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(54) **A construction panel and a method of attaching a light emitter thereto**

(57) A construction panel defining electrically conducting front and rear surfaces to which a light emitter is electrically connected. A method of attaching a light emitter to a construction panel comprising electrically conducting front and rear plates.

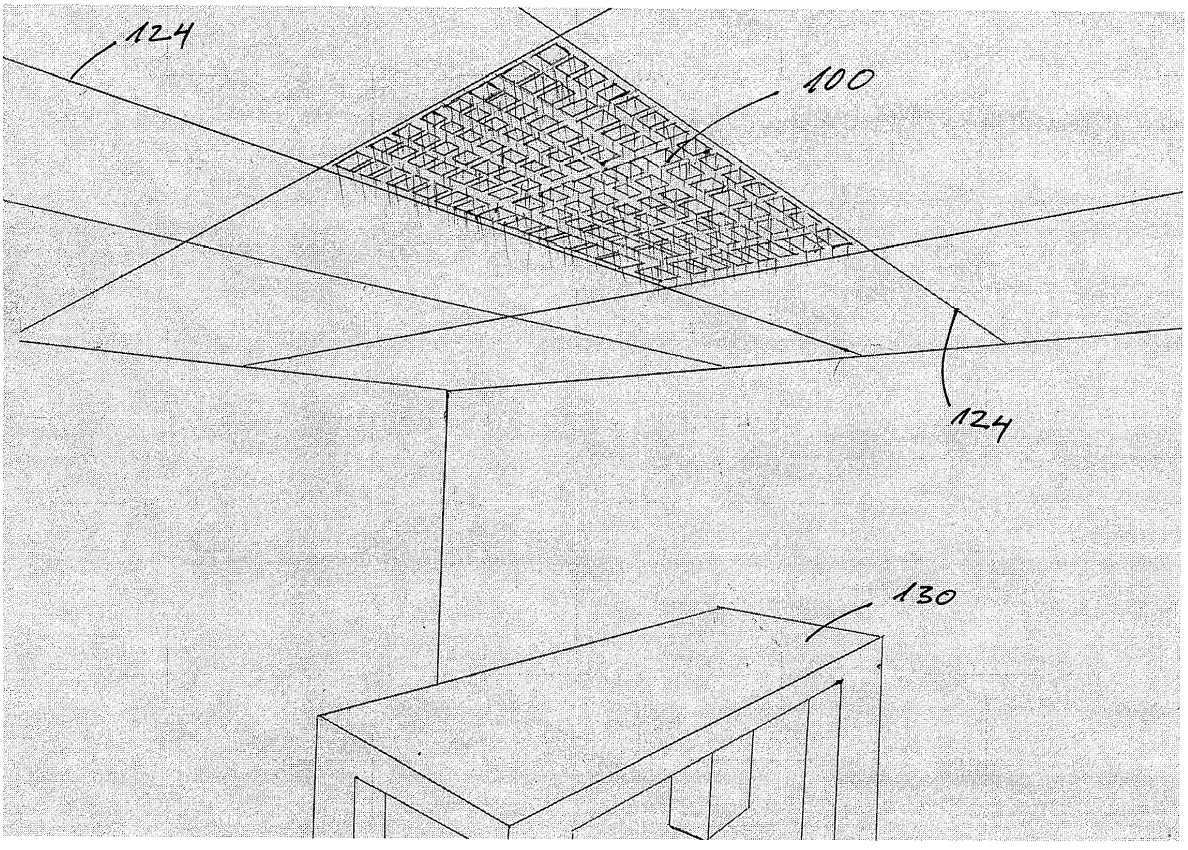

Fig 3

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to construction panel e.g. for use as a ceiling panel. In particular the present invention relates to a construction panel with an electrically conducting front plate and an electrically conducting rear plate. Moreover, the present invention relates to a method of attaching a light emitter to a construction panel.

BACKGROUND OF THE INVENTION

[0002] Attaching and electrically connecting light emitters to sandwich construction panels is known in the art, and is used to create construction panels with decorative light emitting elements.

[0003] One such example is known from WO 03/017435 which discloses an adaptor for electrical power transfer to a light emitter. The adaptor is adapted for mounting in an aperture of a sandwich board.

[0004] WO 2009/076960 discloses an adaptor with at least one electrical component for mounting in a hole extending through or partly through a composite board, which includes at least two layers of electrically conducting material that are separated by at least one insulator of electrically insulating material. The adaptor includes one or more legs adapted for mounting in the hole to establish electric connection with a first layer. A water tight barrier is provided between the adaptor and the board.

[0005] It is an object of embodiments of the invention to provide simpler solution to the problem of fastening a light emitting element to the sandwich construction.

[0006] Moreover, it is an object of embodiments of the invention to provide a solution where the adaptor can be dispensed with.

DESCRIPTION OF THE INVENTION

[0007] In a FIRST aspect, the present invention relates to a construction panel, the construction panel comprising:

- a sandwich structure comprising an electrically conducting front plate and an electrically conducting rear plate which are spaced apart by an electrically insulating layer,

- at least one light emitter each comprising one or more first electrical conductors and one or more second electrical conductors;
  wherein one or more first apertures are formed in the electrically conducting front plate and wherein one of the first electrical conductors extends into one of said first apertures and is electrically connected to said the electrically conducting front plate in the area of said first aperture,
  wherein one or more second apertures are formed in the electrically conducting front plate and wherein one of the second electrical conductors extends into one of said second apertures without being electrically connected to the electrically conducting front plate (e.g. in the area of said second aperture), and wherein one or more third apertures are formed in the electrically conducting rear plate and wherein one of the second electrical conductors extends into one of said third apertures and is electrically connected to the electrically conducting rear plate in the area of said third aperture.

[0008] Construction elements are already used in the construction of buildings. Often the elements are used to cover surfaces e.g. walls or ceilings. One advantage of the present invention is that the construction panel serves as a support member for the light emitter, without using any other element for fastening the light emitter to the construction panel. Another advantage of the present invention is that the front and rear plates of the sandwich construction are used as electrical conductors.

[0009] By using a sandwich construction as an element for support of the light emitter and as an electrical conduction two purposed are solved with one element (the construction element) which is as ready utilized in the construction of buildings.

