the respective front and rear walls 28A, 28B, 38A, 38B.

When in use, the second removable module 3 is associated with the first fixed module 2, so that the front wall 28B of the first enclosure 21 faces the rear wall 38A of the second enclosure 31, preferably in contact therewith. The front wall 28B of the first enclosure 21 and the rear wall 38A of the second enclosure 31 are substantially flat.

In the illustrated embodiment each enclosure 21, 31 comprises a base body 21A, 31A and a closing body 21B, 31B fixable in a sealing manner to the base body 21A, 31A. The rear wall 28A, 38A of each enclosure 21, 31 is formed in the respective base body 21A, 31A, while the front wall 28B, 38B is formed in the respective closing body 21B, 31B.

The second removable module 3 comprises at least one electric load 4 associated with the second enclosure 31. In more detail, the electric load 4 has a supply portion 41

arranged inside the internal cavity 32 of the second enclosure 31, and an operating portion 42 that emerges outside the second enclosure 31, in particular from the front wall 38B. Preferably, the second enclosure 31 has at least one load opening 35, and the electric load 4 is fixed in a sealing manner to the second enclosure 31 at the load opening 35.

The electric load 4 preferably comprises a lighting element, such as for example one or more LEDs, arranged at the operating portion 42 of the load 4.

In Figures 1 to 4 the electric load comprises four LEDs, arranged at corner portions of the second enclosure 31, in particular corner portions of the front wall 38B. Instead, in the embodiment of Figure 5 the electric load 4 (not illustrated, while the relative load opening 35 is illustrated) comprises a series of aligned LEDs, realizing an elongated shape arranged at a central portion of the second enclosure 31, in particular a central portion of the front wall 38B.

Electric loads 4 of a different nature from LEDs can also be provided, such as for example a smoke detector, a gas detector or a siren. Therefore, in an alternative embodiment it is possible that no operating portion 42 emerges outside the second enclosure 31.

The first fixed module 2 comprises a first circuit 23, housed in the first enclosure 21. Similarly, the second removable module 3 comprises a second circuit 33, housed in the second enclosure 31. The first and the second circuit 23, 33 in particular are housed in the internal cavities 22, 32 of the first fixed module 2 and of the second removable module 3.

In the embodiment illustrated by way of non-limiting example in Figures 3 and 4, the first circuit 23 and the second circuit 33 are provided in the form of printed circuits on isolating supports, arranged parallel to the front and rear walls 28A, 28B, 38A, 38B of the enclosures 21, 31, i.e. perpendicular with respect to the longitudinal direction X-X.

The first circuit 23 comprises a primary portion adapted to be connected to an electric network (not illustrated), external to the fixed first module 2 and to the removable second module 3. In the preferred embodiment the first enclosure 21 has a sealed cable gland opening 25, and the fixed first module 2 comprises at least one power supply cable 26, connected to the first circuit 23 and emerging from the first enclosure 21 through the cable gland opening 25.

The power supply cable 26 has an insulating cladding that surrounds one or more conducting wires. In the embodiment illustrated by way of non-limiting example in Figures 1 to 4, there are two power supply cables 26, each of which comprises a single conducting wire.

The power supply cable 26 can therefore be connected to the electric network, preferably without electric contacts exposed to the explosive atmosphere. For example, the power supply cable 26 can extend at least in part through a wall of a room (not illustrated) in which the first fixed module 2 and the second removable module 3 are housed, preferably the wall to which the first fixed module 2 is fixed. Furthermore, the power supply cable 26 is connected to the electric network preferably on an opposite side of the wall with respect to the first fixed module 2.

The second circuit 33 comprises a secondary portion connected to the electric load 4, and in particular to the power supply portion 41 of the electric load 4.

When the removable second module 3 is in the use condition or active position, the primary portion of the first circuit 23 and the secondary portion of the second circuit 33 define a power supply system adapted to convert the electrical energy of the network making it available to the electric load 4. In other words, the primary portion and the secondary portion are electromagnetically coupled to each other. In more detail, the primary portion is configured to receive the electrical energy from the network and

transfer it to the secondary portion, the latter configured to transfer it to the electric load 4.

In fact, the primary portion and the secondary portion each have a plurality of windings. Furthermore, at least one of the first fixed module 2 and the second removable module 3, for example both, can comprise a ferromagnetic core (not illustrated), made of a soft ferromagnetic material. In that case, at least one of the primary portion and the secondary portion extends about the respective ferromagnetic core.

Furthermore, to promote electromagnetic coupling, the first enclosure 21 comprises support elements 29 configured to retain the primary portion in proximity of the front wall 28B of the first enclosure 21. Similarly, the second enclosure 31 comprises support elements 39 configured to retain the secondary portion in proximity of the rear wall 38B of the second enclosure 31.

It is observed that the second circuit 33 is electrically isolated with respect to the first circuit 23. In particular, no electric contacts exist for connection between the first and the second circuits 23, 33 outside of the first fixed module 2 and the second removable module 3.

