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(54) **A ceiling panel system**

(57) A system comprising two or more ceiling panels for covering a ceiling e.g. by being integrated into a support structure suspended from a ceiling. Each panel comprises a plurality of conductors, and one or more connectors for electrically connecting the conductors of said panel to the conductors of another panel. The panel may comprise a controller for controlling the operation of any electrical device electrically connected to the panel. The controller may be adapted to control the operation of one or more other panels.

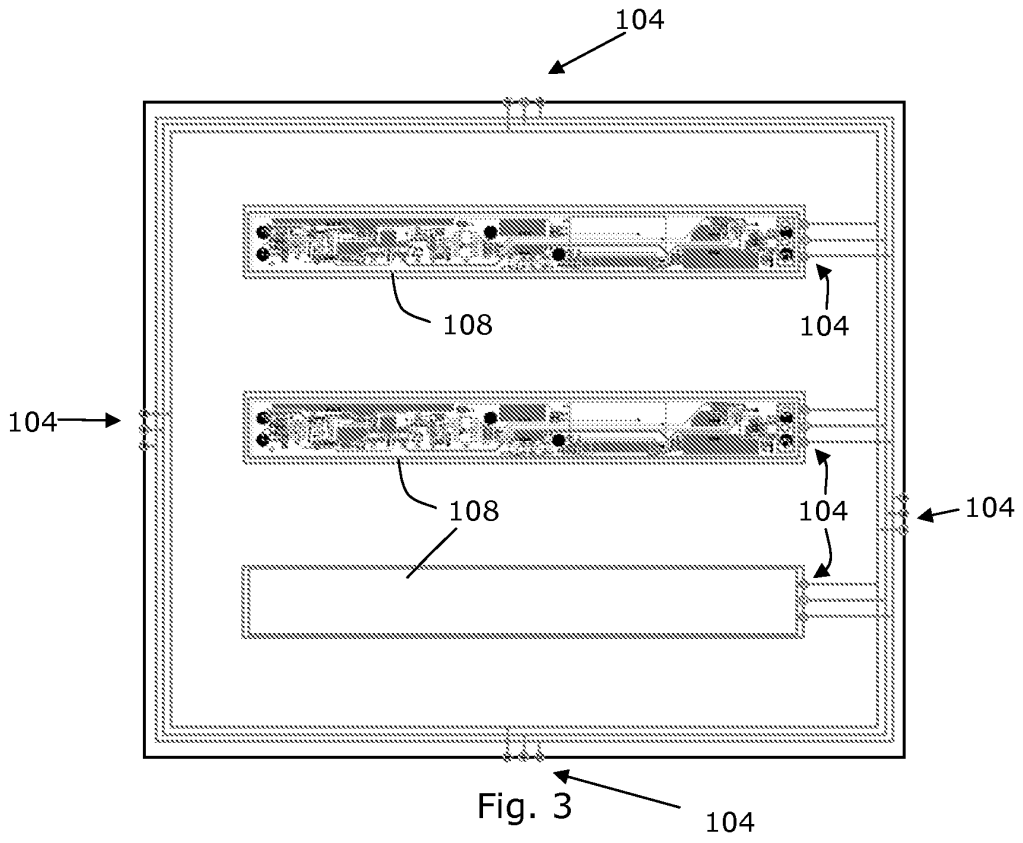

Fig. 3

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Description

BRIEF DESCRIPTION OF THE INVENTION

[0001] The present invention relates to ceiling panels and to a system comprising two or more ceiling panels. In particular the present invention relates to ceiling panels comprising a plurality of conductors and one or more connectors for electrically connecting the conductors of one panel to the conductors of another panel. Moreover, the present invention relates to ceiling panels adapted to be detachably attached to a suspended support structure and to panels comprising electrical circuits.

BACKGROUND OF THE INVENTION

[0002] With the increased focus on global warming, initiatives are needed which may reduce the emission of carbon oxide. In today's buildings, electrical devices are supplied with electrical power via "mains" which is normally a voltage source in the range 110-240 Volt AC. In most cases the mains source is based on fossil fuel power plants, which not only emit large quantities of carbon oxide but also provide a poor energy efficiency as most of the energy contained in the fossil fuel is converted into heat and not into electricity. The electricity is transported from the power plant to the consumer as a high voltage AC source, which often is converted into a low voltage DC source locally. Most AC/DC transformers also have poor energy efficiency and even the most efficient AC/DC converters have undesired energy losses due to emission of heat. Moreover, most green energy sources can produce energy as a DC voltage source which is converted into an AC "mains" source. Such DC/AC transformation devices also have undesired energy losses, as some of the energy is transformed into heat. Accordingly, there is a need for a power supplying system wherein energy losses are eliminated or reduced e.g. by transmission of DC voltage directly form the source to the consumer or by provision of a system wherein the number of AC/DC transformers in a building is reduced to a limited number of the most efficient transformers.

[0003] Moreover ceilings of most commercial buildings comprise a plurality of ceiling panels/plates attached to a support structure suspended from the ceiling. Most ceilings panels are passive in that the panels do not comprise any electronics or electrical conductors.

[0004] However, panels comprising electronics are known in the art. One such example may be seen in EP 1 174 834 which discloses a method and system for identifying panels that embed active and passive components of an electronic device, or that hide certain key components of a building's infrastructure in the plenum of the ceiling.

[0005] Further background art may be found in EP 0 887 587, DE 195 11 042,WO 2004/063484.

[0006] It is an object of an embodiment of the present invention to provide a system of ceiling panels which may be electrically connected to each other e.g. so as to allow supply of electrical power to a plurality of ceiling plates.

[0007] Moreover, it is an object of an embodiment of the present invention to provide a ceiling system wherein one ceiling panel may be adapted to control the operation of electrical devices provided in other ceiling panels.

[0008] It is a further object of an embodiment of the present invention to provide a ceiling panel which is adapted to control the operation of any electrical device electrically connected to and/or detachably attached to the ceiling panel.

[0009] In yet an other embodiment of the present invention, it is an object to provide a system which utilizes a new or an already existing infrastructure to introduce a new low-voltage power supplying system and/or a system enabling data communication.

[0010] Additionally, it is an object of an embodiment of the present invention to provide a system which allows electrical devices to be easily positioned, removed and repositioned in accordance with the preference of the user, thus allowing a user to redesign a room in minutes.

DESCRIPTION OF THE INVENTION

[0011] The abovementioned objects have been solved by the presenting invention which in a FIRST aspect relates to a system comprising two or more ceiling panels for covering a ceiling, each panel comprising:

- a plurality of conductors, and
- one or more connectors for electrically connecting the conductors of said panel to the conductors of another panel.

[0012] One advantage of the present invention is that a conventional ceiling comprising conventional passive panels may easily be turned into an electrically conducting ceiling by replacing the passive panels with the electrically conducting panels of the present invention. This is especially the case when the panels of the present invention have the same geometry as the panels of the conventional systems, i.e. the panels may have the same dimensions as conventional

plates or just dimensions allowing the panels to be installed into the support structure already suspended from a ceiling. As the panels may comprise one or more connectors for electrically connecting a first panel with a second panel, the present invention provides a simple way of transforming a passive ceiling into an electrically conducting ceiling.

[0013] In the context of the present invention the term "electrically conducting ceiling" shall be understood as a ceiling which comprises one or more conductors for conducting electricity. It will be appreciated that the conductors may be insulated so as to prevent shortening of electrical circuits or so as to prevent that a user gets an electrical shock when touching or replacing the panel.

[0014] The conductors may be connected to a power source adapted to provide electrical power in the range of 1-50 Volts DC, such as 2.7 Volts DC or such as 3.0 Volts DC or such as 3.3 Volts DC or such as 5 Volts DC or such as 12 Volts DC or 24 Volts DC or 48 Volts DC. As described below each of the electrical devices may be adapted to operate at another voltage and may comprise one or more transformers for transforming the "backbone" power supply (e.g. 48 volts) of the conductors of the panels to the voltage appropriate for the respective electrical device. The conductors may form part of an Ethernet such that the conductors provide power and signals. This may be based on the Power over Ethernet standard (PoE - IEEE 802.3)

[0015] The panel system may be connected to or comprise a power supply such as solar panels, wind turbines, water turbines, or power plants adapted to transform fossil fuel to electrical energy, or power plants adapted to transform biogas to electrical energy, or fuel-cells. Moreover, the panel system may comprise means for storing the electrical energy, such as a battery. In one embodiment, the panel system is connected to a DC power supply such as a solar panel whereby DC/AC transformation from the solar panel to mains (typically 220/110 Volts AC) may be eliminated and whereby subsequent AC/DC transformation from mains to DC may be avoided. In another embodiment, the system comprises one central AC/DC converter for converting mains to DC (e.g. 48 Volts DC) whereby a plurality of decentral AC/DC converters may be avoided.

[0016] In one embodiment, one or more power supplying devices e.g. a solar panel is electrically connected decentrally. As an example each floor of a building may comprise one or more solar panels for supplying electrical power to the panels and electrical devices of that floor. If too much or too little power is produced by the decentrally provided power supply the power may be transmitted to other parts of the system (e.g. another building) or more power may be retrieved by the system, respectively.

[0017] The size of the panels may vary depending on the suspended support structure. Examples are 625*625 mm; 625*312,5 mm; 600*600 mm; 600*300 mm; 300*300 mm; 750*750 mm; 294*500 mm; 750*2500 mm. In one embodiment the panels are box-shaped closed panels wherein the conductors are provided inside the panels. The box-shaped panels may comprise an upper and a lower part adapted to engage each other so as to provide the panel in the closed state. The upper and lower part may comprise a metal material such as a light metal material e.g. aluminium or titanium. Other metal materials may be cupper, cast iron, chrome, silver, gold and platinum or steel such as stainless steel. Alternatively, or as a supplement, the upper and/or lower part may comprise a plastic material or fibre glass or carbon fibers. At least a part of the panel may be thermally conductive and be designed such that any heat produced by an electrical device is "transported" away from the panel. Accordingly, the panel may comprise cooling ribs e.g. provided on a back surface of the panel.