[0010] The construction panel of the present invention may be adapted to be used in the construction of a building; a ship; an airplane; a vehicle such as a car or a truck; or the like. The construction panel may be used as a ceiling and/or a wall and/or a floor of a construction. The ceiling panel may be used as an outer surface of the building or an inner surface of a room or space.

[0011] As an example the construction panel may be used as a ceiling panel in a building. Such a ceiling panel may be a panel which is attached or secured to a grid-like structure suspended from the ceiling. Alternatively, the ceiling may form a larger surface. The ceiling panel may be directly fastened to a surface such as a ceiling or a wall. In one embodiment, the construction panel is adapted to be used on an outer surface of a building or to form part of a traffic light or an out door lighting.

[0012] In one embodiment, the electrically conducting front surface may be covered or at least partly covered by an element or a plate. As an example, the surface may be covered by a wooden surface, which allows for the light emitter to extend through the wooden material. Alternatively, the wooden material may define transparent areas arranged to allow the light emitted by the light emitter to be emitted therethrougth. When the surface is a wooden material, the construction panel of the present invention may be provided on or form a floor, e.g. a wooden floor with light emitters provided there below.

[0013] In one embodiment, the electrically conducting front surface may be covered by a transparent material such as glass or a plastic material e.g. plexi glass.

[0014] In one embodiment, the term 'sandwich construction' shall be understood as a composite composed of a lightweight core (the electrically insulating layer) to which two outer panels (the electrically conducting front and rear plates) are fastened e.g. by means of an adhesive. In one embodiment, the density of the core is lower than the density of the outer panels. In one embodiment, the e-module (Young's modulus) of the core is lower than the e-module (Young's modulus) of the outer panels. The core may be thicker than each or both of the outer panels.

[0015] In one embodiment, the density of the core is larger than the density of the outer panels. In one embodiment, the e-module (Young's modulus) of the core is larger than the e-module (Young's modulus) of the outer panels. The core may be thinner than each or both of the outer panels.

[0016] In the present invention, the terms electrically conducting front plate and the electrically conducting rear plate shall not be seen as limiting. Accordingly, the electrically conducting rear plate may be used as a front plate and vice versa. Moreover, it will be appreciated that the front plate may be used as an upper surface or a lower surface or an inner surface etc.

[0017] The electrically conducting front and rear plates may be made from the same materials or of different electrically conducting materials. The electrically conducting materials may be one or more of aluminium, cobber, steel, stainless steel, silver, gold, graphite, titanium, brass, silicon and conducting plastic such as conducting polymer.

[0018] The thickness of each of the electrically conducting plates may be up to 50 millimeters, such as up to 40 millimeters, such as up to 30 millimeters, such as up to 20 millimeters, such as up to 10 millimeters, such as up to 5 millimeters, such as up to 1 millimeter, such as 0.1-50 millimeters, such as 0.4 to 1 millimeters.

[0019] The thickness of the electrically insulating layer may be up to 100 millimeters, such as up to 80 millimeters, such as up to 60 millimeters, such as up to 40 millimeters, such as up to 20 millimeters, such as up to 10 millimeters, such as up to 1 millimeter, such as up to 0.5 millimeters, such as 0.1 to 50 millimeters, such as 1-4 millimeters.

[0020] In one embodiment, the thickness of the electrically insulating layer may be 5000% of the thickness of each of the electrically conducting plates, such as 1000% of the thickness of each of the electrically conducting plates, such as 800% of the thickness of each of the electrically conducting plates, such as 600% of the thickness of each of the electrically conducting plates, such as 400% of the thickness of each of the electrically conducting plates, such as 200% of the thickness of each of the electrically conducting plates, such as 150% of the thickness of each of the electrically conducting plates, such as 110 percent of the thickness of each of the electrically conducting plates, such as 100% of the thickness of each of the electrically conducting plates (i.e. have the same thickness), such as 80% of the thickness of each of the electrically conducting plates, such as 60% of the thickness of each of the electrically conducting plates, such as 40% of the thickness of each of the electrically conducting plates, such as 20% of the thickness of each of the electrically conducting plates.

[0021] In one embodiment the electrically conducting front and/or rear plate is divided into one or more separate zones such that different electrical potentials may be defined.

[0022] In one embodiment, the electrically insulating material comprises a foamed material (open and/or closed celled) and/or a reinforced material such as a fiber glass material. The electrically insulating material may be a plastic material such as amorphous plastic materials (e.g. polyvinylchloride, polycarbonate and polystyrene) or crystalline plastic materials (e.g. Nylon, polyethylene and polypropylene), or wood such as balsa wood. In one embodiment, the electrically insulating material defines a honeycomb structure.

[0023] By providing an electrically insulating material which is thermally conducting, this material may be used as a cooling element which is coupled to the light emitter. Moreover, one or more of the electrically conducting front and rear panels may be shaped to enhance the transport of thermal energy away from the light emitter. As an example the electrically conducting rear plate may define cooling ribs.

[0024] In one embodiment, the specific heat capacity of the electrically insulating material and/or the electrically conducting plates is above 0.50 Jules/(grams*degree Kelvin), such as above 0.75 Jules/(grams*degree Kelvin), such as above 0.80 Jules/(grams*degree Kelvin), such as above 0.85 Jules/(grams*degree Kelvin).

[0025] In one embodiment, the thermal conductivity of the electrically insulating material and/or the electrically conducting plates is above 100 W/(mK), such as above 200 W/(mK), such as above 250 W/(mK).

[0026] In one embodiment, the electrical conductivity of the electrically conducting layer is above $3*f10^7$ S/m (siemens per meter) at 20 degrees Celsius, such as above $3.4*10^7$ S/m (siemens per meter) at 20 degrees Celsius, such as above, $4*10^7$ S/m (siemens per meter) at 20 degrees Celsius.

[0027] In one embodiment, the construction panel comprises one or more intermediate electrically conducting layers, such as one or two or three or four or five or six. Each of the electrically conducting layers of the construction panel may be electrically separated. Moreover, the layers may be activated individually. In one embodiment, one of the layers is used as an electrical ground whereas one or more - such as all - of the remaining layers are used to control different light emitters.