The first fixed module 2 comprises at least one pair of magnets 5 appropriately arranged alongside each other so as to contain the magnetic field in proximity to the magnets.

The second removable module 3 comprises at least one pair of magnets 5 appropriately arranged alongside each other so as to contain the magnetic field in proximity to the magnets.

Each pair of magnets 5, as illustrated in Figure 6, is realized by at least two magnets with opposite polarities appropriately arranged alongside each other so as to form a single piece. It is observed that all the pairs of magnets 5 are formed by permanent magnets,

made of a hard ferromagnetic material.

Preferably, each magnet of every pair of magnets 5 of the first and second module 2, 3 has opposite magnetic polarities aligned with each other along the longitudinal direction X-X. Furthermore, considering for each magnet a polarization oriented from the South magnetic polarity towards the North magnetic polarity, the polarizations of the two magnets of each pair of magnets 5 are oriented in parallel and opposite directions to each other.

Therefore, for the single piece defined by every pair of magnets 5, two surfaces 51, 52 opposite each other in the longitudinal direction X-X each have both North and South magnetic polarities. Furthermore, the single piece has at least two North surface polar regions 53, 55 and two South surface polar regions 54, 56, arranged on such opposite surfaces 51, 52 in an alternating sequence between each other. These characteristics can be seen in Figure 6, where a single pair of magnets is shown in oblique perspective from the bottom, in the figure on the left, and oblique from the top in the figure on the right.

It is useful to specify that the two magnetic polarities are perfectly balanced between each other so that a magnetic polarity can, when necessary and advantageously, recall all the magnetic flux generated by the adjacent magnetic polarity. This minimizes dispersed magnetic fluxes and reduces the length of the magnetic field, thus allowing a more efficient magnetic field distribution to be obtained with respect to the use of individual magnets, with the development of larger forces.

In order to further improve the magnetic performance, one of the two surfaces 51, 52 which have both North and South magnetic polarities may rest on a ferromagnetic material, not shown in the figures. In particular, such surface 51, 52 is the one facing longitudinally away from the module 2, 3 opposite the one in which the pair of magnets 5 is located. Therefore, for the pairs of magnets 5 of the first module 2 it is the surface 52

facing towards the rear wall 28a, while for the pairs of magnets 5 of the second module 3 it is the surface 51 facing towards the front wall 28b. This therefore creates a containment path for the magnetic field with an advantage again connected to the minimization of dispersed fluxes.

At the front wall 28B of the first fixed module 2 and at the rear wall 38A of the second removable module 3 at least one pair of appropriately oriented magnets 5 is arranged.

In fact, in the embodiment illustrated in Figures 3 and 4 the first enclosure 21 comprises at least one support 27 configured to retain a pair of magnets 5 and the ferromagnetic material resting on it at the front wall 38A, and the second enclosure 31 comprises at least one support 37 configured to retain a pair of magnets 5 and the ferromagnetic material resting on it at the rear wall 38A. The supports 27, 37 for the pairs of magnets 5 are arranged between the support elements 29, 39.

In the active position, each pair of magnets 5 positioned at the front wall 28B is appropriately facing a respective pair of magnets 5 positioned at the front wall 38A. In more detail, in the active position the pairs of magnets 5 positioned at the front wall 38B and those positioned at the front wall 38A are aligned with each other along the longitudinal direction X-X.

Furthermore, the pairs of magnets 5 positioned at the front wall 28B and those positioned at the front wall 38A are appropriately oriented in order to obtain a magnetic polarization opposite to one another. In particular, the pairs of magnets 5 positioned at the front wall 28B and those positioned at the front wall 38A direct to each other opposite magnetic polarities to one another so that each pair of magnets 5 positioned at the front wall 28B attracts the respective pair of magnets 5 positioned at the front wall 38A.

It is observed that, with the preferred arrangement of magnets described above for

each pair of magnets 5, each pair of magnets 5 directs, in the direction of the module opposite the one in which it is located, a surface 51, 52 in which there are at least two surface polar regions 53, 54, 55, 56 with opposite magnetic polarities. However, the mutually corresponding pairs of magnets 5 for the two modules 2, 3 direct towards each other surface polar regions 53, 54, 55, 56 that are arranged so that opposite polarities are aligned to each other in the longitudinal direction X-X, when the modules 2, 3 are in the active position.

By appropriately orienting the pairs of magnets 5 positioned at the front wall 28B and those positioned at the front wall 38A, it is possible to obtain a magnetic force of attraction and therefore magnetically lock the first fixed module 2 and the second removable module 3 only when the second removable module 3 is in the active position with respect to the first fixed module 2.

The rear wall 38A of the second removable module 3 can therefore be slidable along the front wall 28B of the first fixed module 2 during the orientation of the second removable module 3 in the active position.