[0018] The panel may comprise any number of conductors such as one, two, three, four or five or eight or ten or twenty. In one embodiment at least a part of the conductors such as all the conductors of one panel, may form an integral part of the panel. As an example one or more of the conductors may be moulded into the panel such that only a part of the conductors is accessible from on outer surface of the panel. In the latter example, the conductors may be moulded into the panel such that ends of the conductors are accessible from at the rim portion of the panel.

[0019] The conductors may take any form such as conventional electrical wires e.g. twisted pairs, coax cables, flex prints, printed circuit boards etc.

[0020] In one embodiment the conductors are provided in a predetermined pattern. One example of such a pattern is where two sets of conductors are provided in a cross structure such that one set extends from one corner to another while the other set of conductors extends between the two remaining corners of the panel. At the centre of the panel, the two sets of conductors may be electrically connected such that a first conductor of the first set is electrically connected to a first conductor of the second set, and such that a second conductor of the first set is electrically connected to a second conductor of the second set, etc.

[0021] In the latter embodiment an electrical connector may be provided at each corner, allowing one panel to be electrically connected to any other panel which is provided in the vicinity of the respective corner. As an example four panels may be provided such that one corner of each panel abuts or is placed in the vicinity of the remaining three panels, i.e. each of the four panels may be said to form a quadrant in a coordinate system. In the latter embodiment, the four panels may be electrically connected to each other in the zone at which the four abutting corners are provided, i.e. at the centre of the coordinate system.

[0022] Alternatively or as a supplement, two panels may be adapted to be electrically connected to each other by means of connectors provided along the side of the panel.

[0023] Two or more panels may be electrically connected to another panel by means of a plurality of interconnecting members comprising one or more conductors. In one example the interconnecting members comprise a flex print, i.e. a flexible material such as polythene (or Polyethylene Terephthalate) comprising a plurality of conductors. Each interconnecting member may comprise a connector for electrically connecting the interconnecting member to a corresponding connector of a panel.

[0024] In one embodiment, the interconnecting members are sufficiently long to allow the interconnecting member to electrically connect two non-neighbouring panels such as panels between which one or more other panels are interposed/provided. Due to the length of the aforementioned interconnecting members, the interposed panels may be conventional passive panels. This provides the advantage that an existing ceiling may be updated to a conducting ceiling in steps wherein predetermined panels are converted to conducting panels while the remaining panels continue to be passive panels, which may be converted into conducting panels at a later stage.

[0025] In one embodiment the connectors of one or more panels and the connectors of one or more of the interconnecting members are identical and are adapted to be detachably attached to each other so as to electrically connect the conductors of a panel to the conductors of an interconnecting member. In other embodiments one connector may be a male connector while the other connectors may be female connectors. As an example all the panels may comprise male connectors while the interconnecting members comprise female connectors.

[0026] In one embodiment, at least two of the panels comprise one or more power casting devices which are used for transmitting power from the conductors of one panel to the conductors of another panel. Power casting devices are disclosed in WO07089680 A2, WO07095267 A2, WO07061921 A2, WO06127624 A2, WO06091499 A2. In another embodiment at least one of the panels comprises a power casting device for transmitting/transferring power from the panels to another electrical device located in the area of the panel, such as a PDA, a remote control, a mobile telephone etc.

[0027] In one embodiment one or more of the panels comprises a means for detachably attaching an electrical device to the panel such as a fixture. By allowing electrical devices to be detachably attached to one panel or panels in a large group of panels, a ceiling may be provided in which electrical devices may be attached, removed and re-attached in accordance with the preference of the user. It will be appreciated that in order to allow an electrical device to change position, at least two panels must comprise similar means for detachably attaching an electrical device. In one embodiment all or a large number of the fixtures in the panels are identical. However, in other embodiments a plurality of different forms of fixtures may be provided, e.g. one of each kind in each panel.

[0028] In one embodiment some of the fixtures and the electrical devices comprise magnetic materials such as ferromagnetic materials e.g. Iron, whereby the electrical device(s) may be detachably attached to the fixtures by means of magnetism. In yet another embodiment, the electrical device and/or the conductors comprise snap-locking means for detachably attaching the device to the fixture. In yet another embodiment, one or more of the electrical devices may be attached to the panels by means of screws, bolts or the like.

[0029] In one embodiment, one or more of the panels comprises perforations on its/their front surface i.e. the surface facing downwards during use, and the conductors are arranged such with respect to the perforations that an electrical device may be electrically and physically connected to the panel by introducing pin-shaped contact members through said perforations. This provides the advantage that an electrical device may detachably attached to the panel in an easy manner which do not require that the panel is removed from the suspended-support structure.

[0030] The electrical device may comprise at least one of:

- repeaters for repeating an electrical or electromagnetic signal, routers, printers, access points for wireless communication, VoIP telephones;
- a sensor, such as a movement sensor, an infrared sensor, a heat sensor, a smoke sensor, a light sensor for sensing visible light;
- a transmitter for transmitting a signal by means of electromagnetic radiation, such as a transmitter for transmitting radio frequency signals, UV-signals, or x-ray signals; and
- a receiver for receiving a signal by means of electromagnetic radiation, such as a receiver for receiving radio frequency signals, UV-signals or x-ray signals.
  Moreover, the electrical device may comprise a microphone, a loudspeaker, a video monitor such as an LED monitor, or a lightening device such as an LED, a halogen lamp or an incandescent lamp.

[0031] In the context of the present invention the term "LED" shall be understood as any Light Emitting Diode such as Polymer light-emitting diodes (PLED), Transparent organic light-emitting device (TOLED), Stacked OLED (SOLED), Inverted OLED (IOLED) or organic light-emitting diode (OLED).

[0032] In one embodiment, one electrical device comprises a light emitting element and means for controlling the light

emitting device. The means for controlling the light emitting device may be adapted to turn the device on and off and/or to control the intensity of light emitted from the device.

[0033] In one embodiment the electrical device comprises a fan/blower which may be used for cooling the power consuming components or as part of a system for cooling a room in which the electrical device is provided. As an example the blower/fan may form part of an air conditioning system.

[0034] In one embodiment, a first electrical device comprises means for communicating with a second electrical device. As an example the devices may exchange information or one device may control the other. In one embodiment, the first device furthermore comprises a camera and is adapted to transmit/communicate images (moving or still) recorded with the camera to the second device, which may be adapted to present the images on a monitor provided in the second device.

[0035] In one embodiment, the electrical device comprises means for identifying the device relative to another device e.g. a portable device. Such identification means may be adapted to use RFID or any other suitable wired or wireless identification technology. Moreover, the electrical device may be adapted to emit a visual and/or acoustic and/or tactile signal upon request from another device.

[0036] In one embodiment, one or more electrical devices may be adapted to track the position of a person or an object, which may be provided with means for identifying the person/object.

[0037] In order to allow one electrical device to communicate with another device, one or more of the electrical devices may be adapted to modulate data signals via the conductors.

[0038] Additionally, or as a supplement, one or more electrical devices may comprise means for transmitting signals/data by means of an electromagnetism such as Bluetooth or GPRS or GSM or ZigBee.

[0039] In one embodiment, at least one electrical device may be adapted to be supplied with a predetermined voltage in the range of 1-50 V DC power and power consuming devices of such electrical devices may be adapted to be supplied with said predetermined voltage without the use of an internal transformer. As an example, an electrical device may comprise light emitters adapted to be supplied with 48 V DC. In another embodiment, one or more power consuming components of at least one electrical device is/are adapted to be supplied with a voltage different from the predetermined "backbone" voltage supplied via the conductors, and, thus, said electrical device may comprises a transformer for transforming the voltage supplied by the conductors (e.g. 48 V DC) to the needed voltage (e.g. 5 V DC).

[0040] The electrical device may comprise a printed circuit board (PCB) which may be replaceable. As an example the electrical device may comprise a socket adapted to slidingly receive the PCB. By allowing the PCB to be replaced, the hardware and/or the software of the electrical device may be replaced and/or updated. Accordingly, the electrical device may easily be reconfigured by changing one PCB with another. In one embodiment the electrical device comprises one or more holders for releasable attachment of surface mounted devices. The holders may be provided on a printed circuit board of the electrical device.

[0041] The fixtures of each panel may be provided in a predetermined pattern. Examples are:

- Fixtures provided in a row such as equidistantly in a row i.e. such that the distance between any two neighbouring fixtures of the panel is substantially identical.

- Fixtures provided such that the fixtures define a star i.e. such that one end of each fixture of a panel is provided in a predetermined zone and the opposite end of each fixture extends away from said zone.

- Fixtures provided in a polygonal formation such as quadrangular formation. As an example each side of the polygon may be defined by one or more fixtures. If the formation is a quadrangle, each of the four sides may be defined by one of four fixtures. In one embodiment an electrical device is electrically connected to one or more of the conductors, when the electrical device is attached to the fixture. In one embodiment conductors may be electrically connected by manually moving - by hand - a connector of the panel into engagement with a connector of the electrical device. In another embodiment, the fixture comprises one or more or more resilient/bendable engagement members which are arranged such with the respect to the fixture that corresponding engagement members of the electrical device automatically engages the first mentioned engagement members, when the electrical device is detachably attached to the fixture.

[0042] In one embodiment an electrical device forms an outer surface of the panel, when the electrical device is detachably attached to the panel. As an example at least one fixture and at least one electrical device may be designed such that the electrical device is at the same level as the front surface of the panel, when the electrical device is detachably attached to the fixture.

[0043] In one embodiment one or more panels are not adapted to receive an electrical device but only serve the purpose of transporting electrical signals and electricity. The latter panels do not comprise fixtures for detachably attaching an electrical device but only conductors and connecters allowing the signals and the electricity to be transmitted through the panel.

[0044] In order to allow one or more electrical devices of the panel to communicate with other panels and/or electrical devices, one or more of the panels may comprise a transceiver for electromagnetic communication. The transceiver may comprise an antenna which may integrated into the panel and/or extends parallel to a surface of the panel such as the front surface. Alternatively or as a supplement, an antenna may extend away from the panel in a direction transverse to the front surface of the panel. In one embodiment, the latter antenna may be provided on a back surface (which is defined in a surface opposite the front surface), whereby the antenna is not visible when the panel is attached to the suspended support structure. In another embodiment, the antenna may be provided on the front surface and extends away from the front surface, i.e. downwards when the panel is attached to the suspended support structure.

