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(54) **Ceiling tile for a suspended ceiling and an associated installation method**

(57) In accordance with the present inventive concept, there is provided a polygon-shaped ceiling tile (100) having a front surface (102), a back surface (104) and two adjacent side-edge portions (110, 112), wherein each side-edge portion (110, 112) comprises a first (120, 124) and a second (122, 126) segment, the first segments (120, 124) adjoining each other. Each first segment (120,

124) is provided with an installation groove (140, 150) extending along the side-edge portion (110, 112) associated thereto, and each second segment (122, 126) is provided with a stepped profile extending along the side-edge portion (110, 112) associated thereto for forming a step in the back surface (104). There is also provided a method for mounting the ceiling tile (100) in a supporting frame comprised in a suspended ceiling.

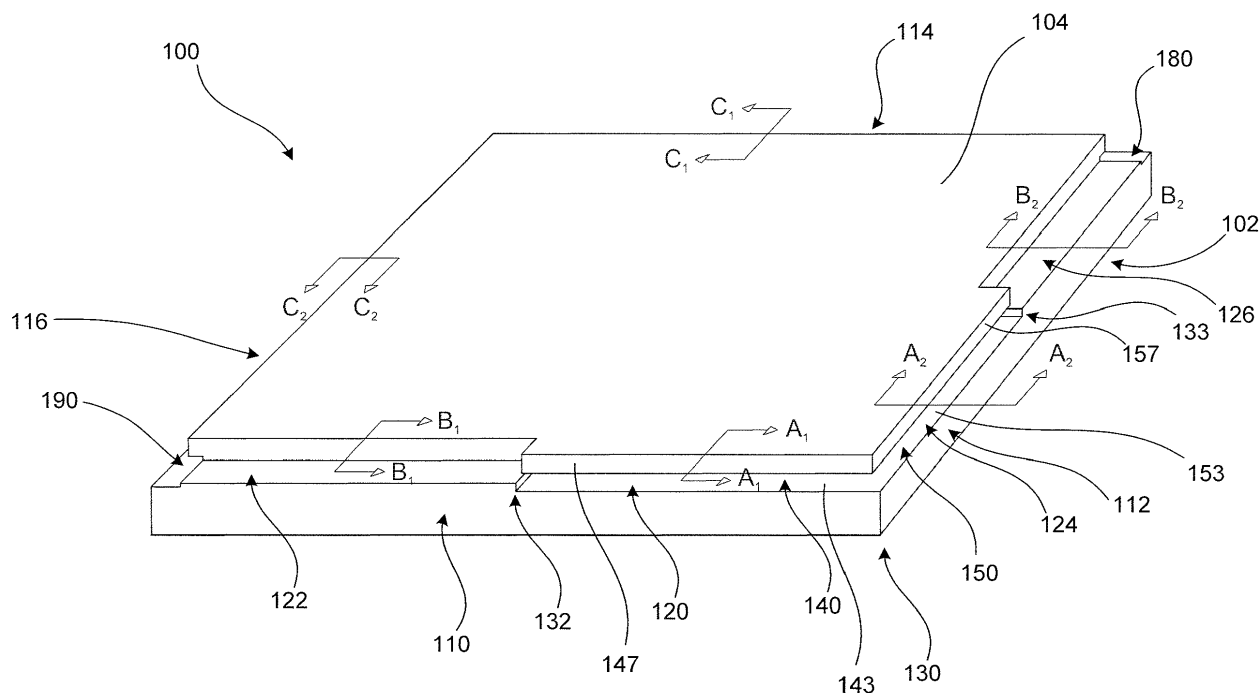


Fig. 1

Description

Field of the invention

[0001] The present invention relates to suspended ceilings. More specifically, the present invention relates to an improved ceiling tile and a method for installing it in a supporting structure comprised in the suspended ceiling.

Background art

[0002] A typical suspended ceiling comprises a plurality of rectangular ceiling tiles which are supported by a supporting structure which often is comprised of inverted T-profiles forming a grid. The supporting structure, in turn, is preferably mounted in a main ceiling of a room or an accommodation in which the suspended ceiling is to be installed. The suspended ceiling may have sound absorbing as well as sound attenuating properties for improving the sound environment inside as well as outside of the room or accommodation.

[0003] Moreover, the undersides of the grid of T-profiles may be exposed or concealed. Often, parts of the grid are exposed, being visible from below the suspended ceiling, while other parts are concealed. One way to conceal the undersides of the T-profiles, thereby increasing the aesthetical characteristics of the suspended ceiling, is to arrange parts of the T-profile within kerfs of the ceiling tile.

[0004] Commonly, it is desirable that the ceiling tiles are demountable from the suspended ceiling. In particular, easily demountable ceiling tiles are convenient when a quick access to the plenum space, which is formed between the suspended ceiling and the main ceiling, is required. For instance, this may happen when a wire, a pipe or a heating, ventilation or air-conditioning device placed in the plenum space needs to be maintained or repaired.

[0005] Sometimes it is important that the ceiling tiles comprised in the suspended ceiling are securely kept in position in the event of voluntary or involuntary forces being applied to them. These forces may be induced by e.g. an earthquake, a cleaning process the ceiling tiles, a sudden change of air pressure in the room caused by an abruptly opened or closed door, etc.

[0006] The granted patent document EP1690994 discloses a ceiling tile comprising an opening between a deep groove in a boundary of the ceiling tile and its back surface. According to EP1690994, the ceiling tile may be mounted by following a series of steps, utilizing the opening and the deep groove, and additionally the ceiling tile may be prevented from being dislodged without the need of external locking devices such as spring arrangements or so called hold-down clips. Furthermore, the ceiling tiles may partly conceal the supporting structure since parts of the flanges of the T-profiles may be inserted into the deep grooves of the ceiling tiles.

[0007] Nevertheless, the mounting method according to EP1690994 is cumbersome and involves a large number of steps. Moreover, the demounting of the ceiling tile is equally cumbersome which makes the plenum space above the suspended ceiling less accessible.

Summary of the invention

[0008] It is therefore an object of the present invention to provide an improved ceiling tile which is easier to mount in the supporting structure comprised in the suspended ceiling. It is a further object of the present invention to provide a ceiling tile which in a mounted state is securely fixed, thereby being prevented from involuntary displacements. An additional object of the present invention is to provide a method for mounting the improved ceiling tile.

[0009] According to a first aspect of the invention, there is provided a polygon-shaped ceiling tile having a front surface, a back surface and two adjacent side-edge portions. Each side-edge portion comprises a first and a second segment, the first segments adjoining each other, wherein each first segment is provided with an installation groove extending along the side-edge portion associated thereto. Moreover, each second segment is provided with a stepped profile extending along the side-edge portion associated thereto for forming a step in the back surface.

[0010] By means of the installation grooves, the ceiling tile may be supported by, for example, engagement with a supporting structure in which the ceiling tile is adapted to be mounted, such as a grid of profiles. The installation groove may be used for permanently or, alternatively, temporarily during an installation process, supporting the ceiling tile. In accordance with the inventive concept, the ceiling tile admits a simple mounting in the supporting structure by following a small number of steps.

[0011] Moreover, the inventive ceiling tile is arranged to be supported along the two side-edge portions as well as along additional side-edge portions of the ceiling tile. Importantly, this additional support thereby admits mounting of larger ceiling tiles. The supporting structure may engage with the installation groove from below and with the stepped profiles from above, thereby counteracting vertical displacements of the first and second side-edge portions.

[0012] From the reasoning above, it is thus clear that an advantage of the present inventive concept is that no external locking devices, such as spring arrangements or hold-down clips, are needed for securing the ceiling tile.

[0013] The first and second segments may jointly extend throughout the entire two adjacent side-edge portions. For example, the first segments may extend along half of the two adjacent side-edge portions while the second segments may extend along the remaining half. Alternatively, the first and second segments may extend throughout parts of the two adjacent side-edge portions; in this case, additional segments may be provided on the

first and second side-edge portions. The additional segments may comprise a stepped profile, a groove extending along the side-edge-portion associated thereto, etc.

[0014] A further advantage of the present inventive concept is that it is unnecessary to lift the ceiling tile above the grid of profiles during mounting, thereby making the mounting process easier. Thereby, a smaller vertical extension of the plenum space may be needed in order to mount the ceiling tile which, for instance, may result in more available headroom in the room.

[0015] Hence, due to the installation grooves and stepped profiles being provided at proper positions with suitable extensions, the inventive ceiling tile admits an easy mounting in the supporting structure and becomes securely fixed in a mounted state. Thereby, involuntary displacements of the ceiling tile may be prevented, which may be induced by a wind uplift, impacts from objects, large forces applied to the ceiling panel from below, e.g. during a cleaning process, an earthquake, a sudden change of air pressure in the room when a door connected to the room is abruptly opened or closed, etc.