[0028] In one embodiment, the construction panel comprises the front and the rear electrically conducting layer as well as one intermediate electrically conducting layer. One of these three electrically conducting layers may be used as an electrical ground layer, while the remaining two layers may define a first and a second non-

ground layer each of which is coupled to an electrical source whereby a first electrical potential is defined between the ground and the first non-ground layer, and a second electrical potential is defined between the ground and the second non-ground layer.

[0029] By providing two non-ground layers two different electrical potentials may be provided and/or the two electrical positionals may be controlled individually. As an example, the first electrical potential may be 10 Volts, whereas the second electrical potential may be 20 Volts.

[0030] In one embodiment, the construction panel comprises a power supply which is electrically connected to the electrically conducting layers such that an electrical potential is defined between the electrically conducting layers. In one embodiment, where the construction panel comprises two electrically conducting layers/surfaces, the electrical potential over these layers/surfaces is in the range 1-12 volts, such as 1-5 Volts, such as 3 volts. In another embodiment the electrical potential is in the range 100-400 volts, such as 110 Volts or 220 Volts.

[0031] Alternatively, or as a supplement, the first electrical potential may be provided at a first period of time, while the second electrical potential may be provided at a second period of time. In one embodiment, the first and second periods of time overlap, whereas in an embodiment, the first and the second periods of time do not overlap.

[0032] In one embodiment, the light emitter may be a Light Emitting Diode (LED). Alternatively, the light emitter may be an OLED or an incandescent light bulb such as a halogen light bulb.

[0033] In one embodiment, the light emitter comprises two first electrical conductors and two second electrical conductors. One or more of the first and second electrical conductors may be adapted to conduct thermal energy away from the light emitter. In one embodiment, this conductor is electrically and thermally coupled to that of the electrically conducting front and rear plate which has the best ability to conduct the thermal energy.

[0034] In one embodiment one electrical conductor of the light emitter has better heat conductivity than another of the electrical conductors of the light emitter. As an example, the second electrical conductors may have better heat conductivity than the first electrical conductors, or vice versa. In one embodiment, the better heat conductivity is achieved by providing electrical conductors where the cross-sectional area is larger than the remaining electrical conductors. As an example, the cross-sectional area of the second electrical conductors may be larger than the cross-sectional area of the first electrical conductors when seen in a direction transverse to the longitudinal direction of the respective electrical conductor.

[0035] As is described above, at least two apertures are formed in the electrically conducting front plate - one or more first apertures and one or more second apertures. In one embodiment, the apertures defines a longitudinally extending track defined in the front or rear plate respectively.

[0036] Where the first aperture and the first electrical conductor are designed such that they are electrically and physically connected to each other, the second aperture and the second electrical conductor are designed such that they are not electrically connected to each other. Additionally, at least one aperture is formed in the electrically conducting rear plate - namely a third aperture. The third aperture and the second electrical conductor are designed such that electrically and physically connected to each other.

[0037] Moreover as is described in further detail below, one or more fourth apertures may be formed in the electrically conducting rear plate.

[0038] In one embodiment, the second and the third apertures are formed over each other. By 'over each other' may be understood that a line extending through the second and the third apertures defines a normal to the electrically conducting front and/or rear plate. This line may extend through the centre of one or both of the two apertures. Alternatively, or as a supplement, the first and the fourth apertures may be formed over each other. Again 'over each other' may be understood such that a line extends through the first and the fourth apertures, which line may define a normal to the electrically conducting front and/or rear plate.

[0039] The geometry of a cross section one or more of the first, second, third and fourth aperture may be oval or may define a circle, an ellipse, a polygon with three or more edges, such as a triangle or a quadrangle. The cross-section may be defined in the plane of the electrically conducting front or rear plate.

[0040] Similarly, a cross-section of one or more of the first or second electrical conductors may define an oval, a circle, an ellipse or a polygon with three or more edges such as a triangle or a quadrangle. In one embodiment, one or more of the first and the second electrical conductors define a cutting edge which when said electrical conductor is forced into engagement with the inner surface of the first or the third aperture causes the respective electrical conductor to cut into the inner surface. By 'cutting edge' shall be understood that an edge is defined by the respective electrical conductor which when the electrical conductor is forced into the respective aperture, causes forces to be concentrated in a small area (i.e. the area of the edge). This concentration of forces causes the inner surface of the aperture to be deformed.

[0041] In one embodiment, the panel is self-supporting. By 'self supporting' shall be understood that the panel is adapted to support its own weight. In one embodiment, the term shall be understood such that a plate which is at least 2 meters long and which is 3. A construction panel wherein, each of the electrically conducting front and rear plates and the electrically insulating layer is self supporting.

[0042] In one embodiment, each of the first electrical conductors which are electrically connected to the electrically conducting front plate engages a first inner sur-

face of the respective first aperture. In the same embodiment, each of the second electrical conductors which are electrically connected to the electrically conducting rear plate may engage a third inner surface of the respective third aperture.

[0043] Furthermore, each of the second electrical conductors which extend into the one of said second apertures may be spaced apart from a second inner surface of the respective second aperture.

[0044] In one embodiment, each of the first electrical conductors which are electrically connected to the electrically conducting front plate is retained relative to the electrically conducting front plate by engagement between the first electrical conductor and the first inner surface. Moreover the same embodiment, each of the second electrical conductors which are electrically connected to the electrically conducting rear plate may be retained relative to the electrically conducting rear plate by engagement between the second electrical conductor and the third inner surface. By being retained may be understood that the respective electrical conductor (or even the entire light emitter) cannot be pulled out of the aperture(s) unless the force used to pull the electrical conductor (or the entire light emitter) is above a predetermined level, such as above 0.1 Newton, such as above 1 Newton, such as above 10 Newton, such as above 20 Newton, such as above 30 Newton, such as above 40 Newton, such as above 50 Newton, such as above 100 Newton, such as above 200 Newton, such as above 1000 Newton.