[0045] The transceiver may be suitable for any electromagnetic communication such as radiofrequency communication or communication by means of infrared radiation.

[0046] The transceiver may be electrically connected to a communication unit for modulating and/or demodulating a signal, e.g.. The communication unit may be adapted to transmit/receive signals by means of the transceiver and/or via one or more of the conductors. Accordingly, the conductors of the panel may be used both for supply of electricity and for communication.

[0047] In one embodiment the panel comprises a controller for controlling one or more electrical devices electrically connected to the panel. In one embodiment the controller is adapted to control any electrical device electrically and/or physically connected to the panel. In other embodiments, the panel is adapted to control a predetermined number of electrical devices, which are physically and/or electrically connected to the panel. One advantage of providing such a controller is that larger numbers of panels may be controlled by sending a signal to each panel which then as an example controls any electrical device connected to the panel, instead of sending a signal to each electrical device. Moreover, each panel may be adapted to control its own operation based on information provided by a sensor (an electrical device) which is electrically connected to the panel.

[0048] In one embodiment, a plurality of electrical devices is electrically and physically connected to the panel. One of the electrical devices may be a sensor for determining a level of daylight and a controller may be adapted to control electrical devices in the form of light emitting elements such as LEDs, such that essentially the same level of light is present in the area of the panel. In another embodiment the sensor is a movement/motion sensor, and the controller is adapted to turn on and off light in response to movements determined by the sensor.

[0049] In yet a further embodiment, the controller is adapted to control any operation of the panel into which it is integrated and/or the operation of one or more other panels. Accordingly a large number of panels may be controlled by sending a signal to one panel which controls the operation of a large number of panels. As the panels may comprise a communication unit for sending signals via an antenna or via the conductors, the panels, which one controller is adapted to control, need not be positioned adjacent to each other. In fact the panels may be positioned and repositioned in the support structure suspended from the ceiling while the controller is still adapted to control the same group of panels. This provides a high flexibility as a user need not be concerned with cabling between the panels as the cabling is already part of the structure. Accordingly, the user may reposition a first panel which is controlled by a second panel while maintaining said control of the first panel.

[0050] It will be appreciated that in order to allow one panel to control another panel and to allow the aforementioned repositioning of panels, each panel may comprise a unique ID which is used by the controlling panel to identify which panel(s) are to react on a predetermined command. The ID may comprise segments, e.g. a first segment used to identify a first group of panels with which the panel is associated, a second segment used to identify a second group of panels with which the panel additionally is associated and a third segment used to identify a respective panel. In one embodiment the first and the second segments are not subsets of each other, while in other embodiments the first segment is a subset of the second segment. It will be appreciated that the ID may comprise any number of segments in accordance with the preference of the designer of the system. In one embodiment each or a plurality of electrical devices comprises an ID as an alternative to or a supplement to the ID of the panels.

[0051] In one embodiment the ID is based on a protocol such as an internet protocol e.g. TCP/IP, IP version 4 or IP version 6, or on a MAC address protocol or on an Ethernet protocol, whereby each panel/electrical device having an ID may be connected to the internet and be accessible via the internet. As an example this may be used to access a predetermined electrical device such as a camera or a sensor via the internet. This may be used for surveillance purposes or for monitoring a building, e.g. by monitoring the temperature, movement, pressure etc.

[0052] In one embodiment, the IDs are suitable for network management systems by means of the simple network management protocol (SNMP). This may be used to control one building from another building, or one site from an other site. The sites/buildings may be located at different locations in the same area or in different countries. Accordingly, one specific panel or one specific electrical device may be controlled and/or monitored from the other side of the world. In one embodiment, one or more of the electrical devices are adapted to send a signal when the device is not operating correctly or when a preconditioned condition occurs e.g. that the power is below a predetermined value or that no ambient light is detected by the device.

[0053] A further advantage of using the SNMP protocol is that one or more - even all - the electrical devices may be

monitored so as to log performance and so as to be able to set up and control maintenance programs.

[0054] In one embodiment the ID is a wireless ID such as an RFID or a secure RFID allowing a panel or an electrical device to be identified wirelessly e.g. by a device such as a laptop present in the room below the suspended ceiling.

[0055] In one embodiment, the controller comprises at least one of: a processor, a memory and a computer programme. The memory may be read only memory and/or random-access memory.

[0056] In one embodiment, the panel system comprises one or more central and/or decentral units for controlling a plurality of electrical devices. In one embodiment, the central/decentral device(s) are adapted to power on or off electrical devices depending on the electricity available. In order to be able to determine which devices are allowed to be supplied with power and which devices shall not be supplied with power, each device may be ranked in a list such that if the power supply is not sufficient, the central/decentral unit may shut down lower ranking electrical devices before shutting down higher ranking devices.

[0057] Moreover, each electrical device may have a unique identifier allowing the device to be identified by other electrical devices and/or the decentral/central unit(s). The electrical devices may form a physical or virtual cluster which the central/decentral devices may be adapted to control or to communicate with. In an alternative embodiment, a predetermined group of electrical devices (e.g. positioned in different panels) may form a virtual cluster and the central/decentral units may be adapted to control all devices in the virtual cluster e.g. in the same way.

[0058] In one embodiment one or more of the abovementioned power management, the wireless communication, the resource management etc is based on the IEEE 802.## standard (see below)

STRUCTURE	Conductors and circuits	IEEE 802.3an
LAN	Ethernet	IEEE 802.3u,z,
PoE+	Power over Ethernet	IEEE 802.3af/t
TCP / IP	Transport Control Protocol / Internet Protocol	IEEE 802.3
SNMP	Simple Network Management Protocol	IETF SNMPv3
RF	Wireless network, radio	IEEE 802.15.4
WIFI	Wireless Network broadband	IEEE 802.11a,b,g,s
WIMAX	Microwave Access	IEEE 802.16
4G	Fourth-Generation Communications	ETSI System
MBWA	Mobile Broadband Wireless Access	IEEE 802.20

By basing the one or more of the above on the same standard, it will be appreciated that most of the systems/structures will be adapted to operate together whereby a substantially seamless integration may be achieved.

[0059] In one embodiment each panel is adapted to be detachably attached to a support structure suspended from a ceiling. The support structure may comprise a plurality of profiles arranged in a predetermined pattern e.g. to allow panels having a predetermined dimension to be detachably attached to the structure. In one embodiment the suspended ceiling comprises a plurality of longitudinally and substantially equidistantly arranged profiles. Between said profiles there may be provided transversely and substantially equidistantly arranged profiles, each of which may define a substantially right angle with the longitudinally extending profiles. In the latter embodiment, a plurality of spaces may be defined between the longitudinally and transversely arranged profiles and the panels may be dimensioned such that one panel may be inserted into each space so as to allow the panel to be detachably attached to the support structure.

[0060] In a SECOND aspect the present invention relates to a ceiling panel for use in a system according to any of the preceding claims.

[0061] The panel according to the second aspect may comprise any combination of features and elements of the invention according to the first aspect.

DESCRIPTION OF THE DRAWINGS

[0062]

Figs. 1 and 2 disclose examples of arrangements of the conductors in a panel,

Fig. 3 discloses electrical devices detachably attached to fixtures of a panel,

Fig. 4 discloses processors inserted into a panel and connected to the conductors,

Fig. 5 discloses electrical devices inserted into fixtures of a panel,

Fig. 6 discloses an LED monitor detachably attached to a panel,

Figs. 7-10 disclose examples of panels which are electrically connected,

Fig. 11 discloses a cross-sectional view of an electrical device detachably attached to a panel,

Fig. 12 discloses an example of a design for an detachably attachable electrical device, and

Figs. 13 and 14 disclose examples of systems for controlling a plurality of panels.

[0063] Fig. 1 and 2 each disclose a ceiling panel 100 for covering a ceiling by being integrated into a suspended support system for supporting a plurality of panels. The panel 100 comprises three conductors 102,102',102" which are adapted to be used for supplying power to an electrical device and/or for transmitting a signal. It will be appreciated that in other embodiments the panel may comprise fewer or further conductors. As an example the panels may comprise two conductors for supplying a positive and a negative lead. It will be appreciated that it will be advantageous in most systems that all panels in a ceiling have the same number of conductors in order to allow voltage/signals to be transmitted from from one conductor 102,102',102" to a similar conductor 102,102',102" at any other location of the ceiling.

[0064] Each of the panels of Figs. 1 and 2 comprises four connectors 104 for electrically connecting the conductors 102,102',102" of one panel to the conductors 102,102',102" of another panel. In the embodiments of Figs. 1 and 2, the connectors 104 are positioned centrally at each of the four sides of the panel. In other embodiments the connectors 104 may be positioned at other positions along the side of the panel 100 see e.g. Fig. 8 or at another position on the panel. However it will be appreciated that the closer the connectors 104 are to the sides of the panel 100 the shorter an interconnecting members 106 (not shown in Figs. 1 and 2) need be in order to be able to interconnect two panels.

[0065] In the Fig. 1 the conductors 102,102',102" interconnecting the connectors 104 form a cross which has the advantage that the conductors 102,102',102" may be as short as possible. In Fig. 2 the conductors 102,102',102" are provided so as to substantially follow the sides of the panel, thus leaving room centrally on the panel 100 for one or more fixtures 108 (not visible in Fig. 1 and 2).

[0066] Fig. 3 discloses a panel 100 comprising a plurality of conductors 102,102',102" which are connected to connectors 104. Three of the connectors 104 are positioned centrally on the panel 100 while one is positioned at the lower part of the right side. The panel 100 comprises three fixtures 108 each of which comprises connectors 104 which are electrically connected to the conductors 102,102',102" of the panel. Electrical devices 110 are inserted into the two uppermost fixtures 108. When the electrical devices 110 are inserted into the fixtures 108 they are electrically connected to the conductors 102,102',102" as each electrical device 110 comprises connectors (not visible) which engage the connectors 104, when the device 110 is inserted into the fixture 108. When the electrical device 110 is inserted into a fixture 108 of a panel 100, a front surface (not visible) of the electrical device 110 may be at substantially the same level as a front surface of the panel 100, whereby it is difficult to visibly determine that en electrical device has been inserted into the panel 100. In order to provide the same visual effect in relation to the lowermost fixture, into which no electrical device 110 has been inserted, an cover plate (not shown) may be inserted into the "empty" fixture.