Advantageously, to obtain the locking of the second removable module 3 to the first fixed module 2, it is sufficient to arrange the second rear wall 38A of the second enclosure 31 in facing relation to the front wall 28B of the first enclosure 21, and to make the rear wall 38A of the second enclosure 31 slide along the front wall 28B of the first enclosure 21 following the forces of attraction and repulsion of the pairs of magnets 5 appropriately positioned inside the first fixed module 2 and the second removable module 3, until perfect alignment is obtained along the longitudinal direction X-X of each pair of magnets 5 positioned at the front wall 28B of the first enclosure 21 and the corresponding pair of magnets 5 positioned at the front wall 28A of the second enclosure 31.

It is observed that this movement orientation and magnetic locking mechanism of

the two modules 2, 3, besides allowing simple and quick locking of the second removable module 3 to the fixed module 2, guarantees that the second removable module 3 is locked to the first fixed module 2 precisely in the active position, i.e. that in which the primary portion and the secondary portion are correctly aligned, despite such portions not being visible from the outside as they are arranged inside the respective enclosures 21, 31.

In the preferred embodiment, as mentioned above, the North/South polarizations of each magnet of the pairs of magnets 5 are perpendicular to the front wall 28B of the first module 2 and to the rear wall 38A of the second module 3, i.e. parallel to the longitudinal direction X-X. In an alternative embodiment the North/South magnetic polarizations of the first and second magnets 5 are perpendicular to the longitudinal direction X-X.

In the preferred embodiment, all the pairs of magnets 5 of the first module 2 positioned at the front wall 28B are arranged to form a first circumference with a first centre. Furthermore, if observed from the second module 3, when in the active position, they direct towards the centre the same magnetic polarity. Such arrangement can therefore be found considering the surfaces 51 of the pair of magnets 5 of the first module 2 that are oriented towards the front wall 28b of the first module 2.

In other words, still observing from the second module 3, a first magnetic polarity is for every pair of magnets 5 radially internal, and a second, opposite magnetic polarity is for every pair of magnets 5 radially external.

If instead the surfaces 52 of the pairs of magnets 5 of the first module 2 turned towards the rear wall 28a of the first module 2 are considered, the opposite magnetic polarity oriented towards the first centre would be observed, i.e. the first magnetic polarity would be radially external and the second magnetic polarity radially internal.

It is observed that, in the case of only two pairs of magnets 5 for every module, as can be seen in the figures, the circumference arrangement is reduced to an arrangement

in which the two pairs of magnets 5 are positioned symmetrically with respect to the centre of the circumference.

Similarly, all the pairs of magnets 5 of the second module 3 positioned at the rear wall 38B are arranged to form a second circumference with a second centre. They also, observed from the second module 2 in the active position, i.e. considering the surfaces 52 oriented towards the rear wall 38a of the second module 3, direct towards the second centre the same magnetic polarity, opposite the polarity that the pairs of magnets 5 of the first module 2 direct towards the first centre.

In detail, observing from the first module 2, the first radially external polarity and the second radially internal polarity are located in the pairs of magnets 5 of the second module 3. Vice versa, for the surfaces 51 of the pair of magnets 5 of the second module 3, oriented towards the front wall 38a of the second module 3, the first polarity is radially internal and the second polarity radially external.

In that way it is more certain that the second removable module 3 can be magnetically locked to the first fixed module 2 only in the active position, i.e. when each pair of magnets 5 positioned at the front wall 28B is aligned with the respective pair of magnets 5 positioned at the front wall 38A.

This prevents any partial magnetic locking in different positions from the active position, in which for example the second removable module 3 is translated or rotated with respect to the active position, whereby some pairs of magnets 5 face different pairs of magnets 5 from those corresponding thereto or do not face any pair of magnets 5. In fact, such unexpected partial locking can lead to non-optimal electromagnetic coupling between the primary portion and the secondary portion, with malfunctioning of the electric load 4.

In an embodiment not illustrated in the appended Figures, such pair of magnets 5

can also be realized without any physical contact between the two magnets that comprise the pair of magnets 5. In such scenario it is sufficient that the two magnets of each pair are magnetically coupled to each other through the interposition of appropriate ferromagnetic elements that can act as a bridge between the two magnets themselves.

The electric device 1 can be integrated in an electric system also comprising a switch (not shown) configured to connect and disconnect the first circuit 23 from an electric network, so as to power and unpower the load 4. Instead, switches adapted to open the second circuit 33 are not provided.

It is further observed that no presence of batteries associated with the second removable module 3 is envisaged, and in particular electrically connected to the second circuit 33. In other words, the electric load 4 is a passive electric load, i.e. it is not able, within a certain time interval, to provide an average positive electric power to a circuit. Therefore, when the second removable module 3 is distanced from the first module 2, the electric load 4 is not supplied with power, since the electromagnetic coupling between the primary portion and the secondary portion is taken away.

It is however observed that, when the second removable module 3 is separated from the first fixed module 2, a current may continue to circulate in the first circuit 23, despite energy no longer being supplied to the second circuit, with a consequent waste of energy and risk of overheating.