[0045] In one embodiment, each of the first electrical conductors which are electrically connected to the electrically conducting front plate is retained by means of an interference fit between the respective first electrical conductor and the respective first aperture. In the latter embodiment, each of the second electrical conductors which are electrically connected to the electrically conducting rear plate may be retained by means of an interference fit between the respective second electrical conductor and the respective third aperture. In the context of the present invention the term 'interference fit' shall be understood as a fastening between two parts which is achieved by means of friction after the parts are pushed together. Such a fit may also be known as a press fit or friction fit.

[0046] In one embodiment, the cross-sectional area of the electrical connector is larger than the cross-sectional area of the aperture into which it is forced. Thus in order to be able to force the electrical connector into said aperture, the inner surface of the aperture must be deformed.

[0047] At least a part of one of the electrical connectors may define a first, a second and a third zone, such that the second zone is tapered with a decreasing diameter/width in the direction of the first zone. The diameter and/or the cross-sectional area of the electrical connector in the first zone may thus be smaller than the diameter and/or the cross-sectional area of the electrical conductor in the third zone. When this electrical connector is inserted into one of the apertures, the diameter and/or the cross-sectional area in the first zone may be smaller than the diameter and/or the cross-sectional area of the aperture. However due to the tapered cross-section, the electrical conductor is forced into engagement with the inner surface of the aperture, when the electrical conductor is moved/forced into the aperture.

[0048] Moreover, each of the first electrical conductors which are inserted into a first aperture may define a first outer surface in an area of overlap between the first electrical conductor and first inner surface of the respective first aperture. The entire area of said first outer surface may be in direct contact with the entire area of the first inner surface. Moreover, in the latter embodiment, each of the second electrical conductors which are inserted into a third aperture may define a second outer surface in an area of overlap between the second electrical conductor and third inner surface of the respective third aperture. Furthermore, the entire area of said second outer surface may be in direct contact with the entire area of the third inner surface.

[0049] The second electrical conductor may be electrically insulated from the electrically conducting front plate by means of a separator provided in the area of the second aperture. The separator may be provided as a member (a fitting) provided between the second aperture and the second electrical conductor. The member may be made of any electrically insulating material such as glass, plastic, fibre glass, etc.

[0050] In an alternative embodiment, the separator is defined as a coating on the inner surface of the aperture and/or as a coating on the outer surface of the second electrical conductor. Such a coating may be a lacquer.

[0051] In one embodiment, a passage is defined in the electrically insulating layer which extends from the area of the second aperture of the electrically conducting front plate to the area of the third aperture of the electrically conducting rear plate.

[0052] In one embodiment, the passage is aligned with the second and third apertures. As an example, the passage and the second and/or third passages may be provided over each other. Again, 'over each other' may be understood that a line extending through the passage and the second and/or the third apertures defines a normal to the electrically conducting front and/or rear plate.

[0053] Alternatively, or as a supplement, the first and the fourth apertures may be formed over each other and over a corresponding passage extending between the first and the fourth apertures.

[0054] The cross-sectional area of the passage may correspond to the cross-sectional area of the second aperture whereby that part of the second electrical conductor which extends from the second to the third aperture is spaced apart from an inner surface of the electrically insulating layer.

[0055] In the alternative, the cross-sectional area of the passage may correspond to the cross-sectional area

of the third aperture whereby that part of the second electrical conductor which extends from the second to the third aperture is in direct contact with an inner surface of the electrically insulating layer, whereby the second electrical conductor is retained relative to the passage in at least one direction. In one embodiment, the direction is a direction is defined in the plane of the electrically conducting front layer and/ the plane of the electrically conducting rear layer. In one embodiment, the second electrical conductor is retained in any direction in the plane of the electrically conducting front and/or rear plate.

[0056] In one embodiment, the construction panel further comprises one or more fourth apertures are formed in the electrically conducting rear plate and wherein one of the first electrical conductors extends into one of said fourth apertures without being electrically connected to the electrically conducting rear plate (in the area of said second aperture).

[0057] The fourth aperture may be designed such that an electrical conductor may extend there through without being electrically connected to the electrically conducting rear layer. Accordingly, the fourth aperture may comprise any feature or element of the second aperture, e.g. a spacing element may be provided for electrically insulating the first conductor from the electrically conducting rear layer.

[0058] In one embodiment, the first and the fourth apertures are formed over each other, such that a line extending through the first and the fourth defines a normal to the electrically conducting front and/or rear plate. This line may extend through the centre of one or both of the two apertures. The line may additionally extend through a passage may be formed in the electrically insulating layer, which is provided over the first and the fourth apertures.

[0059] By providing four apertures which are arranged such that on each of the electrically conducting front and rear panels a wide and a narrow aperture is provided, and such that the wide aperture of one of the panels is connected to the narrow aperture of the opposite panel via a passage, it is possible to insert the light emitter into the construction panel from two sides and ensure the desired electrical contact.

[0060] In a SECOND aspect, the present invention relates to method of attaching a light emitter comprising one or more first electrical conductors and one or more second electrical conductors to a construction panel, the construction panel comprising an electrically conducting front plate and an electrically conducting rear plate which are spaced apart by an electrically insulating layer, the method comprising the steps of:

- forming in the electrically conducting front plate a first aperture for receiving one of the first electrical conductors such that when this first electrical conductor is inserted into the first aperture, the first electrical conductor is electrically connected to the electrically conducting front plate in the area of the first aperture;
- forming in the electrically conducting front plate a second aperture which is dimensioned such that one of the second electrical conductors may extend through the second aperture without contacting the electrically conducting front plate;
- forming in the electrically conducting rear plate a third aperture for receiving one of the second electrical conductors such that when this second electrical conductor is inserted into the third aperture, the second electrical conductor is electrically connected to the electrically conducting rear plate in the area of the third aperture;
- attaching the light emitter to the construction panel such that
- one of the first electrical conductors is inserted into the first aperture and is electrically connected to the electrically conducting front plate in the area of the first aperture, and
- one of the second electrical conductors:
  - extends through the second aperture without being electrically connected to the electrically conducting front plate, and
  - is inserted into the third aperture and is electrically connected to the electrically conducting rear plate in the area of the third aperture.

[0061] It will be appreciated that the construction panel according to the second aspect of the invention may comprise any combination of features and/or elements of the construction panel of the first aspect of the invention. Examples are described below.