[0067] The electrical device 110 may comprise an electric circuit which is electrically connected to the conductors 102,102',102" when the electrical device 110 is inserted into the fixture 108. Due to the electrical connection, the electrical device 110 may by supplied with electricity and/or may transmit/receive signals by modulation via the conductors 102,102', 102". Alternatively, the electrical device 110 may comprise an antenna (not shown) for wireless communication of signals.

[0068] In Fig. 4 the panel comprises two fixtures 108 each of which is adapted to allow an electrical device 110 to be detachably attached to the fixture. In the embodiment of Fig. 4, a first electrical device 110' comprises means for identifying the panel 100, whereas the other electrical device 110" may be another kind of electrical device. In other embodiments, the ID may be integrated into the panel, however it will be appreciated that by providing the ID in the form of an electrical device which may be inserted into a fixture, it is easier to reuse the ID in an other panel is the panel 100 of Fig. 4 is damaged.

[0069] Figs. 5 and 6 show two alternative shapes of the fixtures 108. In Fig. 5 the fixtures 108 are circular and may e.g. be used for light emitting spots, and in Fig. 6 the fixture 108 is relatively large compared to the fixtures of Fig. 3-5. As an example the fixture 108 of Fig. 6 may be used for a monitor 112 such as an LED or an LCD. The monitor 112 may be used for displaying moving or still images or for lighting purposes.

[0070] Figs. 7 and 8 disclose two different ways of connecting the conductors 102,102',102" of panel 100. In Fig. 7 each panel 100 comprises one connector 104 on each of the four sides. As each of the connectors 104 is positioned centrally on the respective side, two connectors 104 are place adjacent to each other when two panels are placed next to each other. This allows for a simple way of connecting the two panels to each other as a relatively short interconnecting member 106 may be used to electrically connect said two panels by means of said connectors 104. In the embodiment

of Fig. 8, three of the sides of the panel 100 comprise one single connector 104, while the last side of the panel 100 comprises two connectors 104 - one positioned centrally along the side of the panel 100 and one positioned closer to one of the edges of the panel. The provision of connectors 104 close to an edge makes it possible to use a short interconnecting members 106 to connect two panels 100 which are do not have opposing sides.

[0071] Each of Figs. 9 and 10 discloses cross-sectional views of two panels 100 which are inserted into a suspended support structure comprising longitudinal profiles 114 and transverse profiles (not shown). Between the longitudinal and transverse profiles spaces are defined for detachably attaching panels - one in each space. In both the drawings it may be seen that the panels are adapted to abut the profiles 114 by hanging on the profiles. Electrical devices 110 are detachably attached to the panels 100 and the electrical devices are electrically connected to conductors of the panel. The conductors of the two panels 100 are electrically connected to each other by means of interconnecting member 106, although only one single line is illustrated, it will be appreciated that the number of conductors in the interconnecting members 106 is equivalent to the number of conductors of the panel. Accordingly, if each panel comprises three conductors 102,102',102" as illustrated in the previous drawings, each of the interconnecting members 106 also comprise three conductors. In Fig. 9 the interconnecting members 106 comprises a flex print comprising two connectors which are adapted to be detachably attached to corresponding connectors of the panel. In Fig. 10 each of the panels 100 comprise flex prints with magnetic connectors 104' which allow two panels to be electrically connected in a fast and reliable manner. When the magnetic connectors 104' are moved into engagement, a magnet or a ferromagnetic material provided in one or both the connectors 104' causes the connectors 104' to be magnetically attracted to each other whereby the conductors of both the flex prints are electrically connected to each other.

[0072] Fig. 11 discloses a cross sectional view of two panels 100 detachably attached to a suspended support structure comprising substantially longitudinal profiles 114 and substantially transverse profiles. Each of the panels 100 comprise an LED monitor for providing still or moving pictures or for use as a light source. Each of the LED monitors defines an outer (lower) surface of the panel 100.

[0073] Fig. 12 discloses a circuit of an electrical device 110 which is electrically connected to the conductors 102,102', 102" of a panel which server as a backbone for providing electricity at a predetermined DC Voltage such as 48 Volts DC. The electrical device 110 comprises a voltage regulator 114 for converting the "backbone" power supplied from the conductors 102,102',102" to another voltage e.g. from 48 Volts DC to 12 Volts DC. In one embodiment, the remaining power consuming devices of the electrical device are supplied with power by means of the regulated/converted power (e.g. 12 volts). As an alternative or a supplement, the power consumers may be provided with electricity directly from backbone power supply. In the embodiment of Fig. 12, the electrical device 110 comprises an application 116 such as a sensor or an LED. However, it will be appreciated that the application 116 may be any other of the previously mentioned applications. The application 116 is controlled by a main processor 118 and an application specific processor 120. The main processor may be identical for all electrical devices 110 whereas the application specific processor 120 is specially designed to control the operation of the application 116. Moreover, the electrical device 110 comprises a communication unit 122 for communication between the electrical device and another electrical device. In one embodiment the communication unit is a master unit for controlling one or more slave units provided in other electrical devices. In other embodiments, the control unit is a slave unit adapted to be controlled by a slave unit of a different electrical device.

[0074] In Fig. 13, the electrical device 110 comprises a main processor 118 and three applications - a lighting device 116', a motion/light sensor 116" and a transceiver 116''' for wireless communication with other devices such as a PDA, a GSM-application, indoor or outdoor light or motion sensor, automated blinds, manual or automated switches and dimmers. Moreover, the electrical device comprises a SNMP management system 124 allowing the electrical device to be controlled and/or monitored externally e.g. from another building. In order to allow the electrical device to be identified, the device comprises a unique ID 126 based on the TCP/IP or MAC protocol.

[0075] The difference between Fig. 13 and 14 is that the electrical device 110 of Fig. 14 comprises a unit of wireless communication 128 such as WLAN, WIFI or GSM. The unit 128 may be used to communicate wireless with a PC, a printer, a television, a server, or a recorder or any other electrical device for wireless communication.

Claims

1. A system comprising two or more ceiling panels for covering a ceiling, each panel comprising:

   - a plurality of conductors, and
   - one or more connectors for electrically connecting the conductors of said panel to the conductors of another panel.

2. A system according to claim 1, wherein at least a part of the conductors of one of the panels form an integral part of said panel.

3. A system according to any of the preceding claims, wherein one or more of the panels comprises a fixture for detachably attaching an electrical device to the panel.

4. A system according to claim 3, wherein an electrical device when detachably attached to the fixture, is electrically connected to one or more of the conductors.

5. A system according to any of the preceding claims, wherein the panel comprises a transceiver for electromagnetic communication.

6. A system according to any of the preceding claims, wherein the panel comprises a communication unit for modulating and/or demodulating a signal.

7. A system according to claim 5 and 6, wherein the communication unit is adapted to receive or transmit the signal from/via one or more of the conductors and/or by means of the transceiver.

8. A system according to any of the preceding claims, wherein the panel comprises a controller for controlling the one or more electrical device electrically connected to the panel.

9. A system according to claim 8, wherein the controller is adapted to control any operation the panel and/or the operation of one or more other panels.

10. A system according to any of the preceding claims, wherein the controller comprises at least one of: a processor, a memory and a computer programme.

11. A system according to any of the preceding claims, wherein one or more of the panels has a unique ID, allowing identification of said panel.

12. A system according to any of the preceding claims, wherein each panel is adapted to be detachably attached to a support structure suspended from a ceiling.

13. A ceiling panel for use in a system according to any of the preceding claims.

Amended claims in accordance with Rule 137(2) EPC.

1. A ceiling panel system comprising two or more ceiling panels (100) each of which is adapted to be inserted into spaces between longitudinal and transverse profiles (114) of a suspended ceiling, each panel comprising:

- a plurality of conductors (102), and
- one or more electrical connectors (104) each of which is electrically connected to the conductors (102),

characterised in that
the ceiling panel system further comprises one or more interconnecting members (106) each of which is detachably connected to the connectors (104) of two different panels (100) so as to electrically connect the conductors (102) of said two panels (100), each interconnecting member (106) being flexible so as to allow it to be lead over at least one profile (114) interposed between the two panels (100) without being electrically connected to profile (114), and wherein at least one of the panels (100) comprises a controller (110') having a unique ID for identification of the controller in an Ethernet, the controller being adapted to control one or more electrical device (110) each of which is electrically connected to the conductors (102) of the panel (100), in response to a signal transmitted to the panel (100) from a point outside the panel (100).

2. A ceiling panel system according to claim 1, wherein the controller (110') of one or more of the panels (100) is adapted to control any electrical device (100) electrically connected to the panel (100).

3. A ceiling panel system according to claim 1 or 2, wherein the controller (110') of a first panel (100) of is adapted control any electrical device (110) which is electrically connected to a second panel (100) on the basis of the signal received by the controller (110') of the first panel.

4. a ceiling panel system according to claim 3, wherein the second panel (100) additionally comprises a controller (110') for controlling any electrical device (110) which is electrically connected to the second panel (100) on the basis of the signal received by the controller (110') of the first panel (100).

5. A ceiling panel system according to any of the preceding claims, wherein the controller (110') of one panel (110) is adapted to power on or off electrical devices (110) connected to said panel (110) depending on the electricity available.

6. A ceiling panel system according to any of the preceding claims, wherein two or more of the panels (100) each comprise a communication unit with an antenna, for wireless communication between the two panels.

7. A ceiling panel system according to any of the preceding claims, wherein the controller (110') comprises at least one of : a processor, a memory and a computer program.