[0016] According to one embodiment, the polygon shape of the ceiling tile is rectangular. In one example, the ceiling tile may be quadratic having side edges of equal lengths. In another example, the ceiling tile is triangular. The triangle may be equilateral or have side edges of different lengths.

[0017] According to one embodiment, the ceiling tile further comprises at least one additional side-edge portion provided with a support groove. By means of this support groove, the ceiling tile may be supported in an additional area, thereby forming a more stable construction. The supporting structure may engage with the support groove from below, thereby counteracting vertical displacement of the additional side-edge portion pointing downwards. Also vertical displacement upwards may be counteracted. Moreover, the support groove may counteract lateral displacements in at least a direction normal to the side-edge portion in which the support groove is provided.

[0018] In the case of a rectangular ceiling tile, the remaining two adjacent side-edge portions, opposite to the two adjacent side-edge portions comprising the first and second segments, may be provided with support grooves.

[0019] According to one embodiment, each first segment is provided with an alignment groove extending along the side-edge portion associated thereto, the alignment groove and the installation groove of the first segment forming a stepped profile. The alignment groove may be utilized for further simplifying the mounting of the ceiling tile. The installation groove may be used when mounting the ceiling tile and the alignment groove may be used for aligning the ceiling tile and supporting it in a mounted state. During mounting of the ceiling tile in a supporting structure, it may click down into a proper supporting position as it is extracted from the installation groove into the alignment groove, i.e. in going from being

supported by the upper boundary surface provided in the installation groove to being supported by a first upper bearing surface provided in the alignment groove. The clicking down of the ceiling tile may also serve as a confirmation for a person installing it that the ceiling tile is positioned in or close to a proper position. Furthermore, a shoulder section formed between the upper boundary surface and the first bearing surface may prevent displacement of the ceiling tile in at least one lateral direction.

[0020] According to one embodiment, each installation groove has a depth D_1 and each alignment groove has a depth D_2 , the depth D_1 being greater than the depth D_2 . Optionally, the depths D_1 and D_2 may vary between different side-edge portions, as long as D_1 on each side is greater than D_2 .

[0021] According to one embodiment, each alignment groove comprises a first upper bearing surface and each support groove comprises a second upper bearing surface, wherein the first and second upper bearing surfaces are situated at the same level. The first and second upper bearing surfaces are adapted to engage with the supporting structure in a mounted state of the ceiling tile. The supporting structure may engage with the first and second upper bearing surfaces from below. Thus, since the bearing surfaces are situated at the same level, the ceiling tile may be mounted in a horizontal position between two profiles comprised in the supporting structure, provided that the two profiles are situated at the same height.

[0022] According to one embodiment, the ceiling tile comprises an elastically deformable material. According to another embodiment, the ceiling tile comprises compressed fibre material. The compressed fibre material may be mineral wool such as rock wool or, especially, glass wool.

[0023] According to one embodiment, there is provided a suspended ceiling comprising a ceiling tile of the type according to any of the preceding embodiments and a grid of profiles forming a frame which supports the ceiling tile. In one example, there is a gap between adjacent ceiling tiles in at least one direction. As a consequence, the grid of profiles may be partially concealed. In another example, there is no gap between adjacent ceiling tiles whereby the grid of profiles may be completely concealed.

[0024] According to a second aspect of the invention, there is provided a method for mounting a ceiling tile for installing a suspended ceiling. The method comprises the steps of providing a grid of profiles forming a frame which comprises a first, a second, and a third flange, wherein the first and second flanges are connected along a connection portion and a polygon-shaped ceiling tile having a front surface, a back surface, a first and a second adjacent side-edge portion and a third side-edge portion, wherein each of the first and second side-edge portions comprises a first and a second segment, the first segments adjoining each other at a vertex portion and each

second segment being provided with a stepped profile extending along the side-edge portion associated thereto for forming a step in the back surface; and installing the ceiling tile in a frame of the grid of profiles. The step of installing the ceiling tile comprises: arranging the ceiling tile in an inclined position and directing the vertex portion towards the connection portion; inserting, by relative displacement of the ceiling tile and the grid of profiles, the first flange and second flange into a respective installation groove provided in each of the first segments extending along the side-edge portion associated thereto, to such an extent that the third side-edge portion clears the third flange of the frame, whereby the first flange and second flange engage from below with upper boundary surfaces associated with each of the installation grooves; arranging the ceiling tile in a horizontal position and aligning a support groove provided along the third side-edge portion with the third flange, the first flange and the second flange continuing to engage from below with the upper boundary surfaces associated with each of the installation grooves; and displacing the ceiling tile towards the third flange, the first and second flange continuing to engage with the upper boundary surfaces and with the stepped profiles, such that the third flange engages from below with the third side-edge portion.

[0025] Here, the ceiling tile is arranged in an inclined or a horizontal position with respect to a plane which may be substantially in parallel with a plane defined by the grid of profiles, or alternatively, with the floor or a main ceiling.

[0026] According to one embodiment, in the steps of arranging and displacing the ceiling tile, the first and second flanges of the frame engage from above with a respective one of the stepped profiles provided in the second segments.

[0027] According to one embodiment, each first segment is provided with an alignment groove extending along the side-edge portion associated thereto, the alignment groove and the installation groove of the first segment forming a stepped profile.

[0028] According to one embodiment, the step of displacing the ceiling tile continues until the first and second flanges engage from below with first upper bearing surfaces associated with each of the alignment grooves. Thus, as a result of the further displacement, the first and second flanges may disengage with the upper boundary surfaces.

[0029] According to one embodiment, the grid of profiles engages with the first and second segments under elastical deformation of at least one of the first and the second segment. According to one embodiment, the grid of profiles engages with the first and second segments under elastical deformation of at least one of the first and the second flange.

[0030] According to one embodiment, the third flange engages from below with a second upper bearing surface associated with a support groove which is provided along the third side-edge portion.

[0031] The details and advantages of the second aspect of the invention are largely analogous to those of the first aspect of the invention, wherein reference is made to the above. In addition, it is noted that the ceiling tile may be mounted in a preassembled grid of profiles.

[0032] Generally, all terms used in the claims are to be interpreted according to their ordinary meaning in the technical field, unless explicitly defined otherwise herein. All references to "a/an/the [element, device, component, means, step, etc]" are to be interpreted openly as referring to at least one instance of said element, device, component, means, step, etc., unless explicitly stated otherwise. The steps of any method disclosed herein do not have to be performed in the exact order disclosed, unless explicitly stated.

Brief Description of the Drawings

[0033] The above, as well as additional objects, features and advantages of the present invention, will be better understood through the following illustrative and non-limiting detailed description of preferred embodiments of the present invention, with reference to the appended drawings, where the same reference numerals will be used for similar elements, wherein:

Fig. 1 is a perspective view illustrating a two side edges and a back surface of an embodiment of the inventive ceiling tile.

Figs. 2a-f illustrate cross-sectional views of the inventive ceiling tile taken along the lines A₁-A₁, A₂-A₂, B₁-B₁, B₂-B₂, C₁-C₁ and C₂-C₂, respectively, in Fig. 1.

Fig. 3 is a perspective view schematically illustrating a suspended ceiling comprising a plurality of ceiling tiles of the type shown in Fig. 1 and a grid of T-profiles.

Fig. 4a is a cross-sectional side view of side-portions of two ceiling tiles of the type shown in Fig. 1 and Fig. 2 as mounted into an inverted T-profile, taken along the lines A₁-A₁ and C₁-C₁ with regard to the first and second ceiling tile, respectively.

Fig. 4b is a cross-sectional side view of side-portions of two ceiling tiles of the type shown in Fig. 1 and Fig. 2 as mounted into an inverted T-profile, taken along the lines B₁-B₁ and C₁-C₁ with regard to the first and second ceiling tile, respectively.

Figs. 5a-c schematically illustrate an embodiment of a method for mounting a ceiling tile in a grid of T-profiles according to the present inventive concept as seen from a top view.

Fig. 6 illustrates a side view perspective of the step comprised in the method according to Fig. 5b taken along the line D-D.

Detailed Description of Preferred Embodiments

[0034] In the following, an embodiment of a ceiling tile

100 will be described with reference to Fig. 1 and Figs. 2a-b. The ceiling tile 100 is adapted to be mounted in a supporting structure, such as a grid of profiles, which will be described further below.

[0035] According to the present embodiment, the ceiling tile 100 is rectangularly shaped and comprises four sides, wherein at least a portion of each side is adapted to engage with a profile. Alternatively, the ceiling tile may have other shapes. For example, the ceiling tile may be in the shape of a polygon, such as a triangle, a quadrilateral, a pentagon, etc.