[0062] The steps of forming the first and/or the second and/or the third and/or the fourth apertures may be performed by means of machining of the plate, such as by means of a drilling tool, such as by means of a punching tool, such as by means of milling, such as by means of grinding, such as by means of boring, such as by means of shaping. Alternatively, or as a supplement, the step of forming the first and/or the second and/or the third and/or the fourth apertures may be performed by means of laser cutting, plasma cutting, etching and/or electro erosion.

[0063] In one embodiment, different tools are used to form the different apertures, as an example four tools may be used concurrently to form four apertures at the same time. In other embodiments, the same tool may be used to form two or more apertures. As an example, the same tool may be used to form the second and the third aperture, i.e. the two apertures through which the second electrical conductor extends. As described previously, the second and third apertures may be formed over each other such that a line forming a normal to the electrically

conducting front and/or rear plate extends through the second and third apertures. It will be appreciated that when the apertures are formed by the same tool in a one-step motion, the centre axis of the tool may during formation of the apertures, define the line extending through both apertures. Moreover, this tool may also be used to form the aperture in the electrically insulating layer. In one embodiment, the tool is adapted to form:

- a third aperture of a third diameter in the electrically conducting rear plate,
- a passage with a fifth diameter is formed in the electrically insulating layer, and
- a second aperture with a second diameter is formed in the electrically conducting front plate.

[0064] In the latter embodiment, the tool may initially be inserted into the electrically conducting front plate and subsequently be moved further into the electrically insulating layer and finally into the electrically conducting rear layer. In order to achieve the desired diameters of the two apertures and the passage, the tool may define

- a distal portion having a diameter corresponding to the diameter desired in the third aperture,
- a middle portion having a diameter corresponding to the diameter desired in the aperture of the electrically insulating layer, and
- a proximal portion having a diameter corresponding to the diameter desired in the second aperture.

[0065] In the above, the distal portion may be closer to a tip of the tool than the proximal portion. In order to ensure that the second electrical conductor is electrically separated from the second inner surface of the second aperture, the diameter of the proximal portion which is used to form the second aperture may be wider than the diameter of the middle and the distal portion.

[0066] The abovementioned description of the formation of the second and the third aperture also applies to the formation of the first and the fourth aperture, as these two apertures may be provided over each other and may be formed by use of the same tool. However, it will be appreciated that only some embodiments comprises a fourth aperture. Thus in embodiments which comprise a first aperture but not a fourth aperture, the tool used to form the first aperture may be different than the tool used to form the second and third apertures.

[0067] In order to ease the insertion of the first and second electrical conductors, the temperature of the conductors and/or the electrically conducting front and/or rear plates may be elevated prior to insertion.

[0068] In one embodiment, the step of inserting the first electrical conductor into the first aperture comprises the step of forcing the first electrical conductor into the first aperture with a predetermined force so as to create an interference fit between the first electrical conductor and the first aperture.

[0069] Moreover, the step of inserting the second electrical conductor into the third aperture may comprise the step of forcing the second electrical conductor into the third aperture with a predetermined force so as to create an interference fit between the second electrical conductor and the third aperture.

[0070] In one embodiment, the method comprises a step of welding or soldering or gluing the electrical conductors the respective aperture.

[0071] In one embodiment, the method further comprises the step of:

- determining whether the light emitter is fastened to the construction panel.

[0072] Moreover, the step of determining whether the light emitter is fastened to the construction panel may comprise the step of:

- applying a force of a predetermined size and direction to the light emitter.

[0073] In one embodiment, the electrically conducting layers are coupled to an electrical source during attachment of the light emitters whereby it may immediately be detected whether the light emitter is correctly attached to the electrical conductors as the light emitter will only emit light when the attachment is correct.

BRIEF DESCRIPTION OF THE FIGURES

[0074]

Fig. 1 discloses a cross-sectional view of first way of fastening a light emitter to a construction panel,

Fig. 2 discloses a cross-sectional view of second way of fastening a light emitter to a construction panel,

Fig. 3 discloses a first embodiment where the construction panel is integrated into a grid-like structure suspended from the ceiling, and

Fig. 4 discloses a second embodiment where the construction panel is suspended from a ceiling.

DETAILED DESRIPTION OF THE FIGURES

[0075] Fig. 1 discloses a construction panel 100 defining a sandwich structure comprising an electrically conducting front plate 102 and an electrically conducting rear plate 104 which are spaced apart by an electrically insulating layer 106.

[0076] A light emitter 108 is attached to the construc-

tion panel 100 such that a first electrical conductor 110 is inserted into a first aperture 112 formed in the electrically conducting front plate 102 and a passage 122 formed in the electrically insulating layer 106.

[0077] Similarly, a second electrical conductor 114 is inserted into a second aperture 116 formed in the electrically conducting front plate 102, a passage 118 formed in the electrically insulating layer 106 and a third aperture 120 formed in the electrically conducting rear plate 104.

[0078] The first electrical conductor 110 is electrically connected to an inner surface of the first aperture 112. Moreover, the first electrical conductor 110 is secured to the electrically conducting front plate 102 by engagement between an outer surface of the first electrical conductor 110 and an inner surface of the first aperture 112. Prior to insertion of the light emitter 108 all the electrical conductors 110,114 have the same length, however in order to avoid that the first electrical conductor 110 is electrically connected to the electrically conducting rear plate 104, the first electrical conductor 110 has been cut so as to be shorter.

[0079] The second electrical conductor 114 is electrically connected on an inner surface of the second electrical conductor 114. However in order to electrically insulate the second electrical conductor 114 from the electrically conducting front plate 102, the second aperture 116 is wider than the third aperture 120. It will be appreciated that an electrically insulating material may be provided between the inner surface of the second aperture 116 and the outer surface of the second electrical conductor 114.

[0080] The second electrical conductor 114 is secured to the electrically conducting rear plate 104 by engagement between an outer surface of the second electrical conductor 114 and an inner surface of the second aperture 116.

[0081] Fig. 2 discloses an alternative way of fastening the light emitter 108 to the construction panel 100. Reference numbers which are identical to the reference numbers of Fig. 1 refer to identical elements.