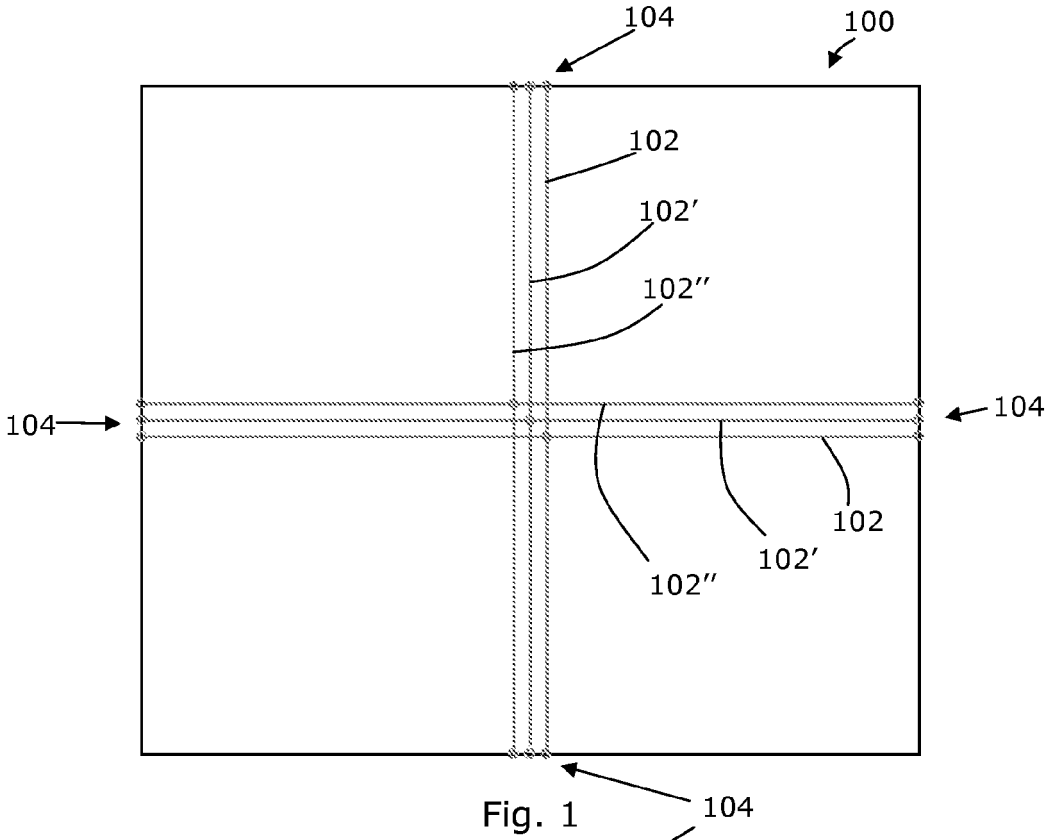

Fig. 1

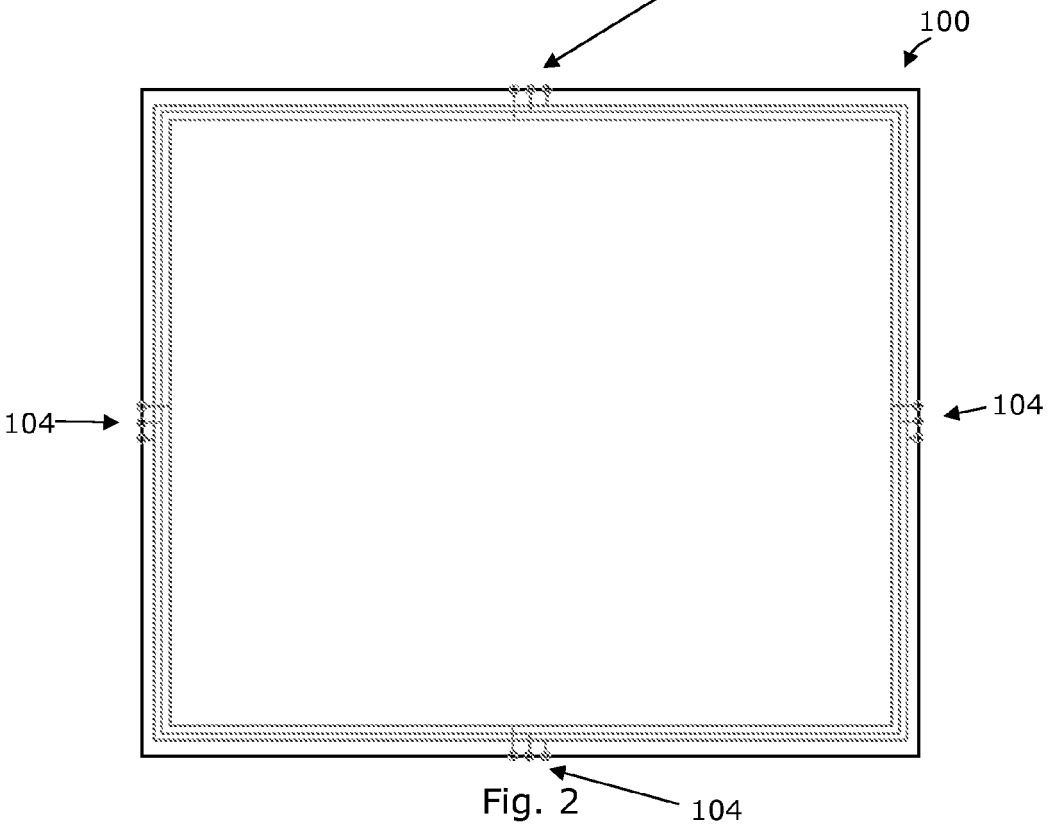

Fig. 2

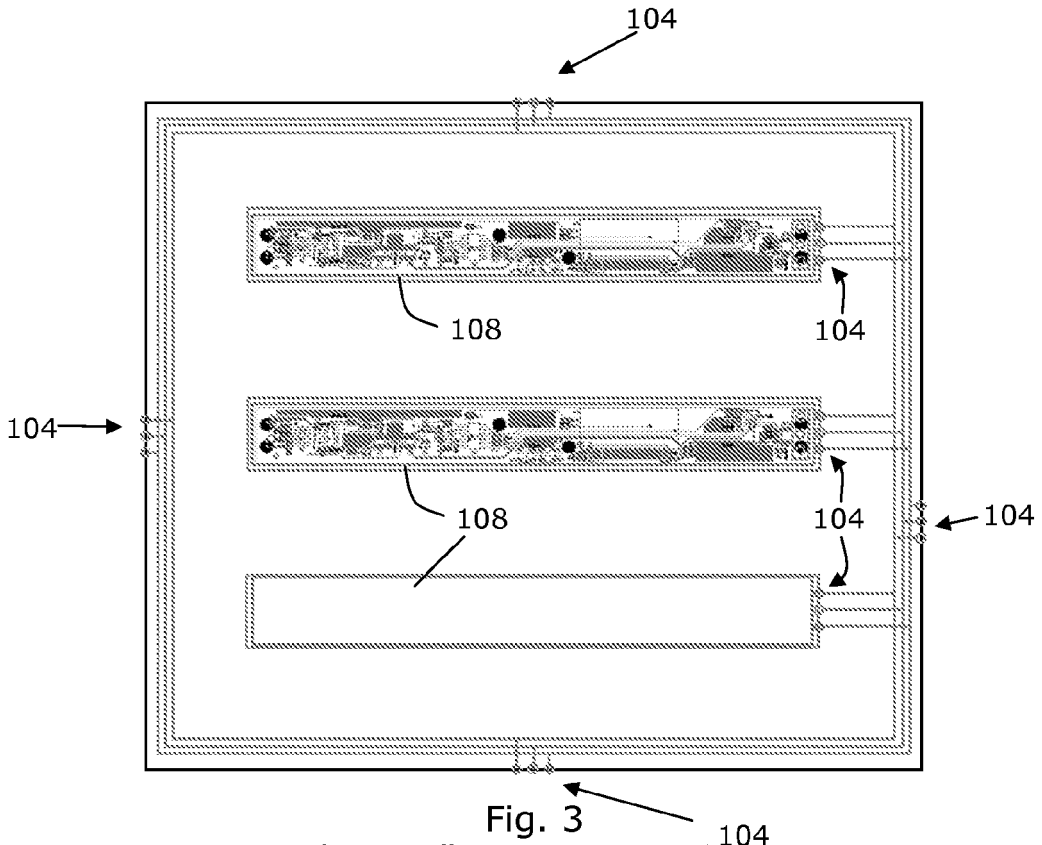
104
108
104
104
108
104
104
104

Fig. 3

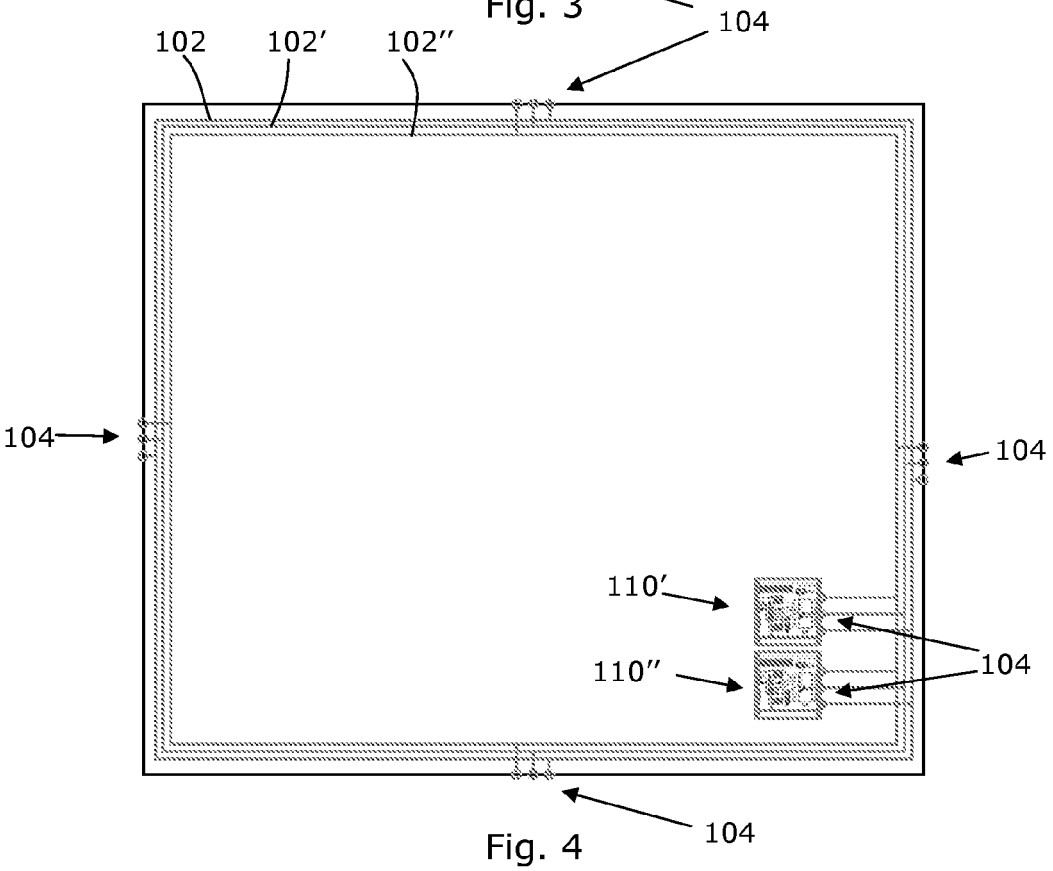
102
102′
102″
104
104
104
110′
110″
104
104