[0036] The ceiling tile 100 comprises a front surface 102, a back surface 104 and four side-edge portions 110, 112, 114, 116. The front surface 102 is arranged to be visible from below when the suspended ceiling is mounted. A first 110 and a second 112 of the four side-edge portions form two adjacent side-edge portions 110, 112. The first side-edge portion 110 comprises a first 120 and a second 122 segment while the second side-edge portion 112 comprises a first 124 and a second segment 126. The third 114 and fourth 116 side-edge portions are arranged oppositely to the first 110 and the second 112 side-edge portions, respectively.

[0037] The first segments 120, 124 are joined along a vertex portion 130 located in a corner of the ceiling tile 100 where the first 110 and second 112 side-edge portions meet each other.

[0038] The first segment 120 comprised in the first side 110 is provided with a groove 140 which has a stepped profile (not seen in Fig. 1). Indeed, from the cross-sectional view of the first segment 120 in Fig. 2a, taken along the line A₁-A₁ in Fig. 1, it is evident that the groove 140 comprises a deep 141 and a shallow 142 part constituting an installation groove 141 and an alignment groove 142, respectively. The installation groove 141 is defined by a lower 143 and an upper 144 boundary surface while the alignment groove 142 is defined by the lower boundary surface 143 and a first upper bearing surface 145. As measured from the front surface 102, the first upper bearing surface 145 is situated at a higher level than the upper boundary surface 144 which in turn is situated at a higher level than the lower boundary surface 143. The surfaces 143, 144 and 145 are parallel with the front surface 102 of the ceiling tile 100. The rightmost part of the upper 144 boundary surface and the leftmost part of the first upper bearing surface 145 are joined by a vertical shoulder section 146 and thereby form a stepped profile in the groove 140.

[0039] Likewise, the first segment 124 comprised in the second side 112 is provided with a groove 150 having a stepped profile (not seen in Fig. 1). The stepped profile has the same shape and dimensions as the stepped profile of the groove 141, 142 described above. According to an alternative embodiment, however, the shape and dimensions may differ. From the cross-sectional view of the first segment 124 in Fig. 2b, taken along the line A₂-A₂ in Fig. 1, it is seen that the groove 150 comprises a deep 151 and a shallow 152 part constituting an installation

groove 151 and an alignment groove 152, respectively. The installation groove 151 is defined by a lower 153 and an upper 154 boundary surface while the alignment groove 152 is defined by the lower boundary surface 153 and a first upper bearing surface 155. As measured from the front surface 102, the first upper bearing surface 155 is situated at a higher level than the upper boundary surface 154 which in turn is situated at a higher level than the lower boundary surface 153. The surfaces 153, 154 and 155 are parallel with the front surface 102 of the ceiling tile 100. The rightmost part of the upper 154 boundary surface and the leftmost part of the first bearing surface 155 are joined by a vertical shoulder section 156 and thereby form a stepped profile in the groove 151, 152.

[0040] According to the present embodiment, a lateral extension of an upper lip 147, 157 is smaller than a lateral extension of a protrusion 148, 158. According to an alternative embodiment, the upper lips 147 and 157 have essentially the same lateral extensions as the protrusions 148 and 158 of the first 120 and second 124 segments, respectively. Alternatively, the lateral extension of the upper lip 147, 157 may be larger than the lateral extension of the protrusion 148, 158.

[0041] In the first 110 and second 112 side-edge portion, the second segments 122, 126 extend along the first 110 and second 112 side-edge portion, respectively, from the boundary of the first segment 120, 122 to the corner of the fourth 116 and third 114 side-edge portion, respectively.

[0042] A cross-sectional view of the second segment 122 of the first side-edge portion 110, taken along the line B₁-B₁ in Fig. 1, is depicted in Fig. 2c. It is seen that in the second segment 122, the upper lip 147 of the first segment 120 is absent. Instead, there is a stepped profile formed in the back surface 104 comprising a wall portion 160 and a horizontal segment 162. A thickness of the lower lip 164 in the second segment 122 is larger than a thickness of the protrusion 148 of the first segment 120 so that a step 132 between the first 120 and second 122 segments is formed, see Fig. 1. Alternatively, the transition between the first 120 and second 122 segments may be smooth. For example, the thickness of the segment may decrease continuously in going from the right side of the second segment 122 in Fig. 1 towards the left side of the first segment 120.

[0043] According to one embodiment, the thickness of the lower lip 164 may substantially correspond to a thickness of the protrusion 148 so that no compression of the lower lip 164 may be needed when mounting the ceiling tile. According to another embodiment, the second segment 122 may be provided with an inclined profile, e.g. with an increasing or decreasing thickness 164 in going towards the corner of the fourth side-edge portion 116.

[0044] Moreover, a cross-sectional view of the second segment 126 of the second side-edge portion 112, taken along the line B₂-B₂ in Fig. 1, is depicted in Fig. 2d. The upper lip 157 of the first segment 124 is absent. Instead, there is a stepped profile in the second segment 126

formed in the back surface 104 comprising a wall portion 170 and a horizontal segment 172. A thickness of the lower lip 174 is larger than a thickness of the protrusion 158 of the first segment 124 so that a step 133 between the first 124 and second 126 segments is formed, see Fig. 1. Alternative embodiments of the second segment 126 are analogous to those described in connection with the second segment 122.

[0045] According to the present embodiment, the second segments 122 and 126 extend along half of the first 110 and second 112 side-edge portions, respectively. Moreover, the first segments 120 and 124 extend along the remaining parts of the first 110 and second 112 side-edge portions, respectively. However, other length proportions A: B between the first 120, 124 and second 122, 126 segments are equally conceivable. For example, the length proportions may be 1:1, 2:3, 3:4, 4:5, 3:2, 4:3, 5:4, etc.

[0046] The third 114 and fourth 116 side-edge portions are provided with support grooves 180 and 190, respectively.

[0047] A cross-sectional view of the third side-edge portion 114 taken along the line C₁-C₁ in Fig. 1 is shown in Fig. 2e. The support groove 180 is defined by an upper 182 and a lower 184 projection, the lateral extension of the upper projection 182 being smaller than the lateral extension of the lower projection 184. The upper projection 182 in turn is defined by a portion of the back surface 104 and a second upper bearing surface 186 and the lower projection 184 is defined by a portion of the front surface 102 and a lower surface 188. The upper bearing surface 186 and the lower surface 188 are parallel with the front 102 and back 104 surfaces. According to an alternative embodiment, the upper projection 182 may have essentially the same lateral extension as the lower projection 184.

[0048] Furthermore, a cross-sectional view of the fourth side-edge portion 116 taken along the line C₂-C₂ in Fig. 1 is shown in Fig. 2f. The support groove 190 is defined by an upper 192 and a lower 194 projection, the lateral extension of the upper projection 192 being smaller than the lateral extension of the lower projection 194. The upper projection 192 in turn is defined by a portion of the back surface 104 and a second upper bearing surface 196 and the lower projection 194 is defined by a portion of the front surface 102 and a lower surface 198. The upper bearing surface 196 and the lower surface 198 are parallel with the front 102 and back 104 surfaces.

[0049] The upper projections 182 and 192 have a thickness corresponding to a thickness of the upper lips 147 and 157. Alternatively, the thickness of the upper projections 182, 192 may be larger than the thickness of the upper lips 147, 157. In the latter case, it may be necessary for the lower projections 184, 194 to be compressed against the supporting structure in order to be able to mount it.

[0050] The first upper bearing surfaces 145, 155 and the second upper bearing surfaces 186, 196 are situated

at the same level, or distance, as measured from, say, the front surface 102, so that in a mounted state, the ceiling tile 100 is essentially parallel with the floor in the room.

[0051] According to an alternative embodiment, at least one of the installation grooves 141, 151 and the support grooves 180, 190 is tapering, such that the width of the groove in question is smallest at its deepest part. A tapering groove of this kind may, for instance, allow for a wedging of the ceiling tile 100, temporarily or permanently.

[0052] According to an alternative embodiment, the installation 141, 151 and alignment 142, 152 groove may be inclined with respect to either the front surface 102 or the back surface 104 of the ceiling tile 100. More specifically, at least one of the upper first bearing surfaces 145, 155, the lower 143, 153 and upper 144, 154 boundary surfaces may be provided obliquely with respect to either the front surface 102 or the back surface 104. Preferably, the installation and alignment groove 141, 142, 151, 152 is then arranged at an angle which allows for a simple installation of the ceiling tile 100 from below.

[0053] According to an alternative embodiment, the ceiling tile 100 further comprises external units. An external unit may be a lighting fixture, a device related to heating, ventilation or air condition, etc. For example, the external unit may be located at a center point of the front surface 102 of the ceiling tile 100. Thus, according to this embodiment, there is provided an external unit integrated with the ceiling tile 100 which is easily mountable in a suspended ceiling. Additionally, the external unit may be easily accessible from the back surface 104 since the inventive ceiling tile 100 in which the external unit is provided is easily demountable.