[0082] The main difference between Fig. 2 and 1 is that in Fig. 2, the first electrical conductor 110 has not been shortened in length. Thus, in order to prevent the first electrical conductor 110 from being electrically connected to the electrically conducting rear plate 104, a fourth aperture 122 is formed in the electrically conducting rear plate 104. The width of the fourth aperture 122 is chosen such that the first electrical conductor 110 is not electrically connected thereto. This is similar to the design of the second aperture 116. Again an electrically insulating material (not shown) may be provided in the space defined between the outer surface of the first electrical conductor 110 and the inner surface of the fourth aperture 122. It will be appreciated that due the symmetry of the apertures 112,116,120,122, a light emitter 108 may be inserted into the construction panel 100 from either side thereof, as the electrical conductors 110,114 will each only be connected to one of the electrically conducting front plate 102 and the electrically conducting rear plate 104.

[0083] Fig. 3 discloses one way of using the construction panel 100 in that it is attached to a grid-like structure 124 such that it is inserted into the square spaced defined by this structure 124. It will be appreciated that in this way, the construction panel 100 may be moved from one square space to another.

[0084] Fig. 4 discloses another way of using the construction panel 100 in that the panel it self is suspended from the ceiling 126 by means of wires. This provides the advantage that the construction panel 100 may be positioned closer to e.g. a table.

[0085] In one embodiment of the invention, a plurality of light emitters are provided which defines a first zone which is encirculated by a second zone of light emitters. In one embodiment, the beam angle of the light emitters of the first zone is wider than the beam angle of the light emitters of the second zone. In another embodiment, the beam angle of the light emitters of the first zone is narrower than the beam angle of the light emitters of the second zone.

Claims

1. A construction panel, the construction panel comprising:

- a sandwich structure comprising an electrically conducting front plate and an electrically conducting rear plate which are spaced apart by an electrically insulating layer,
- at least one light emitter each comprising one or more first electrical conductors and one or more second electrical conductors;

wherein one or more first apertures are formed in the electrically conducting front plate and wherein one of the first electrical conductors extends into one of said first apertures and is electrically connected to said the electrically conducting front plate in the area of said first aperture,
wherein one or more second apertures are formed in the electrically conducting front plate and wherein one of the second electrical conductors extends into one of said second apertures without being electrically connected to the electrically conducting front plate, and wherein one or more third apertures are formed in the electrically conducting rear plate and wherein one of the second electrical conductors extends into one of said third apertures and is electrically connected to the electrically conducting rear plate in the area of said third aperture.

2. A construction panel according to claim 1, wherein the panel is self-supporting.

3. A construction panel wherein, each of the electrically conducting front and rear plates and the electrically insulating layer is self supporting.

4. A construction panel according to any of the preceding claims, wherein

- each of the first electrical conductors which are electrically connected to the electrically conducting front plate engages a first inner surface of the respective first aperture, and wherein
- each of the second electrical conductors which are electrically connected to the electrically conducting rear plate engages a third inner surface of the respective third aperture.

5. A construction panel according to claim 4, wherein

- each of the first electrical conductors which are electrically connected to the electrically conducting front plate is retained relative to the electrically conducting front plate by engagement between the first electrical conductor and the first inner surface, and wherein
- each of the second electrical conductors which are electrically connected to the electrically conducting rear plate is retained relative to the electrically conducting rear plate by engagement between the second electrical conductor and the third inner surface.

6. A construction panel according to claim 4 or 5, wherein

- each of the first electrical conductors which are electrically connected to the electrically conducting front plate is retained by means of an interference fit between the respective first electrical conductor and the respective first aperture, and
- each of the second electrical conductors which are electrically connected to the electrically conducting rear plate is retained by means of an interference fit between the respective second electrical conductor and the respective third aperture.

7. A construction panel according to any of the preceding claims, wherein

- each of the first electrical conductors which are inserted into a first aperture defines a first outer surface in an area of overlap between the first electrical conductor and first inner surface of the respective first aperture, and wherein the entire area of said first outer surface is in direct contact with the entire area of the first inner surface, and
- each of the second electrical conductors which are inserted into a third aperture defines a second outer surface in an area of overlap between the second electrical conductor and third inner surface of the respective third aperture, and wherein the entire area of said second outer surface is in direct contact with the entire area of the third inner surface.

8. A construction panel according to any of the preceding claims, wherein the second electrical conductor is electrically insulated from the electrically conducting front plate by means of a separator provided in the area of the second aperture.

9. A construction panel according to any of the preceding claims, wherein a passage is defined in the electrically insulating layer which extends from the area of the second aperture of the electrically conducting front plate to the area of the third aperture of the electrically conducting rear plate.

10. A construction panel according to claim 9, wherein the cross-sectional area of the passage corresponds to the cross-sectional area of the second aperture whereby that part of the second electrical conductor which extends from the second to the third aperture is spaced apart from an inner surface of the electrically insulating layer.

11. A construction panel according to claim 9, wherein the cross-sectional area of the passage corresponds to the cross-sectional area of the third aperture whereby that part of the second electrical conductor which extends from the second to the third aperture is in direct contact with an inner surface of the electrically insulating layer, whereby the second electrical conductor is retained relative to the passage in at least one direction.

12. A construction panel according to any of the preceding claims, wherein one or more fourth apertures are formed in the electrically conducting rear plate and wherein one of the first electrical conductors extends into one of said fourth apertures without being electrically connected to the electrically conducting rear plate.

13. A method of attaching a light emitter comprising one or more first electrical conductors and one or more second electrical conductors to a construction panel, the construction panel comprising an electrically conducting front plate and an electrically conducting rear plate which are spaced apart by an electrically insulating layer, the method comprising the steps of:

- forming in the electrically conducting front plate a first aperture;

- forming in the electrically conducting front plate a second aperture;
- forming in the electrically conducting rear plate a third aperture;
- attaching the light emitter to the construction panel such that
- one of the first electrical conductors is inserted into the first aperture and is electrically connected to the electrically conducting front plate in the area of the first aperture, and
- one of the second electrical conductors:
- extends through the second aperture without being electrically connected to the electrically conducting front plate, and
- is inserted into the third aperture and is electrically connected to the electrically conducting rear plate in the area of the third aperture.