Therefore, the first fixed module 2 preferably comprises a presence sensor (not illustrated) configured to detect whether the second removable module 3 is in the active position, or at least whether it is in contact with the first fixed module 2. For example, the presence sensor may be a magnetic contact sensor or an optical contact sensor. The positioning of the sensor in the first fixed module 2 guarantees the reliable power supply thereof.

Furthermore, the system comprises a processing unit (not shown) in signal communication with the presence sensor and with the switch. The processing unit is configured to control the switch to disconnect the first circuit 23 from the electric network when the sensor detects that the second module 3 is not in the active configuration, or at least that it is not in contact with the first fixed module 2.

Obviously a person skilled in the art can make numerous equivalent changes to the embodiments disclosed above, without departing from the scope of the appended claims.

CLAIMS

1. Electric device for supplying power to electric loads (1) in explosion risk environments, comprising:

- a first module (2) configured to be fixed to a building element, comprising a sealed first enclosure (21) and a first circuit (23) housed in the first enclosure (21), the first circuit (23) comprising a primary portion adapted to be connected to an electric network, and

- a second module (3) comprising a sealed second enclosure (31), a second circuit (33) housed in the second enclosure (31) and an electric load (4) associated with the second enclosure (31), the second circuit (33) comprising a secondary portion connected to the electric load (4), said second module (3) being adapted to be removably associated with the first module (2) in an active position in which the primary portion of the first circuit (23) and the secondary portion of the second circuit (33) define a power supply system, which is adapted to convert electric power from the network and make it available to the electric load (4),

characterized in that:

- the first module (2) comprises a plurality of pairs of magnets (5) which are arranged along a first circumference that extends about a first centre, and that direct a same magnetic polarity towards the first centre, as seen from the second module (3), and

- the second module (3) comprises a plurality of pairs of magnets (5) which are arranged along a second circumference that extends about a second centre, and that direct a same magnetic polarity towards the second centre, as seen from the first module (2), which is opposite with respect to the polarity that the pairs of magnets (5) of the first module (2) direct towards the first centre, so as to orient as a function of said first and second polarity the second module (3) in the active position and magnetically lock the second module (3) to the first module (2).

2. A device (1) according to claim 1, wherein the electric load (4) comprises a lighting device, preferably an LED.

3. A device (1) according to claim 1 or 2, wherein no electric contacts exist for connection between the first and the second circuits (23, 33) outside of the first and second enclosures (21, 31).

4. A device (1) according to any one of claims 1 to 3, wherein the second circuit (33) is not electrically connected to batteries.

5. A device (1) according to any one of claims 1 to 4, wherein each pair of magnets (5) is realized by at least two magnets alongside one another so as to realize a single piece in which two mutually opposite surfaces (51, 52) each have both North and South magnetic polarities.

6. A device (1) according to claim 5, wherein the single piece identified by each pair of magnets (5) has at least two North surface polar regions (53, 55) and two South surface polar regions (54, 56) arranged in an alternating sequence.

7. A device (1) according to claim 5 or 6, wherein:

- in the active position, each pair of magnets (5) of the first module (2) is aligned in a longitudinal direction (X-X) with a corresponding pair of magnets (5) of the second module, and

- each magnet of each pair of magnets (5) of the first and the second module (2, 3) has opposite magnetic polarities aligned with each other along the longitudinal direction (X-X).

8. A device (1) according to any one of claims 5 to 7 wherein, for each pair of magnets (5), one of the two surfaces (51, 52) that have both North and South magnetic polarities rests on a ferromagnetic material.

9. A device (1) according to any one of claims 1 to 8, wherein the pairs of magnets (5) of the first module (2) are arranged at a front wall (28B) of the first module (2), and the pairs of magnets (5) of the second module (3) are arranged at a rear wall (38A) of the second module (3), facing the front wall (28B) of the first module (2), the rear wall (38A) of the second module (3) being slidable along the front wall (28B) of the first module (2) during the orientation of the second module (3) in the active position.

10. A device according to any one of claims 1 to 9, wherein the first module (2) comprises a presence sensor configured to detect whether the second module (3) is in the active position.

11. An electric signalling system for explosion risk environments, comprising:

- a device (1) as claimed in claim 9,
- a switch configured to connect and disconnect said first circuit (23) from an electric network, and
- a processing unit in signal communication with the presence sensor of the device (1) and with the switch, the processing unit being configured to control the switch to

disconnect the first circuit (23) from the electric network when the sensor detects that the second module (3) is not in the active configuration.