[0054] In order to improve the acoustical environment of the room in which it is to be mounted, the ceiling tile 100 may comprise a material which is sufficiently acoustically absorbing and/or acoustically insulating for the room under consideration. In addition, the material comprised in the ceiling tile 100 is preferably relatively lightweight, thereby giving rise to a lightweight ceiling. Moreover, the material of the ceiling tile 100 preferably comprises an elastically deformable material. For example, the ceiling tile 100 may be made of a compressed fibre material comprising mineral wool such as rock wool, or especially glass wool.

[0055] The lateral dimensions of the ceiling tile 100 substantially correspond to the lateral dimensions of the inner or outer frame of the grid of profiles into which it is to be inserted.

[0056] Next, a suspended ceiling in which the ceiling tile is adapted to be mounted will be described with reference to Fig. 3 and Figs. 4a-b. Even though the present embodiment is described in relation to a flat suspended ceiling, which is substantially in parallel with either a main ceiling or a floor of a room, the inventive concept is equally applicable to multilevel or inclined suspended ceilings which form an angle with the main ceiling or the floor.

[0057] Fig. 3 is a schematic perspective view illustrating an embodiment of a suspended ceiling 200 comprising a plurality of inventive ceiling tiles 220, 222 and a grid of profiles 210, 212, as seen obliquely from above. Each ceiling tile 220, 222 may be constructed as the ceiling tile 100 described above. The suspended ceiling 200 is adapted to be mounted underneath a main ceiling of a room or another accommodation, thereby forming a two-dimensional visible ceiling surface as seen from below. When mounted, the grid of profiles 210, 212 comprised in the suspended ceiling 200 may be at least partly concealed.

[0058] The grid of profiles 210, 212 is a supporting structure for the ceiling tiles 220, 222 and comprises profiles 210, 212 in the form of main runners 210 as well as cross runners 212. A first set of main runners 110 may be suspended in the main ceiling, thereby supporting the grid of profiles 110, 112, while a second set of main runners 110 may be non-supported in the same. Moreover, the first set may extend across several ceiling tiles 120, 122 while the second set may comprise several segments, whereby each segment extends along the adjacent side edges of one pair of neighbouring ceiling tiles 120, 122. The cross runners 212 are provided at right angles to the main runners 210 and are connected to the same at a discrete set of locations. Thereby, the main runners 210 and the cross runners 212 form a grid-like structure which is adapted to support ceiling tiles 220, 222 of a rectangular shape. Optionally, the grid of profiles 210, 212 may also comprise wall runners as is well-known to a person skilled in the art. It is also understood that the overall geometry of the profiles may vary. For instance, the profiles may be curved, horizontally and/or vertically, and may consequently be adapted to support ceiling tiles of other shapes. For example, a ceiling tile may be in the shape of a polygon, such as a triangle, a quadrilateral or a pentagon, etc.

[0059] According to the present embodiment, the grid of profiles forms frames in the shape of inner rectangular frames and outer rectangular frame portions into which the ceiling tiles 220 and 222 are to be inserted, respectively. Thus, each ceiling tile 220, 222 is at least partly enclosed by profiles. The inner rectangular frames are adapted to support ceiling tiles with lateral dimensions 600 mm x 1200 mm, while the outer rectangular portions are adapted to support ceiling tiles having smaller lateral dimensions, such as 600 mm x 300 mm and 200 mm x 300 mm. Naturally, also other lateral dimensions are conceivable. For example, a quadratic ceiling tile may have the dimensions 600 mm x 600 mm.

[0060] The grid of profiles 210, 212 is suspended by hangers 230 such as hanger wires, rods, etc. In Fig. 3, each hanger 230 comprises a first and a second hanger element which are arranged in parallel. An end portion of each of the first hanger elements is provided with a hook and is inserted into a corresponding hole in a hanger clip which is provided in a main runner 210. Moreover, the length of each hanger 230 is adjustable by means of

an arrangement which allows for a relative lengthwise displacement of the first and second hanger element. The second hanger elements are fastened to a permanent structure of the room, such as the main ceiling of the room (not shown), thereby upholding the suspended ceiling.

[0061] According to the present embodiment, each of the profiles 210, 212 is an inverted T-profile, or a tee, thereby having a cross-section in the form of an inverted T. Thus, each of the profiles has a central web and two flanges which protrude to an equal extent from a lower part of the web in two opposite horizontal directions. The flanges are adapted to support the ceiling tiles 220, 222. A non-limiting example of a thickness of each of the flanges is 1.1 mm. Optionally, the central web may comprise a bulb, e.g. for reinforcing the T-profile. Preferably, the profiles are comprised of a light-weight material. For example, the material may be a metal such as steel or a sheet metal. Alternatively, the material may be a rigid plastic, a light metal, such as aluminium, or similarly. The profiles 210, 212 according to the present embodiment are fairly rigid. However, it is equally conceivable to utilize resilient profiles 210, 212 which may further simplify the installation of the ceiling tiles 220, 222.

[0062] According to an alternative embodiment, the profiles 210, 212 may comprise at least one of an L-profile, an H-profile, an I-profile and a Z-profile.

[0063] Fig. 4a is a cross-sectional side view of side-ports of two ceiling tiles 100, 300 of the type shown in Fig. 1 and Fig. 2 as mounted into a first inverted T-profile 500, taken along the lines A₁-A₁ and C₁-C₁ with regard to the first 100 and second 300 ceiling tile, respectively. In fact, Fig. 4a is equally applicable for a cross-sectional view of side-ports of two ceiling tiles taken along the lines A₂-A₂ and C₂-C₂, whereof one is the first ceiling tile 100. In a mounted state, the front surfaces 102 and 302 of the ceiling tiles 100 and 300 are visible from below the suspended ceiling 200, while the back surfaces 104 and 304 are concealed, facing the main ceiling of the room.

[0064] Along the first segment 120, the T-profile 500 engages from below with the first ceiling tile 100. More specifically, the upper side 510 of the T-profile 500 engages with the first ceiling tile 100 along its first upper bearing surface 145. Thus, in a mounted state, the left-side flange 530 is being inserted into the shallow 142 part of the groove, viz. the alignment groove 142, along the first segment 120.

[0065] Moreover, along the third side-edge portion 314 of the second ceiling tile 300, the T-profile 500 engages from below with the second ceiling tile 300. More specifically, a rightmost part of the upper side 512 of the T-profile 500 engages with the second ceiling tile 300 along its second upper bearing surface 386. Optionally, if the thickness of the flange 512 is larger than the distance between the second upper bearing surface 386 and the lower surface 388, the flange 512 may have to be forced into the support groove 380, thereby causing engage-

ment also between an underside 520 of the right-side flange and the lower surface 386.

[0066] There is a gap between the protrusion 148 of the first ceiling tile 100 and a lower projection 384 of the second ceiling tile 300, thereby exposing at a least part of the underside 520 of the T-profile 500 in a direction along, say, the cross runners 212. The gap may have a width of 8 mm, but other widths are equally conceivable. According to an alternative embodiment, there is substantially no gap between the protrusion 148 and the lower projection 384.

[0067] Furthermore, Fig. 4b is a cross-sectional side view of side-portions of the same two ceiling tiles as mounted into the same inverted T-profile 500, taken along the lines B₁-B₁ and C₁-C₁ with regard to the first 100 and second 300 ceiling tile, respectively. Similarly to the above, Fig. 4b is equally applicable for a cross-sectional view of side-portions of two ceiling tiles taken along the lines B₂-B₂ and C₂-C₂, whereof one is the first ceiling tile 100.

[0068] Along the second segment 122 of the first ceiling tile 100, the T-profile 500 engages from above. More specifically, in a mounted state, the underside 520 of the T-profile 500 engages with the first ceiling tile 100 along its horizontal segment 162. Similarly to the above, the T-profile 500 engages from below with the second ceiling tile 300 along the third side-edge portion 314 of the second ceiling tile 300, and, optionally also from above. It is noted that according to another embodiment, the T-profile 500 does not engage second segment 122, so that the latter hangs freely.

[0069] In an unmounted state, the distances between the front surface 102 of the ceiling tile 100 and the first upper bearing surfaces 145, 155, the horizontal segments 162, 172 and the second upper bearing surfaces 186, 196 are given by X, Y and Z, respectively, as indicated in Figs. 2a-f. In a mounted state, the ceiling tile 100 engages with the T-profile 500 along the first upper bearing surfaces 145, 155, the horizontal segments 162, 172 and the second upper bearing surfaces 186, 196. In the following, primed quantities X', Y', Z' refer to the quantities X, Y, Z in a mounted state, see Fig. 4a and Fig. 4b. In the present embodiment, the following relations hold: $X' > X$, $Y' < Y$ and $X' = Z' = Z$, where the equality signs mean that there is substantially no compression of the ceiling tile 100 in the associated segment or side-edge portion. Indeed, while the T-profile 500 engages with the first 145, 155 and second 186, 196 upper bearing surfaces essentially by means of the gravitational force, the engagement with the horizontal segments 162, 172 is accomplished by compressing the lower lips 164, 174 provided in the second segments 122, 126 so that the distance Y decreases in a mounted state. Non-limiting examples of the distances are given by $X' = Z' = Z = 15.05$ mm, $Y = 14$ mm, $Y' = 13.95$ mm. Note that if the flange 512 has been forced into the support groove 380, Z' may differ from Z; e.g. $Z' > Z$.