Fig. 4

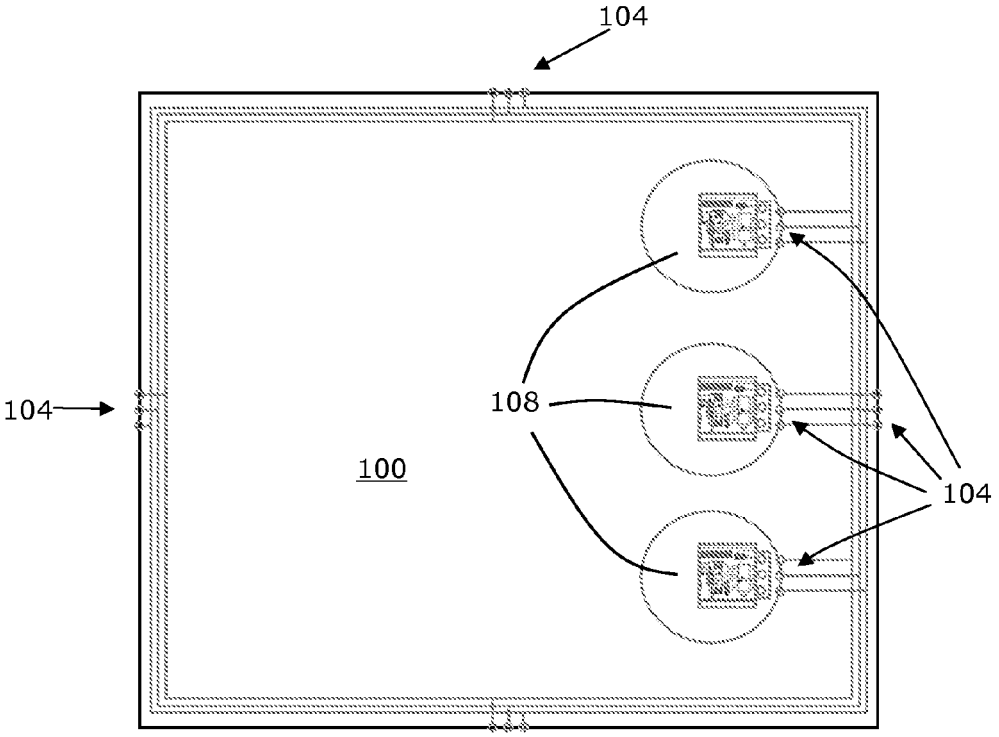

Fig. 5

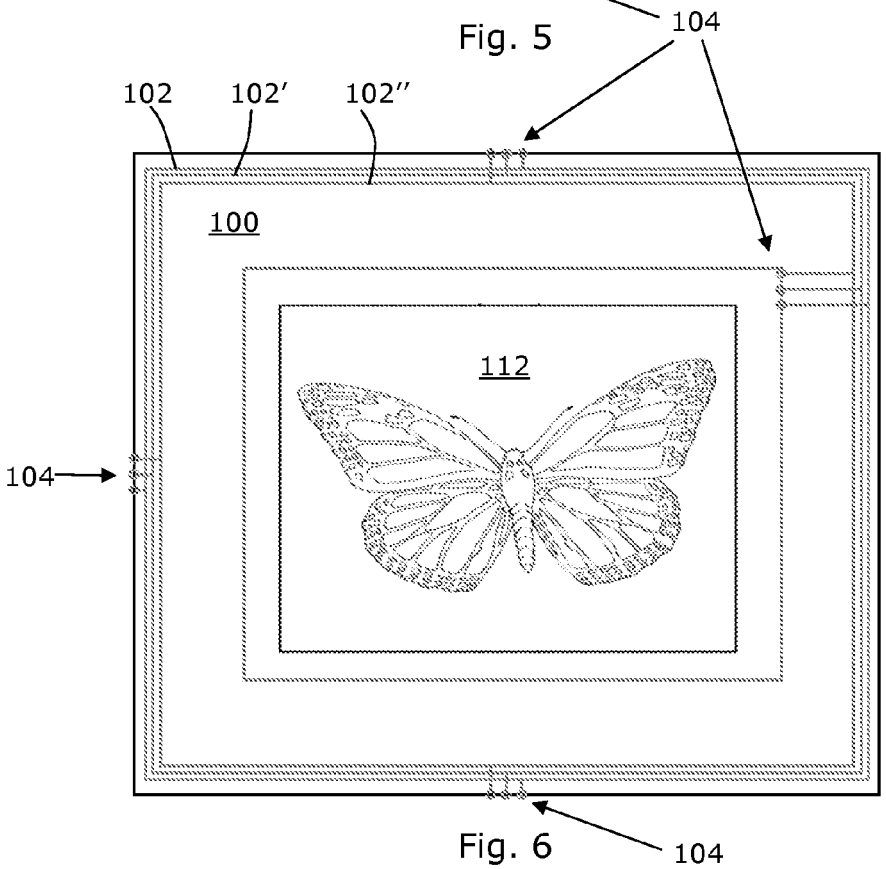

Fig. 6

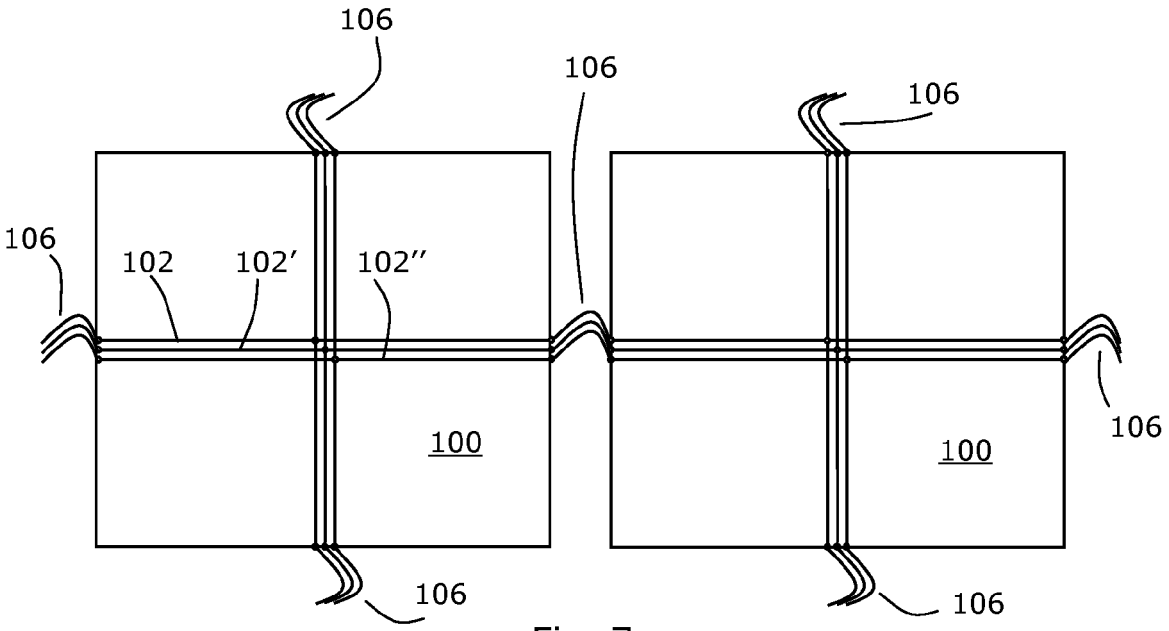
106
106
106
106
102
102'
102''
100
100
106
106
106