14. A method according to claim 13, wherein

- the step of inserting the first electrical conductor into the first aperture comprises the step of forcing the first electrical conductor into the first aperture with a predetermined force so as to create an interference fit between the first electrical conductor and the first aperture, and wherein
- the step of inserting the second electrical conductor into the third aperture is comprises the step of forcing the second electrical conductor into the third aperture with a predetermined force so as to create an interference fit between the second electrical conductor and the third aperture.

13. A method according to claim 11 or 12, further comprising the step of:

- determining whether the light emitter is fastened to the construction panel.

14. A method according to claim 13, wherein the step of determining whether the light emitter is fastened to the construction panel comprises the step of:

- applying a force of a predetermined size and direction to the light emitter.

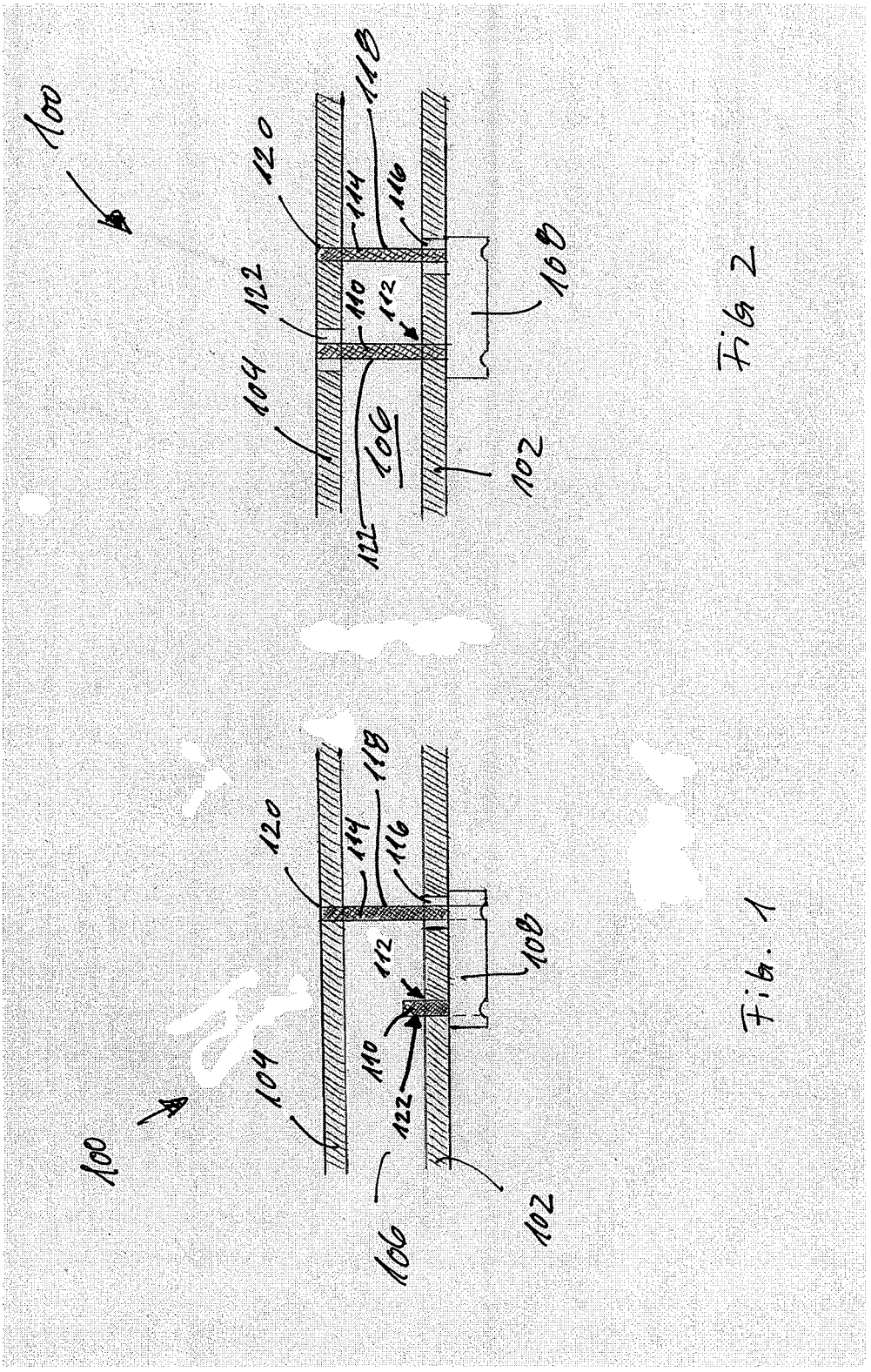

Fig. 1

Fig 2

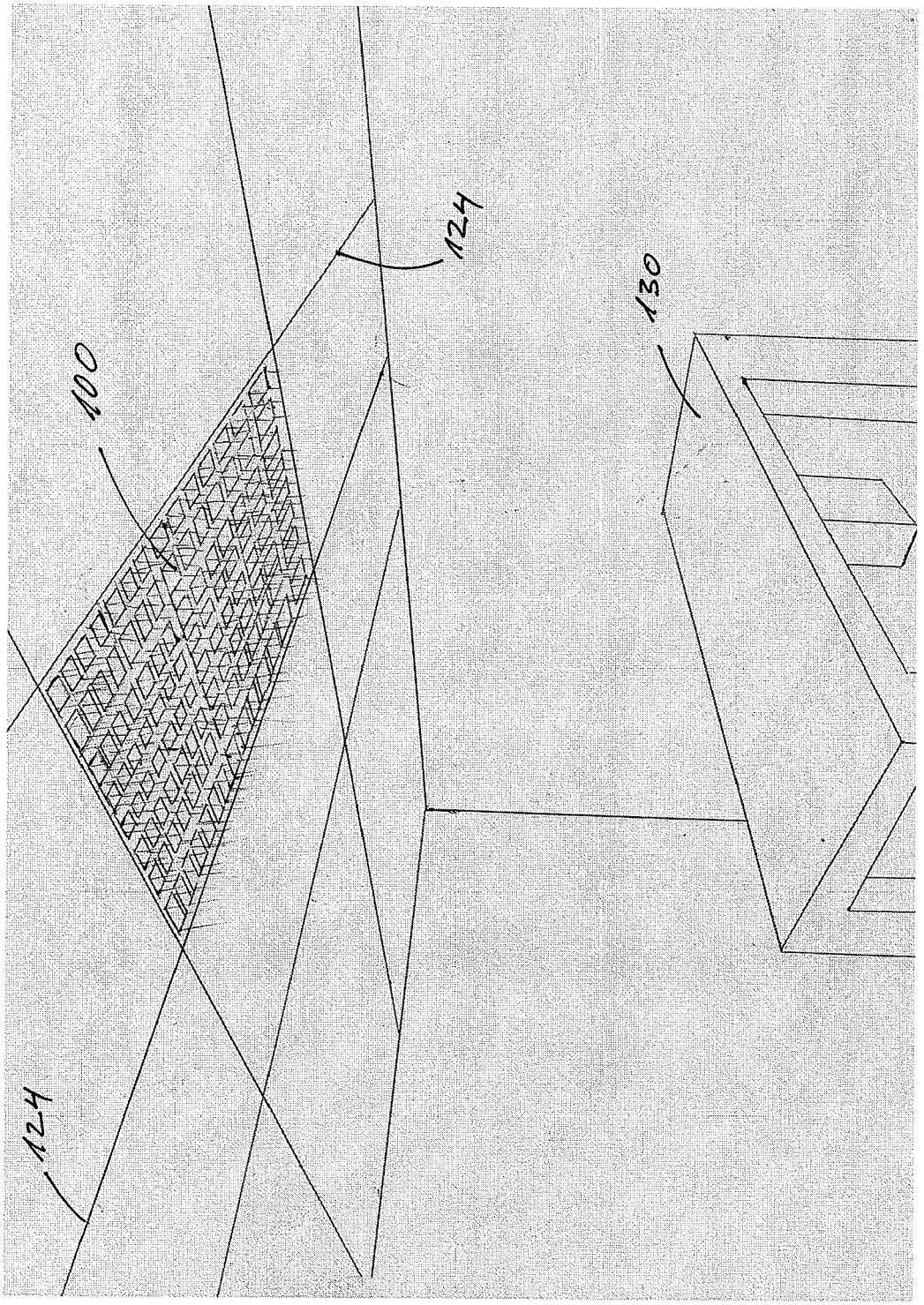

Fig 3

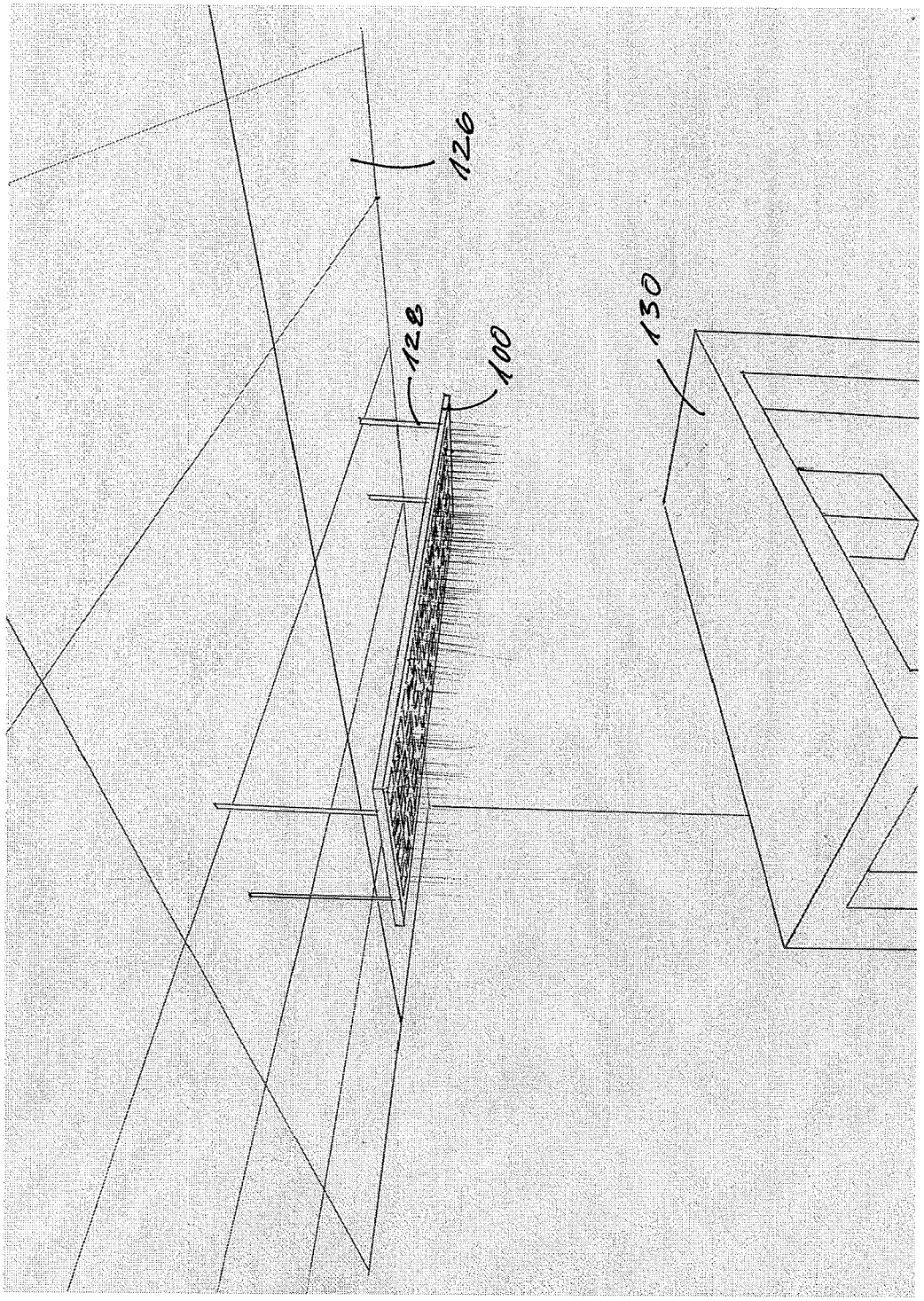

Fig. 4

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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