[0070] There is a gap between the lower lip 164 of the

first ceiling tile 100 and a lower projection 384 of the second ceiling tile 300, thereby exposing at a least part of an underside 520 of the T-profile 500 in a direction along, say, the main runners 212. The gap may have a width of 8 mm, but other widths are equally conceivable. According to an alternative embodiment, there is substantially no gap between the lower lip 164 and the lower projection 384. According to yet another embodiment, the lower lip 164 and the lower projection 384 engage with each other.

[0071] Note that the lateral dimensions of the ceiling tiles 100, 300, 400 substantially correspond to the dimensions of a frame formed by the upwardly directed web portions of the T-profiles surrounding the ceiling tile under consideration. Furthermore, the thickness of each ceiling tile 100, 300, 400 is preferably smaller than a height of the upwardly directed web portions of the surrounding T-profiles, although a different thickness is equally conceivable. For instance, the thickness may be 20 mm.

[0072] Next, an embodiment of a method for mounting a suspended ceiling 200 will be described with reference to the top views in Fig. 5a-c of the ceiling tile 100 and the inverted T-profiles 600, 610, 620, 630 comprised in the grid of profiles 210, 212. The installation of other ceiling tiles 220, 222 in the suspended ceiling 200, comprising the grid of profiles 210, 212, proceeds analogously.

[0073] Fig. 5a schematically shows a grid of inverted T-profiles 600, 610, 620, 630 before a ceiling tile has been mounted in it. The T-profiles are situated at the same height from a floor of the room in which the suspended ceiling 200 is to be mounted. Each of the T-profiles 600, 610, 620, 630 comprises a central web, and two opposing flanges, cf. 500, 530, 540 in Fig. 4a. With reference to Fig. 5a, the T-profiles 600, 610, 620, 630 form a frame in which the T-profile 600 is parallel with the T-profile 620 and the T-profile 610 is parallel with the T-profile 630. Moreover, the T-profiles 600, 610, 620, 630 are connected along connection portions 640, 642, 644 and 646, thereby forming four corners. The T-profiles 600 and 620 on the one hand, and 610 and 630 on the other hand, are separated by a first and a second distance, respectively. In the present embodiment, a distance between the rightmost end of the flange 630 and the leftmost end of the flange 610 is smaller than a corresponding width of the ceiling tile 100, extending from the second 112 and fourth 116 side edges. Moreover, a distance between the uppermost end of the flange 600 and the lowermost end of the flange 620 is smaller than a corresponding height of the ceiling tile 100, extending from the first 110 and third 114 side edges. Therefore, the ceiling tile 100 needs to be inclined in order to be able to mount it between the T-profiles.

[0074] As shown schematically in Fig. 5b and Fig. 6, the vertex portion 130 of the ceiling tile 100 is first directed towards the connection portion 640 in an inclined manner, i.e. the ceiling tile 100 forms an angle with the frame formed by the flanges 600, 610, 620 and 630. Here, the flanges 600 and 610 engage with the installation grooves 141 and 151, respectively, by means of the upper bound-

ary surfaces 144 and 154. The movement of the ceiling tile 100 is directed in a direction as indicated by the arrows P_1 and P_2 in Fig. 5b and 6, respectively, i.e. obliquely towards the connection portion 640. Fig. 6 is side view of the ceiling tile 100 and the flange 600 of the T-profile, as seen from the line D-D in Fig. 5b. Alternatively, the precise movement of the ceiling tile 100 may be different, as long as the movement is such that the vertex portion 130 is directed towards the connection portion 640.

[0075] Next, while the flanges 600 and 610 continues to engage with the installation grooves 141 and 151, the third 114 and fourth 116 side-edges are lifted upwards into a horizontal position so that the support grooves 180, 190 become aligned with the flanges 620 and 630, respectively. The direction of the uplift is illustrated in Fig. 6 by the arrow P_3 . During the uplift, the horizontal segments 162 and 172 of the second segments 122 and 126 engage with the flanges 600 and 610, respectively, cf. Fig. 2c and Fig. 2d. According to the present embodiment, the lower surfaces 188 and 198 do not engage with the flanges 620 and 630 in the horizontal position. Optionally, however, the lower surfaces 188 and 198 may engage with the flanges 620 and 630, respectively. In fact, if a thickness of the lower projections 184, 194 exceeds Y' , i.e. Y in a mounted state, the ceiling tile 100 has to be compressed along the third 114 and the fourth 116 side-edge portions. Thus, at this point in the mounting process, the ceiling tile 100 is located essentially in a horizontal position with respect to either a floor or a main ceiling of the room.

[0076] Finally, the ceiling tile 100, while being in the horizontal position, is directed towards the connection portion 644. The direction is indicated by the arrow P_4 in Fig. 5c. As a result of the diagonal movement in the direction P_4 , the ceiling tile 100 has clicked down by means of the stepped profiles 144, 145, 146, 154, 155, 156 provided in the grooves 140, 150. More specifically, the movement is continued at least until the engagement between the upper boundary surfaces 144, 154 of the installation grooves 141, 151 and the flanges 600, 610 is ceased and the engagement instead occurs between the first upper bearing surfaces 145, 155 and the flanges 600, 610. The mounted ceiling tile 100 is shown in the top view depicted in Fig. 5c.

[0077] The invention has mainly been described above with reference to a few embodiments. However, as is readily appreciated by a person skilled in the art, other embodiments than the ones disclosed above are equally possible within the scope of the invention, as defined by the appended patent claims.

Claims

1. A polygon-shaped ceiling tile having a front surface, a back surface and two adjacent side-edge portions, wherein each side-edge portion comprises a first and a second segment,

said first segments adjoining each other, wherein each first segment is provided with an installation groove extending along the side-edge portion associated thereto, and wherein each second segment is provided with a stepped profile extending along the side-edge portion associated thereto for forming a step in said back surface.

2. The ceiling tile according to claim 1, wherein the polygon shape of the ceiling tile is rectangular.
3. The ceiling tile according to claim 1 or 2, further comprising at least one additional side-edge portion provided with a support groove.
4. The ceiling tile according to any of the preceding claims, wherein each first segment is provided with an alignment groove extending along the side-edge portion associated thereto, said alignment groove and said installation groove of said first segment forming a stepped profile.
5. The ceiling tile according to claim 4, wherein each installation groove has a depth D_1 and wherein each alignment groove has a depth D_2 , the depth D_1 being greater than the depth D_2 .
6. The ceiling tile according to claim 4 or 5, when referring to claim 3, each alignment groove comprises a first upper bearing surface and wherein each support groove comprises a second upper bearing surface, wherein the first and second upper bearing surfaces are situated at the same level.
7. The ceiling tile according to any of the preceding claims, wherein said ceiling tile comprises an elastically deformable material.
8. The ceiling tile according claim 7, wherein said ceiling tile comprises compressed fibre material.
9. A suspended ceiling comprising a ceiling tile of the type according to any of the preceding claims and a grid of profiles forming a frame which supports said ceiling tile.
10. A method for mounting a ceiling tile for installing a suspended ceiling, comprising the steps of:

- providing a grid of profiles forming a frame which comprises a first, a second, and a third flange, wherein said first and second flanges are connected along a connection portion, and a polygon-shaped ceiling tile having a front surface, a back surface, a first and a second adja-

cent side-edge portion and a third side-edge portion, wherein each of the first and second side-edge portions comprises a first and a second segment, said first segments adjoining each other at a vertex portion and each second segment being provided with a stepped profile extending along the side-edge portion associated thereto for forming a step in said back surface; and
 - installing the ceiling tile in a frame of said grid of profiles, wherein the step of installing said ceiling tile comprises:

- arranging the ceiling tile in an inclined position and directing said vertex portion towards said connection portion;
- inserting, by relative displacement of the ceiling tile and the grid of profiles, said first flange and second flange into a respective installation groove provided in each of said first segments extending along the side-edge portion associated thereto, to such an extent that said third side-edge portion clears said third flange of the frame, whereby said first flange and second flange engage from below with upper boundary surfaces associated with each of the installation grooves;
- arranging the ceiling tile in a horizontal position and aligning a support groove provided along said third side-edge portion with said third flange, the first flange and the second flange continuing to engage from below with said upper boundary surfaces associated with each of the installation grooves; and
- displacing the ceiling tile towards the third flange, the first and second flange continuing to engage with said upper boundary surfaces and with said stepped profiles, such that said third flange engages from below with said third side-edge portion.