Fig. 7

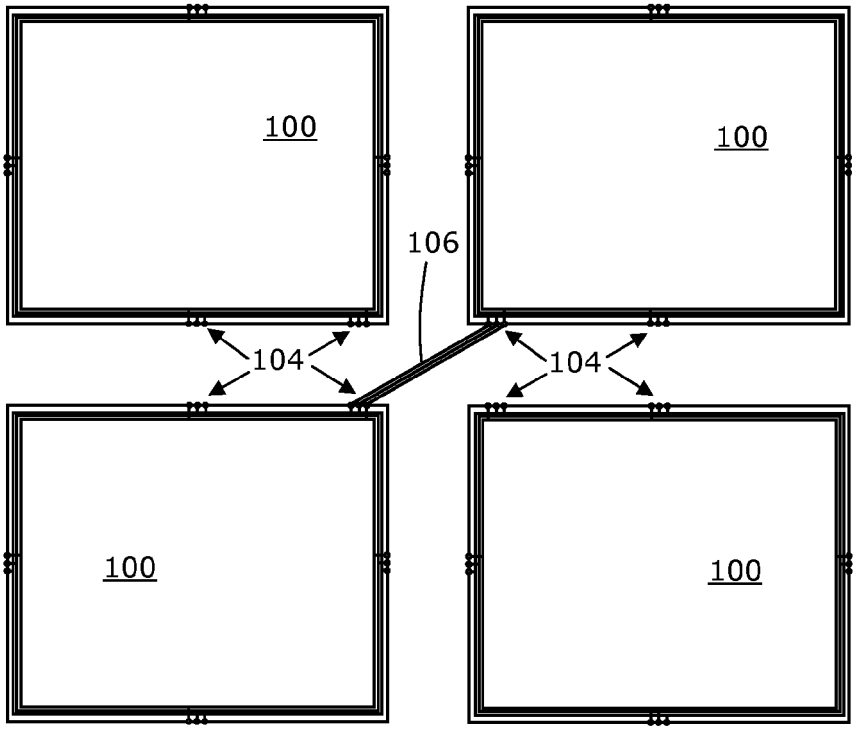
100
100
106
104
104
100
100

Fig. 8

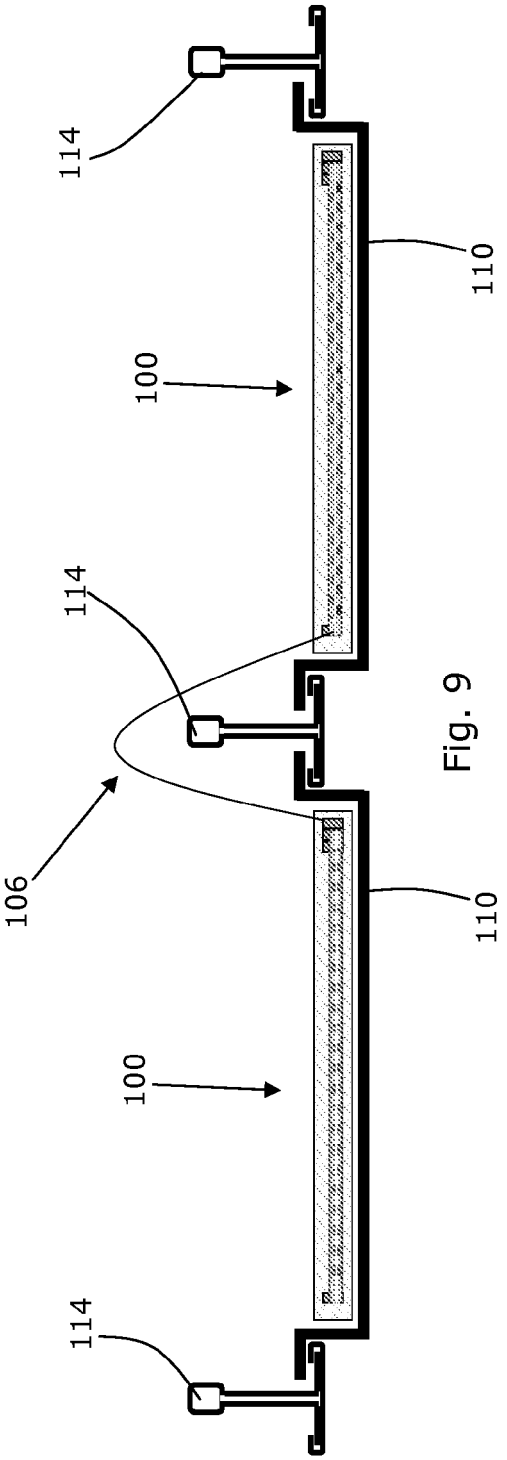

Fig. 9

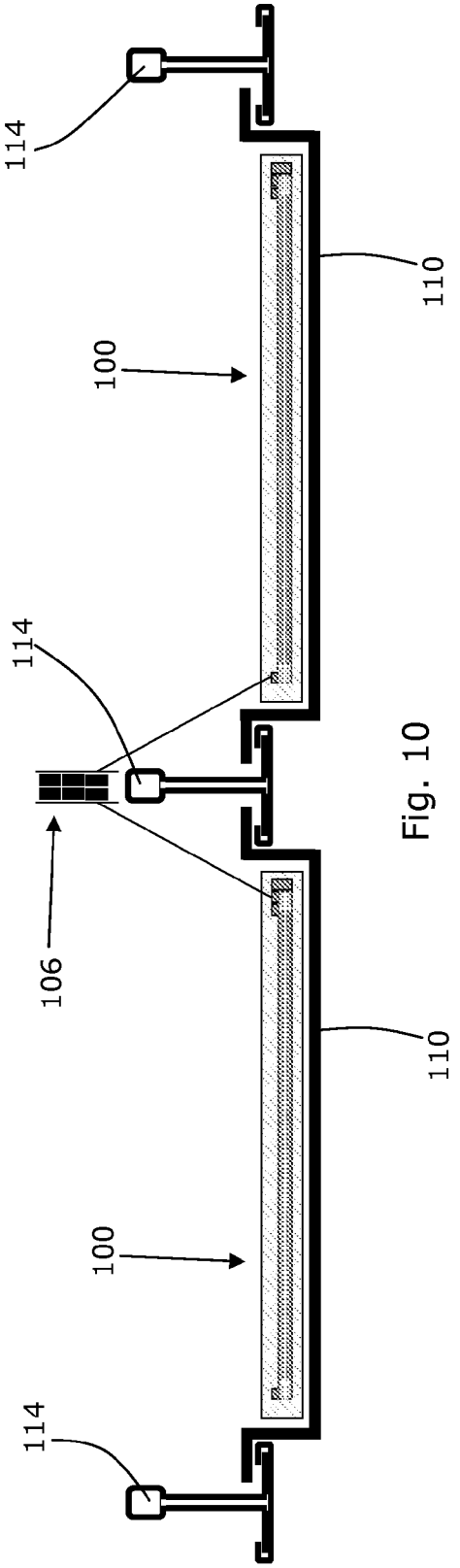

Fig. 10

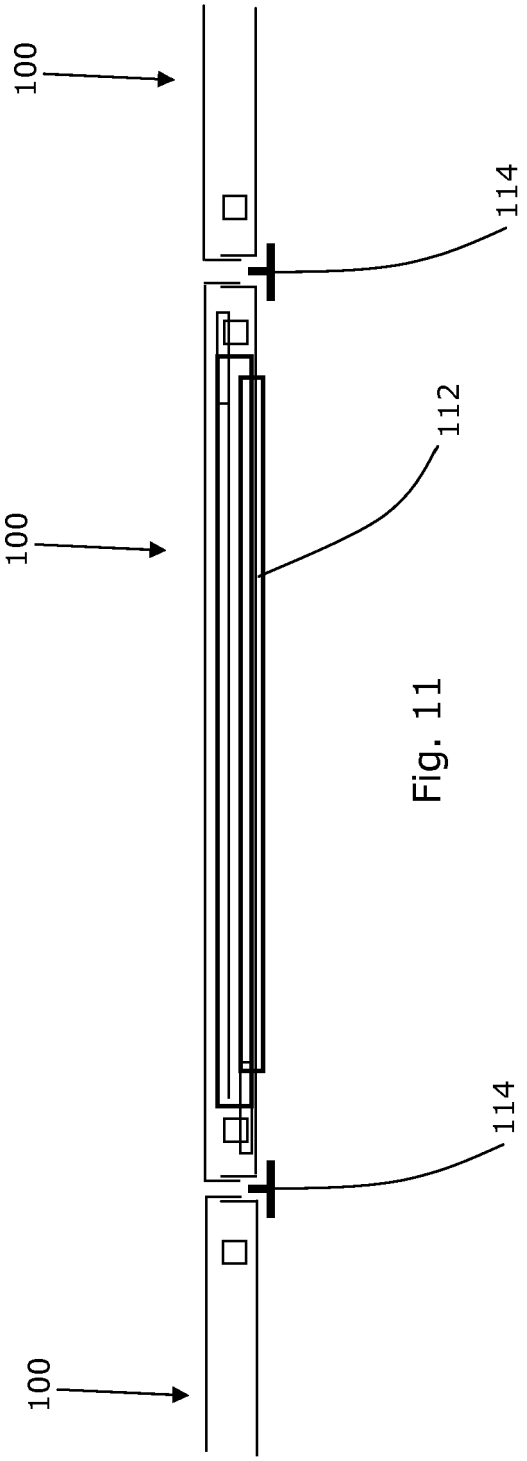

Fig. 11

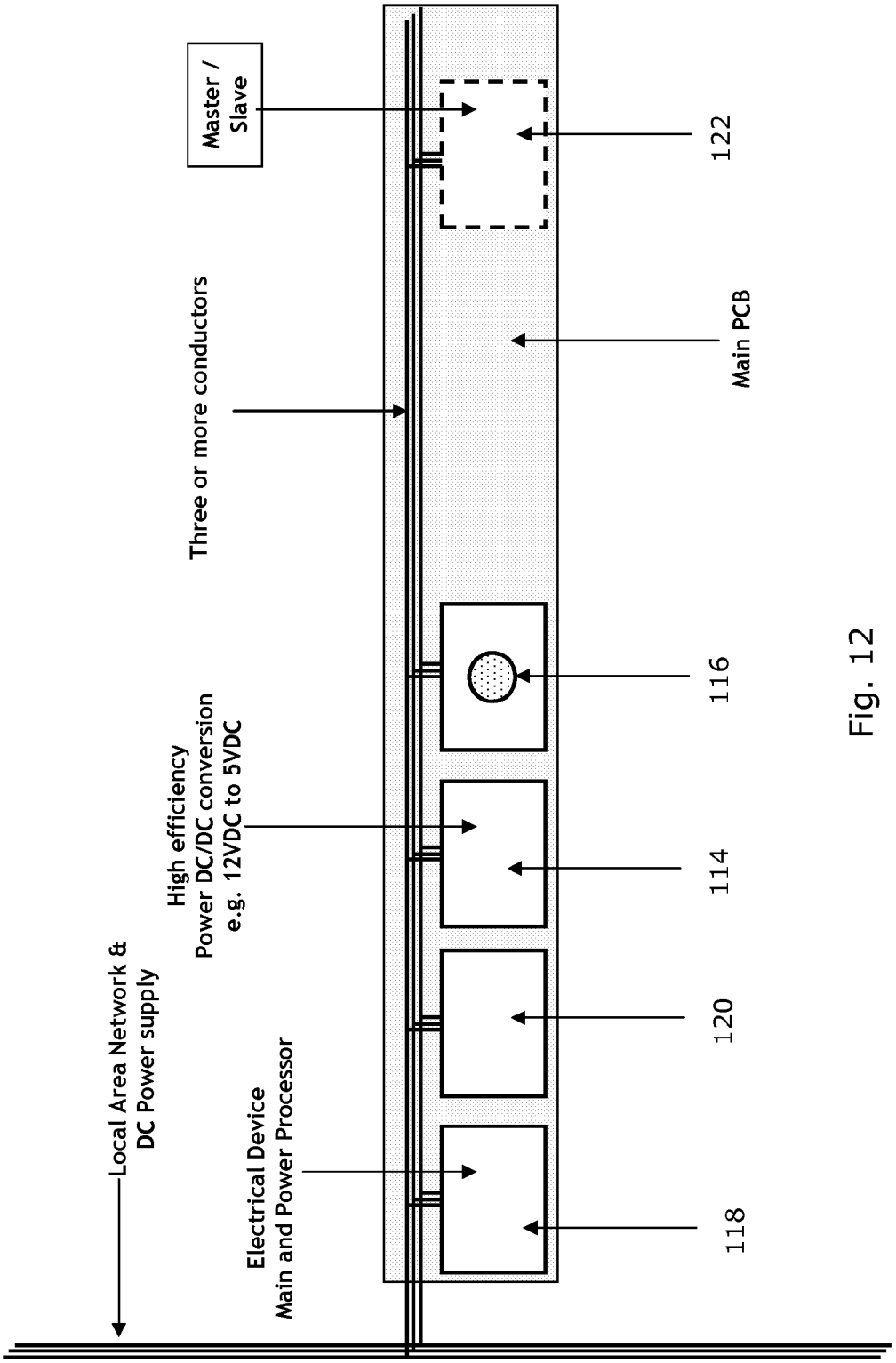
Master / Slave
122
Three or more conductors
Main PCB
116
High efficiency
Power DC/DC conversion
e.g. 12VDC to 5VDC
114
120
Local Area Network &
DC Power supply
Electrical Device
Main and Power Processor
118