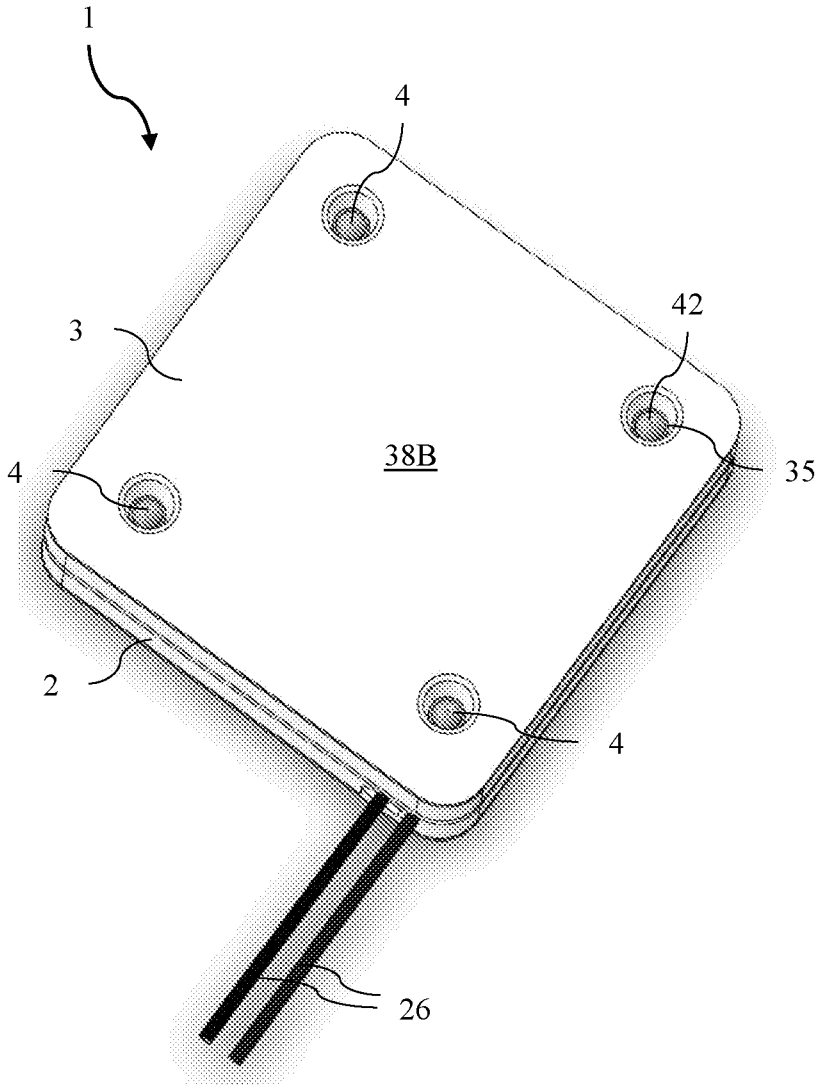

Fig. 1

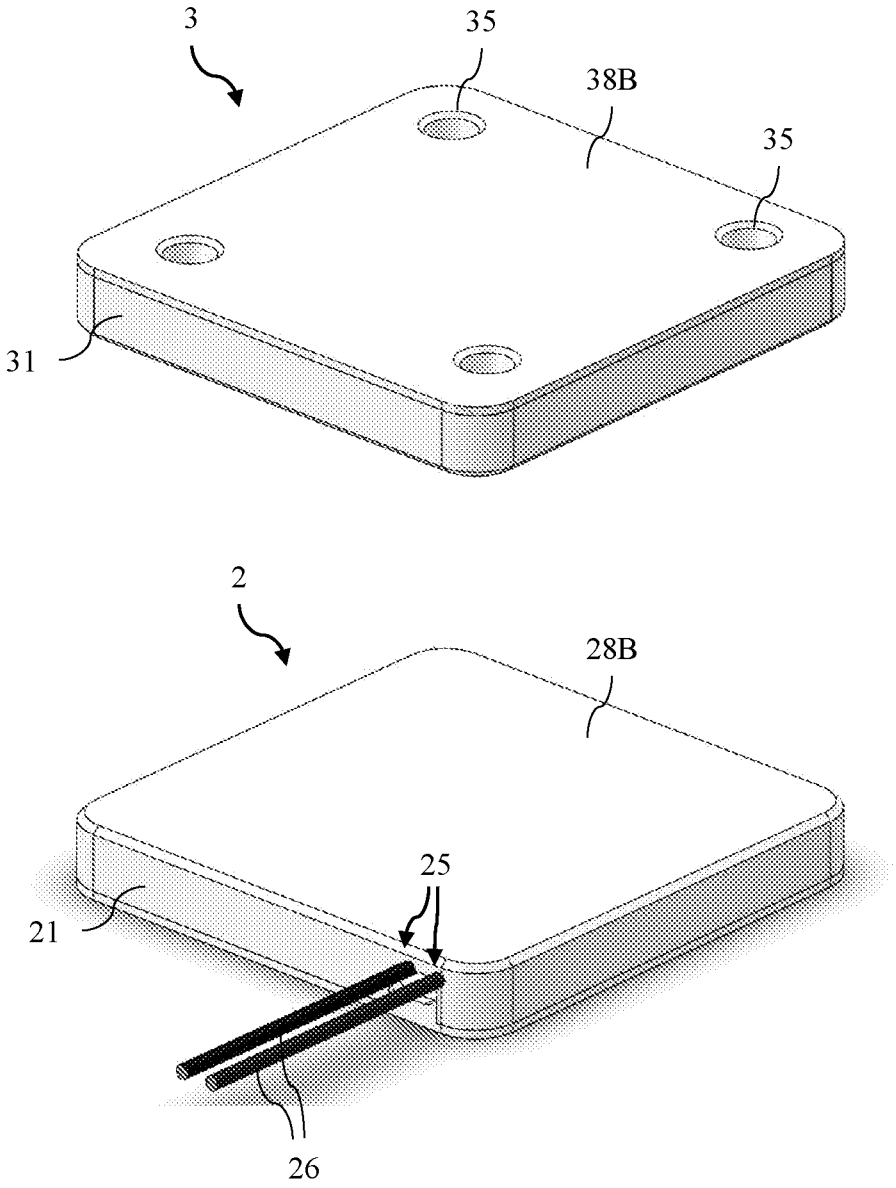

Fig. 2