11. The method according to claim 10, where, in the steps of arranging and displacing the ceiling tile, said first and second flanges of said frame engage from above with a respective one of said stepped profiles provided in the second segments.
12. The method according to claim 10 or 11, wherein each first segment is provided with an alignment groove extending along the side-edge portion associated thereto, said alignment groove and said installation groove of said first segment forming a stepped profile.
13. The method according to claim 12, wherein the step of displacing the ceiling tile continues until said first and second flanges engage from below with first up-

per bearing surfaces associated with each of said alignment grooves.

14. The method according to any of the claims 10-13, wherein said grid of profiles engages with said first and second segments under elastical deformation of at least one of the first and the second segment.
15. The method according to any of the claims 10-14, wherein said grid of profiles engages with said first and second segments under elastical deformation of at least one of the first and the second flange.
16. The method according to any of the claims 10-15, wherein said third flange engages from below with a second upper bearing surface associated with a support groove which is provided along said third side-edge portion.

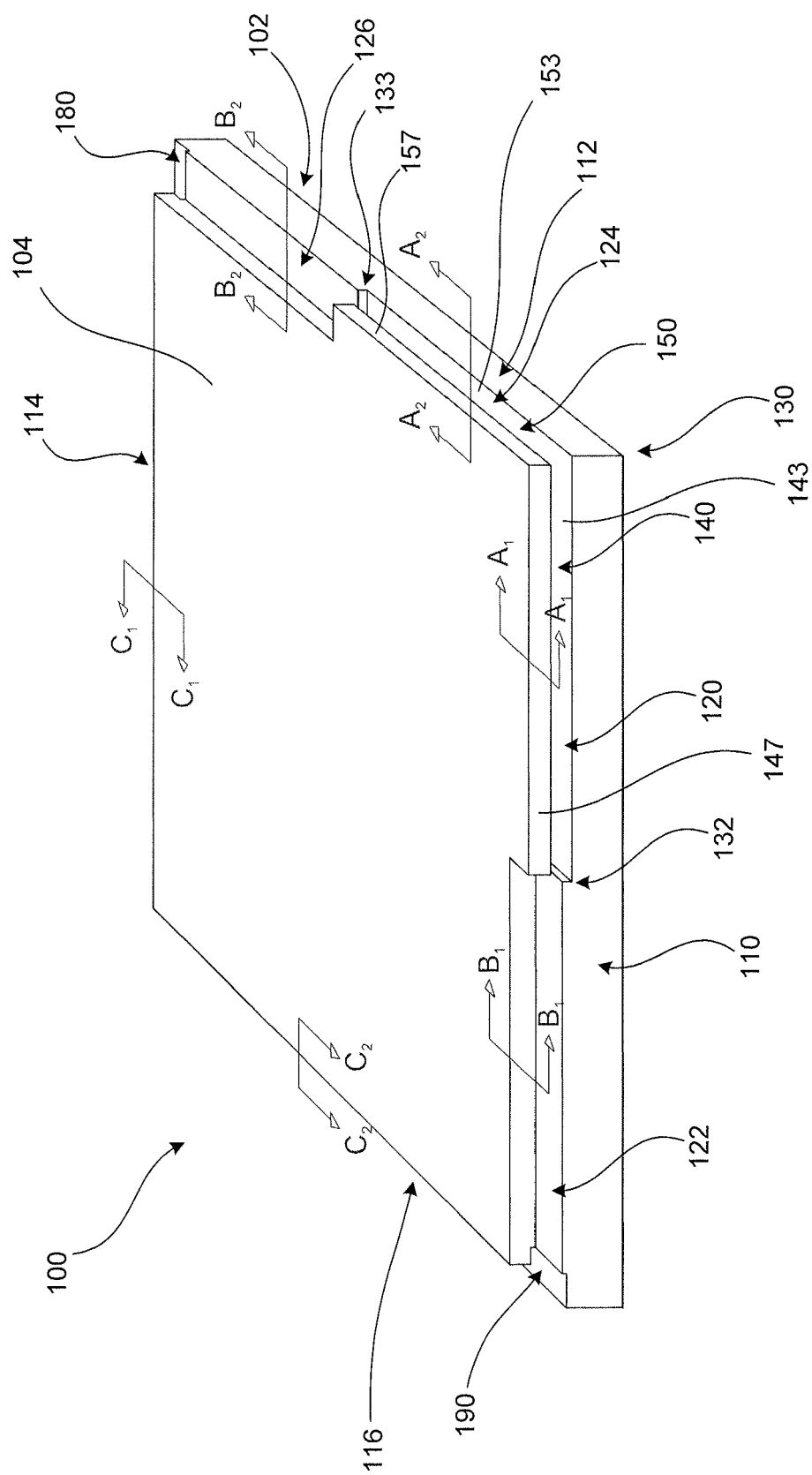
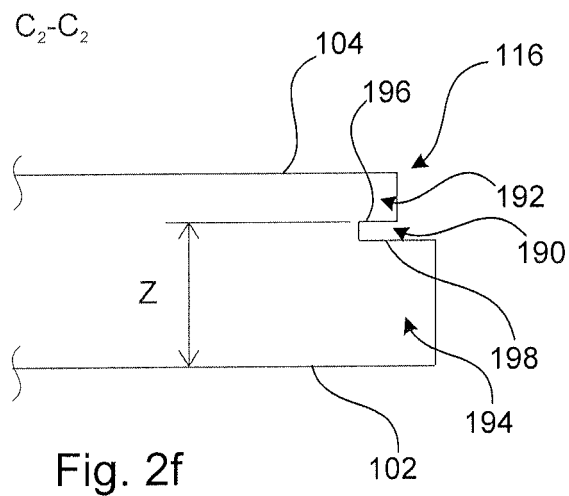
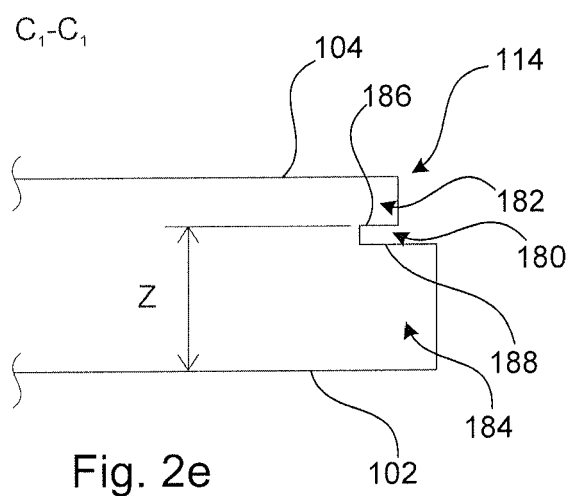
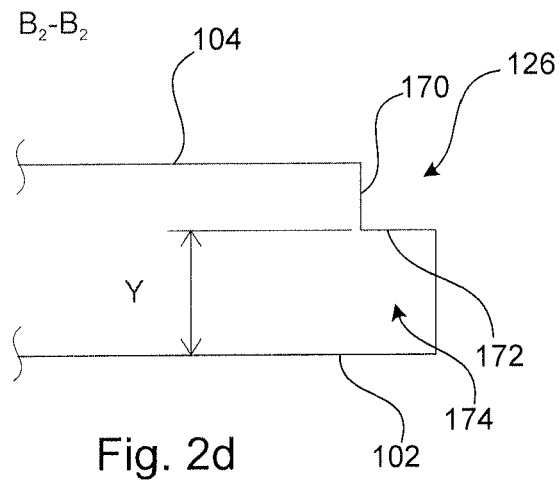
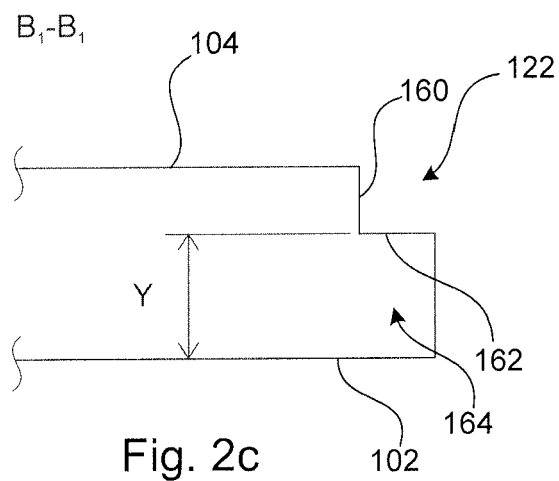
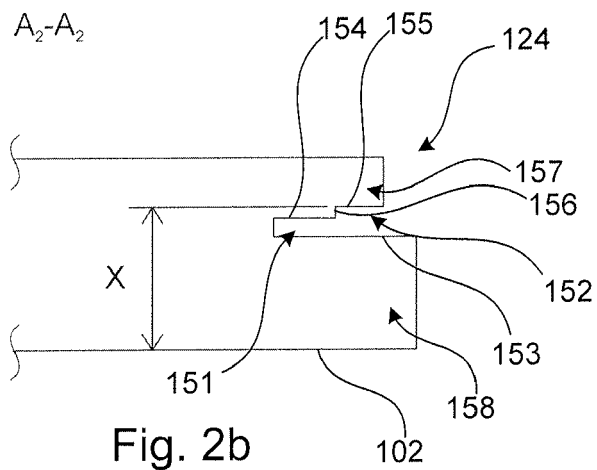
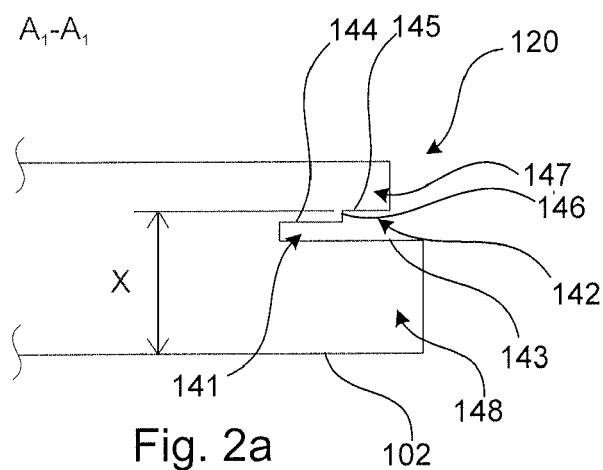