Fig. 12

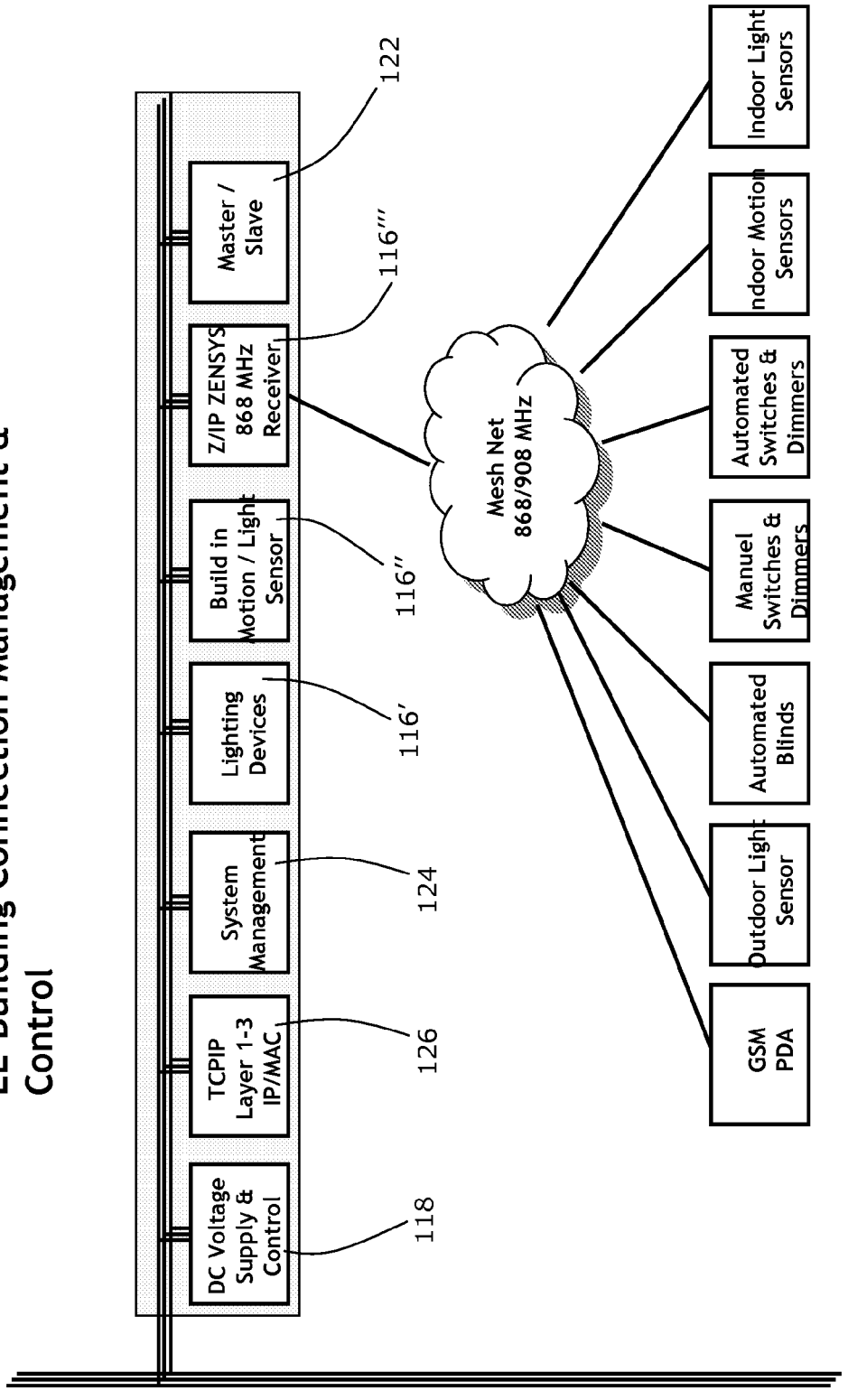
EE-Building Connection Management & Control
DC Voltage Supply & Control
TCPIP Layer 1-3 IP/MAC
System Management
Lighting Devices
Build in Motion / Light Sensor
Z/IP ZENSYS 868 MHz Receiver
Master / Slave
118
126
124
116'
116''
116'''
122
Mesh Net 868/908 MHz
GSM PDA
Outdoor Light Sensor
Automated Blinds
Manuel Switches & Dimmers
Automated Switches & Dimmers
Indoor Motion Sensors
Indoor Light Sensors

Fig. 13

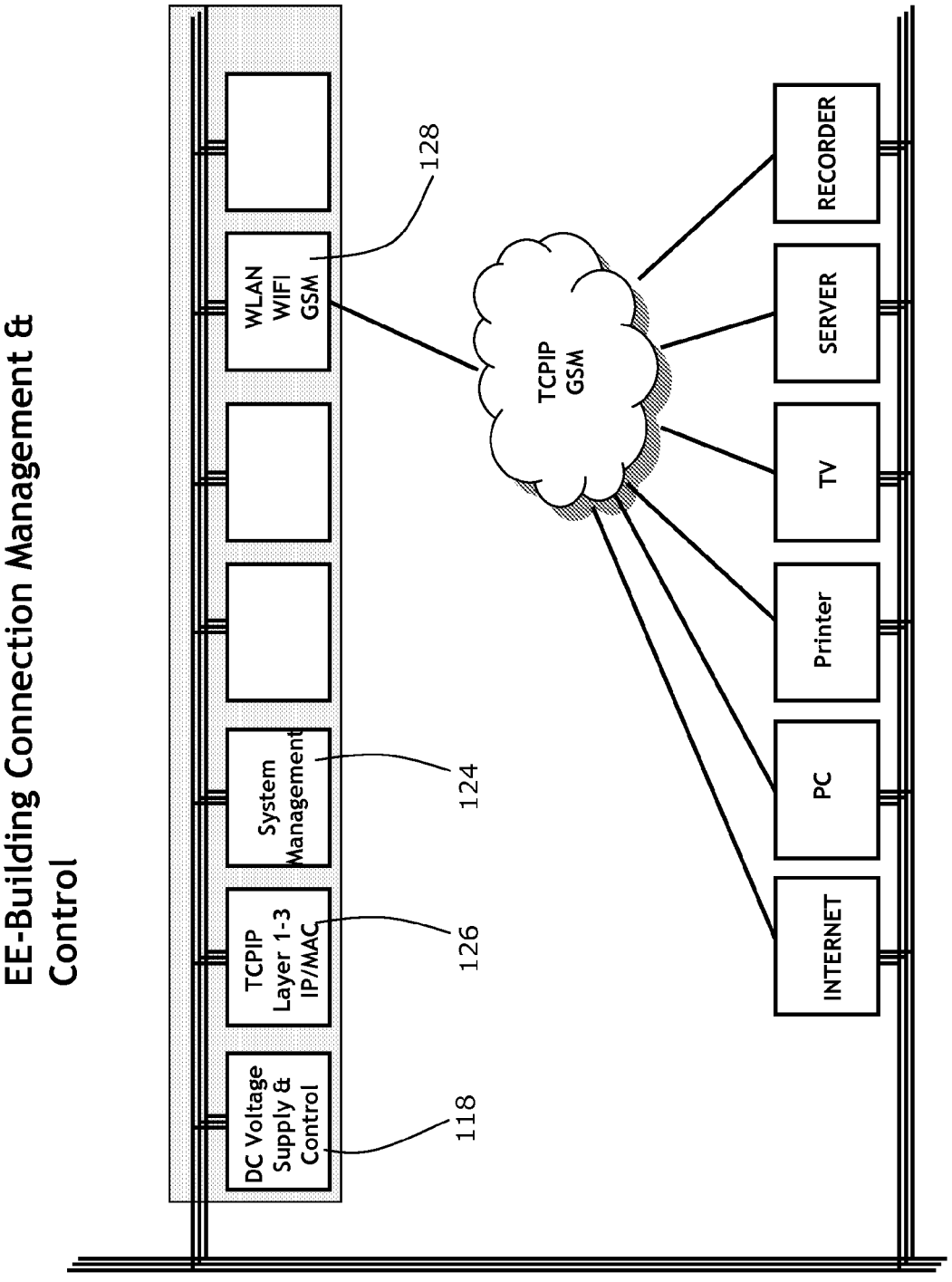
EE-Building Connection Management & Control
DC Voltage Supply & Control
TCPIP Layer 1-3 IP/MAC
System Management
WLAN WIFI GSM
128
124
126
118
TCPIP GSM
INTERNET
PC
Printer
TV
SERVER
RECORDER

Fig. 14

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 07 11 9985

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	4 March 2008	Berthommé, Emmanuel

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X : particularly relevant if taken alone
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