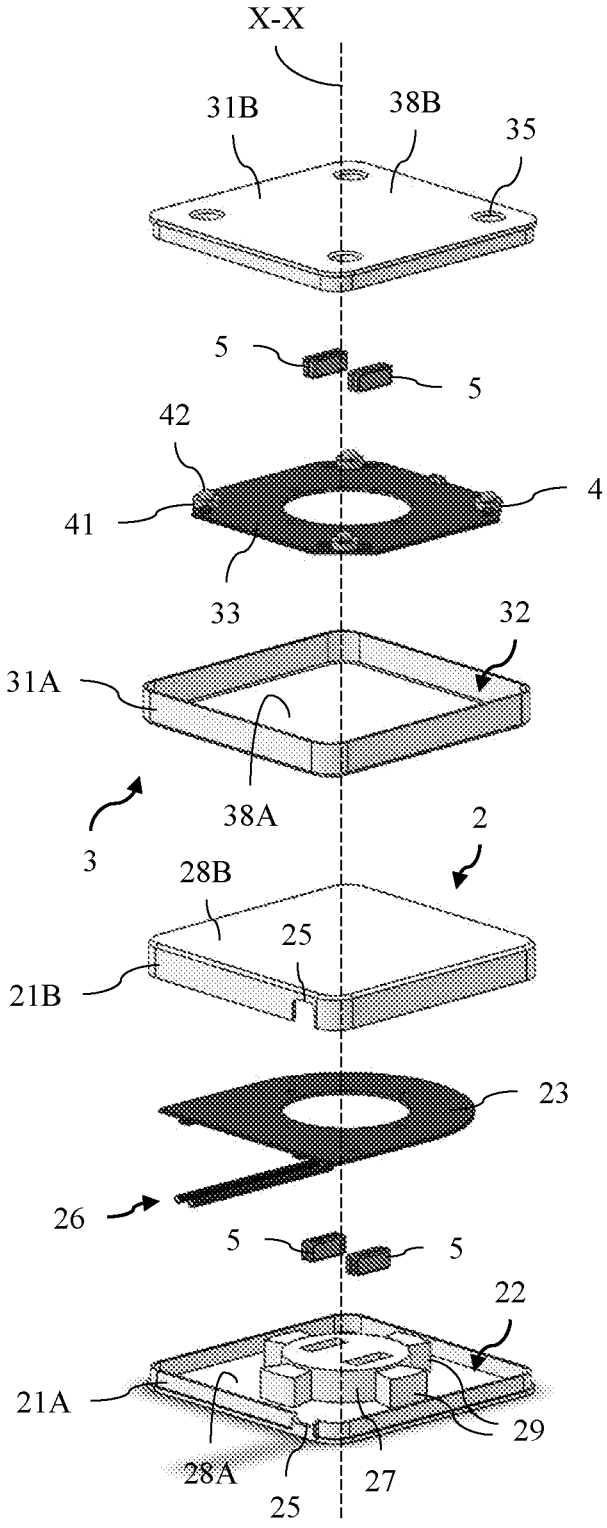
X-X
31B
38B
35
5
5
42
41
4
33
32
31A
38A
3
2
28B
25
21B
23
26
5
5
22
21A
29
28A
25
27