Fig. 1



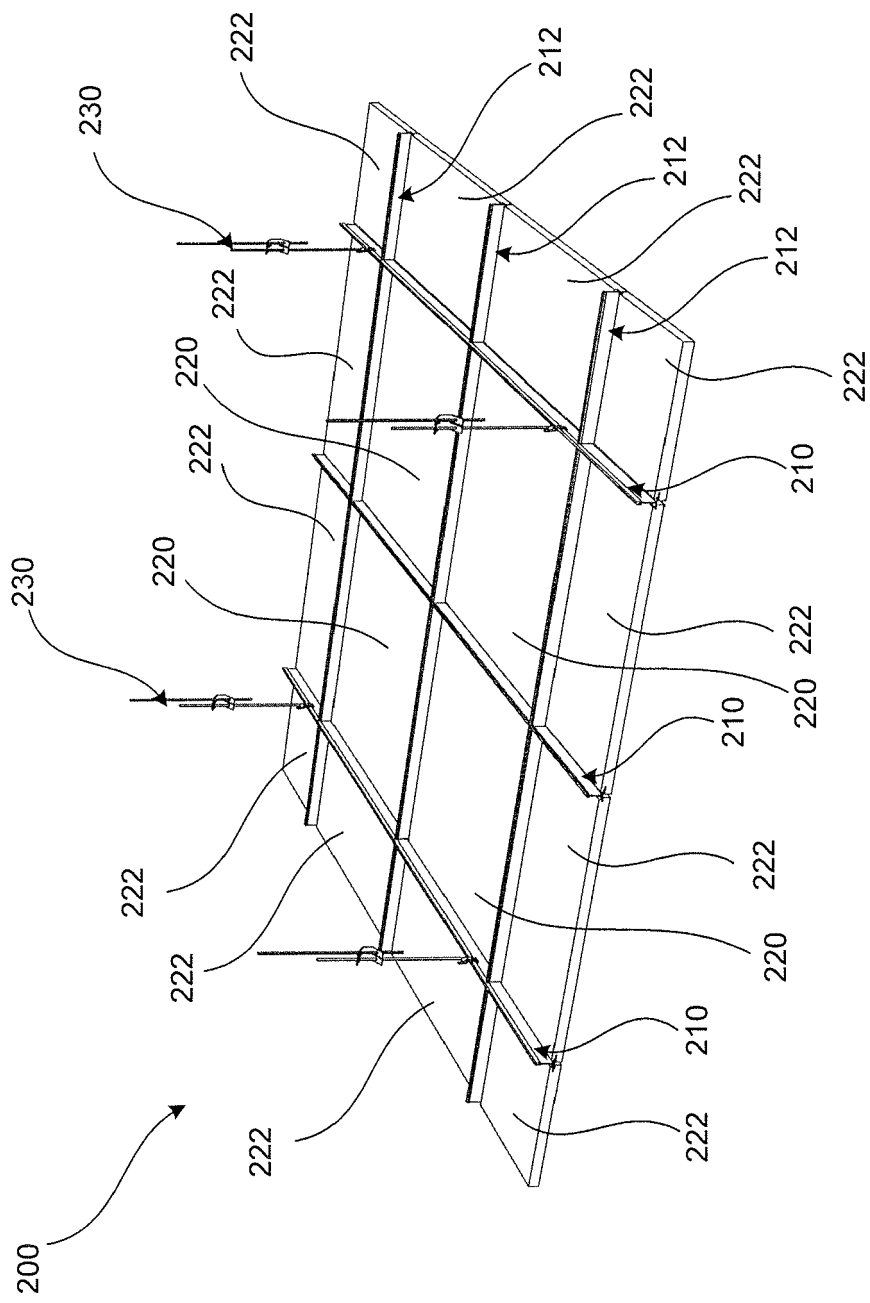


Fig. 3

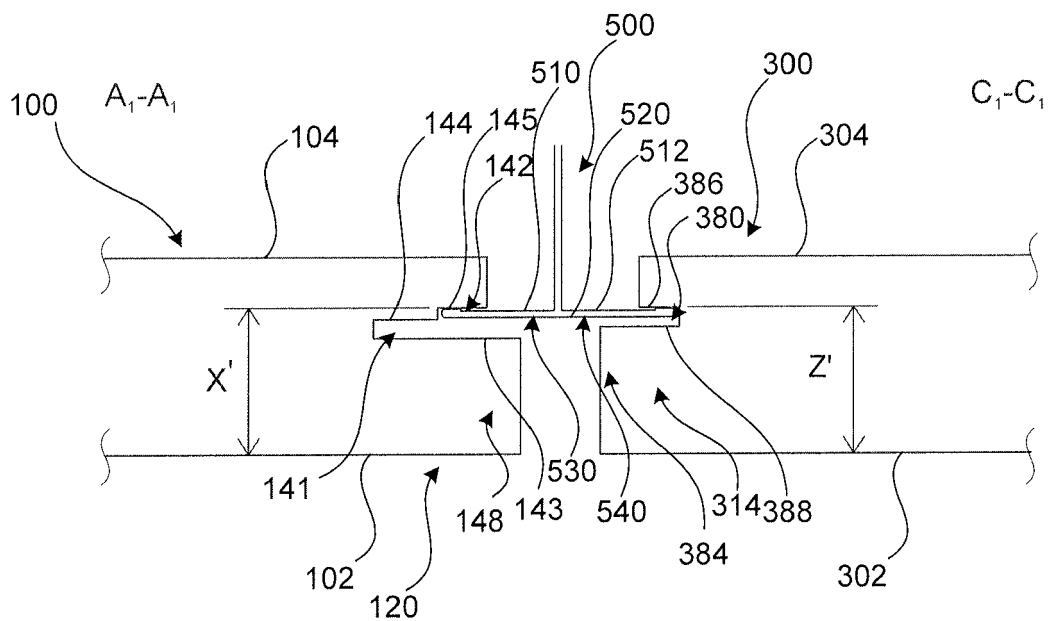


Fig. 4a

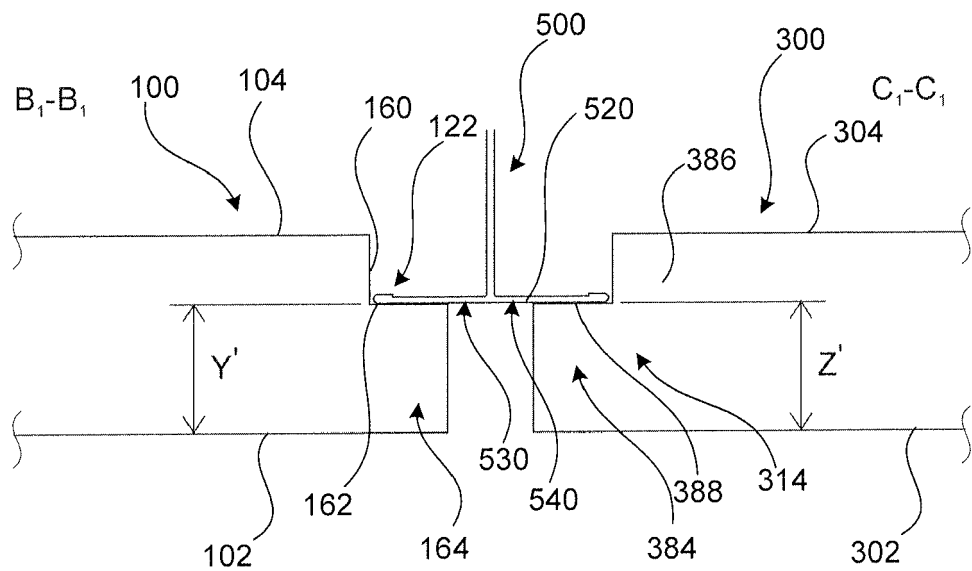


Fig. 4b

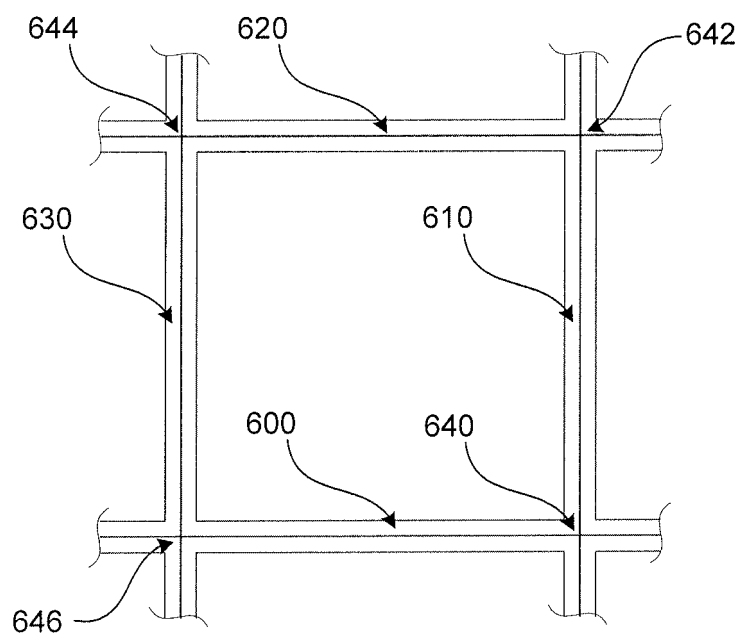


Fig. 5a

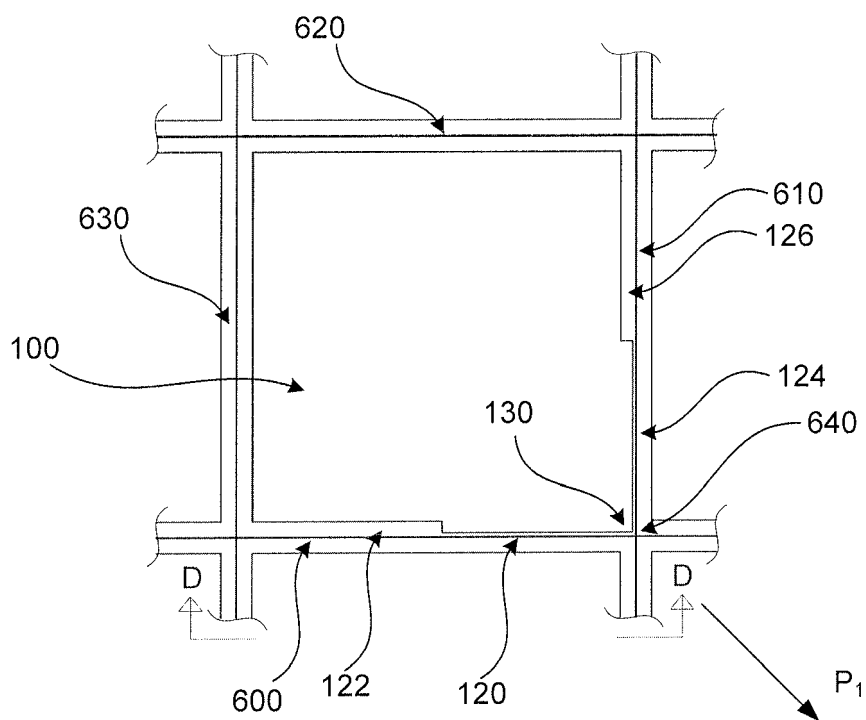


Fig. 5b

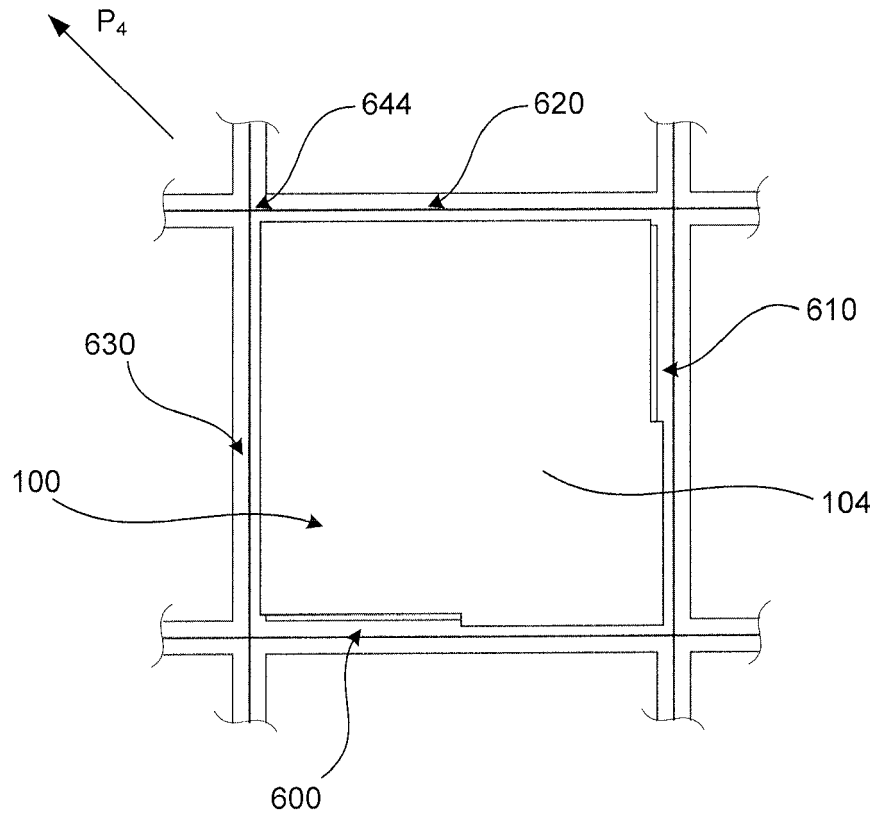


Fig. 5c

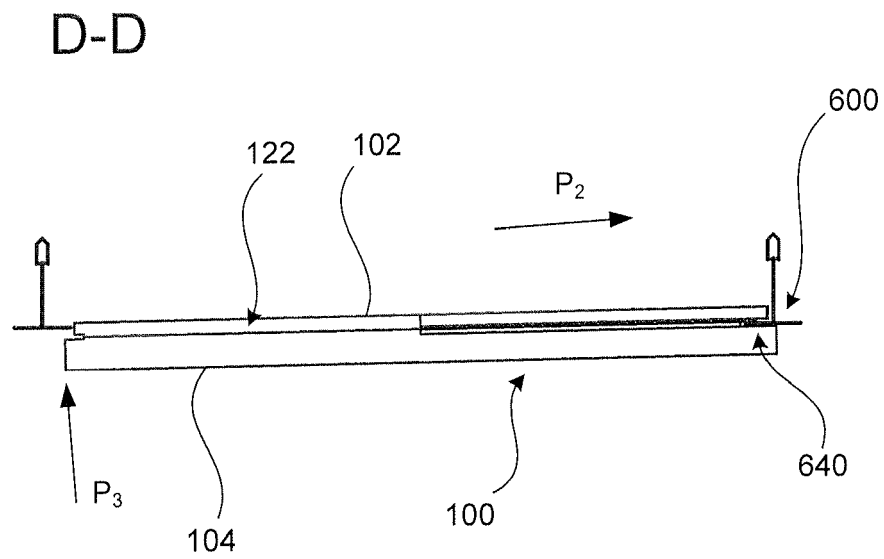


Fig. 6



EUROPEAN SEARCH REPORT

Application Number
EP 12 15 6742

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	BE 572 794 A (S.A.D.I SOC. P. AZ.) 29 November 1958 (1958-11-29) * the whole document *	1-3,7-9	INV. E04B9/24 E04B9/28 E04B9/04
X	US 3 488 908 A (JAHN MARTIN D) 13 January 1970 (1970-01-13) * column 4, lines 11-41; figures 1-5 *	1-3,7-9	
			TECHNICAL FIELDS SEARCHED (IPC)
			E04B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 31 July 2012	Examiner Rosborough, John
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 12 15 6742

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31-07-2012

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BE 572794	A	29-11-1958	NONE	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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