Fig. 3

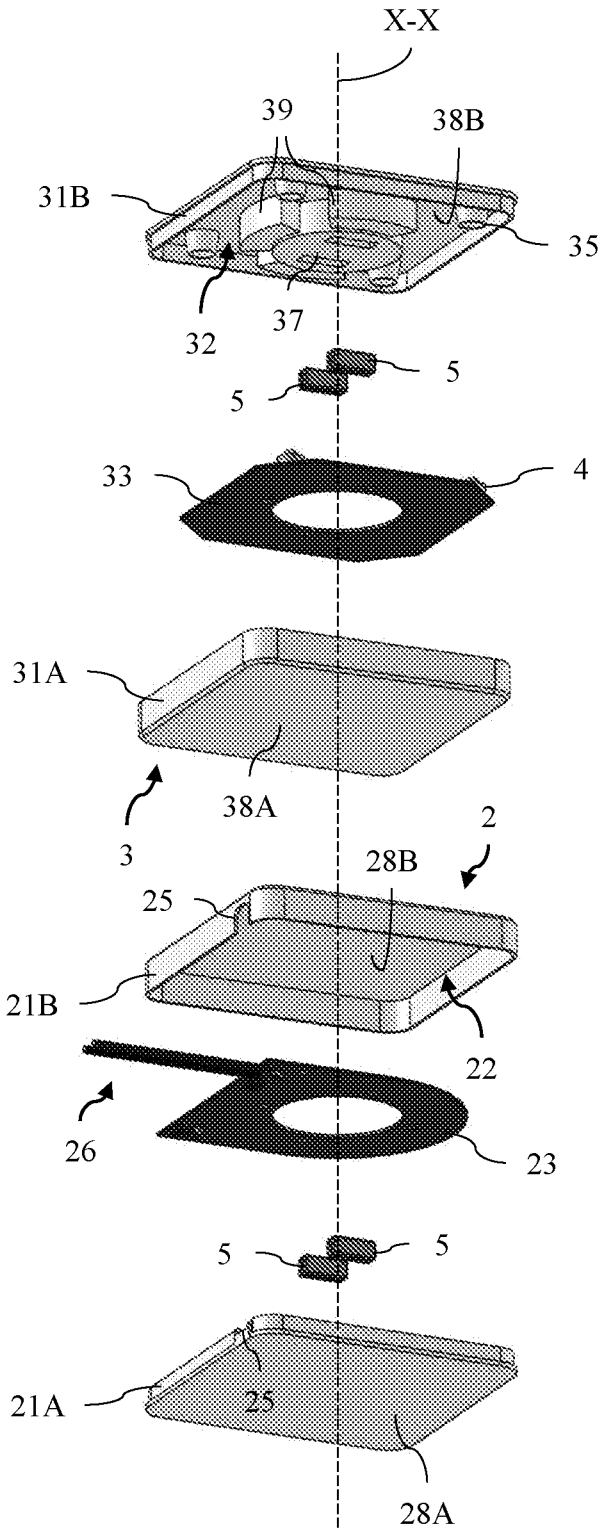
X-X
39
38B
31B
35
32
37
5
5
33
4
31A
38A
3
2
28B
25
21B
22
26
23
5
5
21A
25
28A

Fig. 4

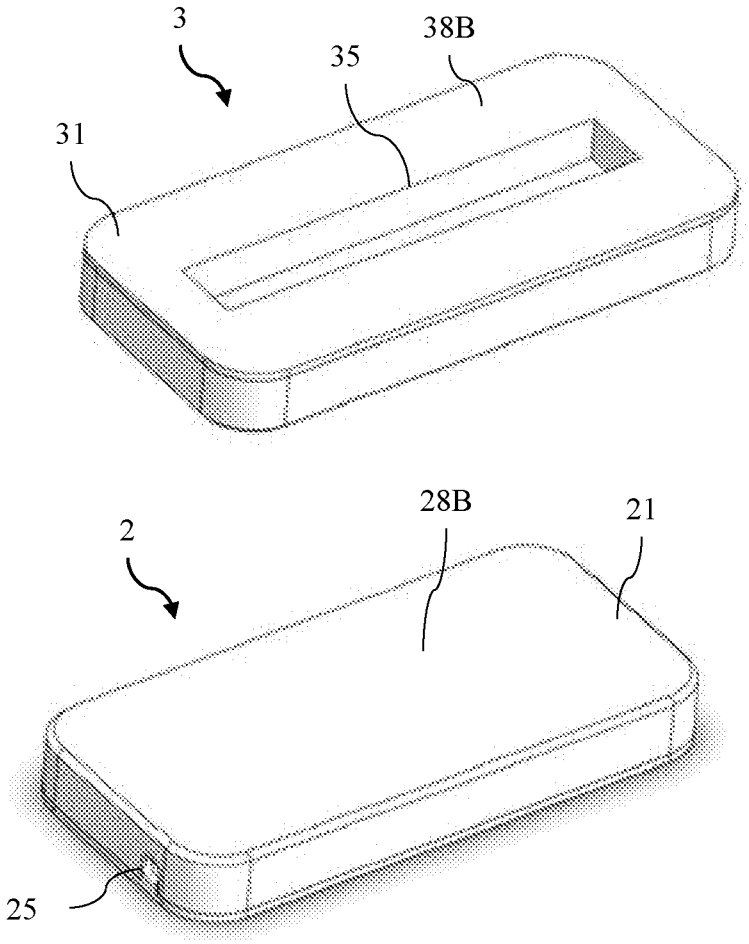

Fig. 5

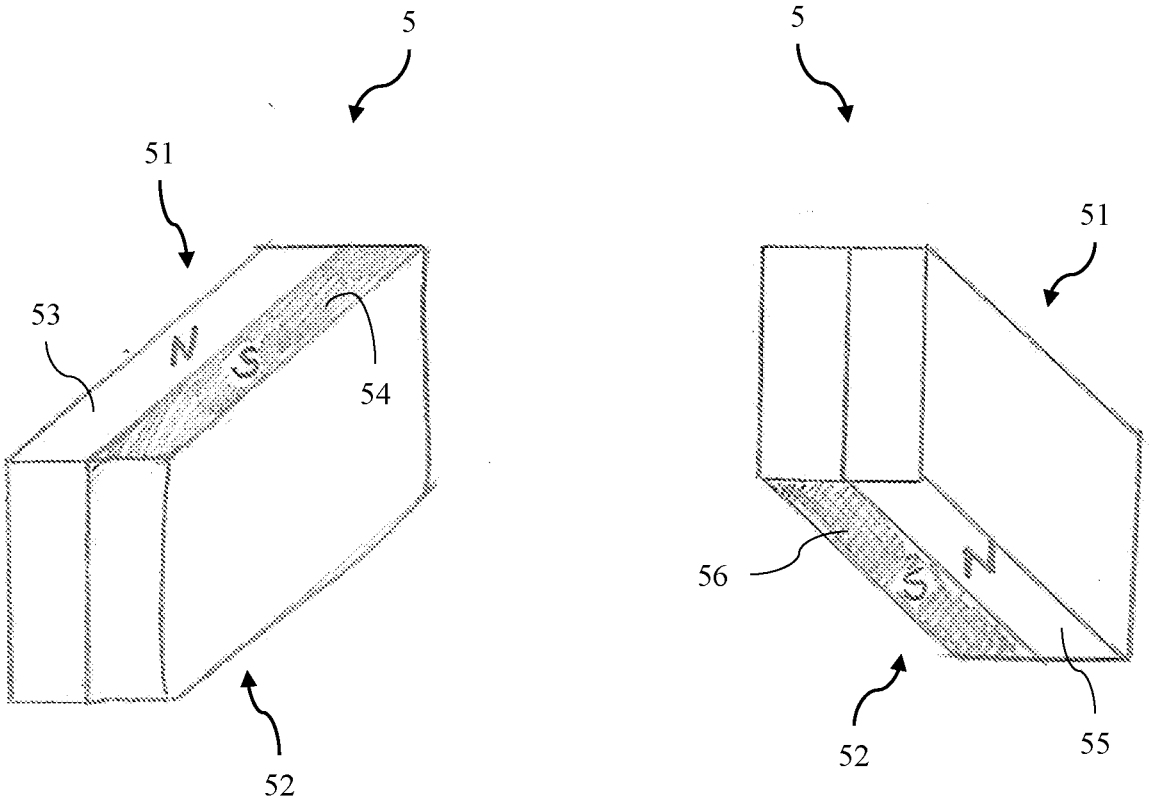

Fig. 6

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2019/055904

A. CLASSIFICATION OF SUBJECT MATTER
INV. F21V25/12 H01F38/14 H05B37/00
ADD. F21Y115/10 F21V21/096

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F21V H01F F21Y H05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	CN 201 437 940 U (INTEX IND XIAMEN CO LTD) 14 April 2010 (2010-04-14) the whole document -----	1-11 1-10
Y	WO 2006/077498 A1 (SPINELLO ANTONIO [IT]) 27 July 2006 (2006-07-27) page 7, line 20 - page 10, line 32; figures 8-20 -----	1-10
Y	DE 10 2012 212254 B3 (FRAUNHOFER GES FORSCHUNG [DE]) 9 January 2014 (2014-01-09) paragraph [0033] - paragraph [0048]; figures 1-2 paragraph [0102] - paragraph [0117]; figures 6A-6E ----- -/--	1-10

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 September 2019	24/09/2019

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Thibaut, Arthur

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2019/055904

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2009 159685 A (PANASONIC ELEC WORKS CO LTD) 16 July 2009 (2009-07-16) paragraph [0051] - paragraph [0056]; figures 1-3	1-10
Y	GB 2 499 233 A (CAMBRIONIX LTD [GB]) 14 August 2013 (2013-08-14) page 10, line 11 - page 15, line 19; figures 1-4	1-10
Y	US 2013/099696 A1 (MAXIK FREDRIC S [US] ET AL) 25 April 2013 (2013-04-25) figures 1-4 paragraph [0023] - paragraph [0036] paragraph [0044] - paragraph [0048] paragraph [0054] - paragraph [0056]	1-10

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2019/055904

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		WO 2014009380 A2	16-01-2014
JP 2009159685 A	16-07-2009	JP 5314278 B2	16-10-2013
		JP 2009159685 A	16-07-2009
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US 2013099696 A1	25-04-2013	NONE	