(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 335 989 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
13.03.2024 Bulletin 2024/11

(21) Application number: **23196157.4**

(22) Date of filing: **08.09.2023**

(51) International Patent Classification (IPC):
E04F 15/02 *(2006.01)* ***E04F 13/08*** *(2006.01)*

(52) Cooperative Patent Classification (CPC):
E04F 15/02038; E04F 13/0826; E04F 13/0894;
E04F 2015/02094; E04F 2201/0517

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(30) Priority: **09.09.2022 NL 2032991**

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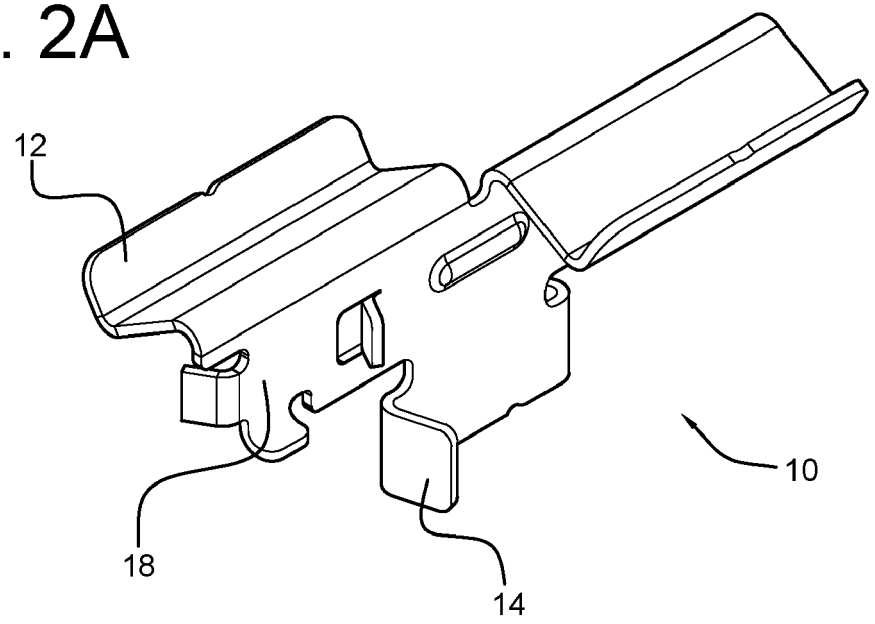
(54) **FASTENING ELEMENT FOR FASTENING BOARDS TO SUPPORT PROFILES**

(57) A fastening element for fastening boards to a support profile to form a modular surface, the fastening element comprising a central section, a board engaging section, and a support profile engaging section. The central section is formed of a single sheet of material and connects the support profile engaging section to the board engaging section, the board engaging section comprises at least two flanges extending in opposite directions with respect to the central section, each of the flanges configured to enter within a groove provided in a lateral surface of a board, and the support profile engaging section is configured to pass through a channel opening in a support profile in a first orientation and to lock the fastening element to the support profile upon rotating the fastening element to a second orientation. The invention further relates to a modular surface such as a floor, wall, or ceiling comprising boards fastened to support profiles using the fastening element.

Fig. 2A



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Description

Field of the invention

[0001] The present invention relates to a fastening element, in particular a fastening element for fastening a board to a support profile to form a modular surface. The invention further relates to a modular surface comprising such a fastening element.

Background art

[0002] Fastening elements are known from the prior art. When forming a surface such as a floor, a wall, a ceiling, a fence, or alike, the fastening elements are used to fasten planks or boards to a support profile in order to form the surface. A vast number of different fastening elements is used for such purposes. Typically, the fastening elements form a first connection with a support profile and a second connection with the board.

[0003] For example, patent document EP 3387197 B1 discloses one such fastening element. Here, a securing clip for installation of flooring elements on a supporting element having a guiding groove for engagement with the securing clip is disclosed. The securing clip has a cross section of a double-flange T-type with an upper flange, a web and a lower flange, wherein at least the upper flange is made of elastic material. The upper flange is adapted to engage on both its sides with neighbouring flooring elements and comprises at least two parts located on the opposite sides of the web. The lower flange comprises lips extending beyond each end of the web in the direction along the web and the lips are adapted to be blocked in the guiding groove upon rotation. Disadvantageously, the fastening element requires quite some material because of the double flange T-type.

[0004] More traditional fastening elements that have lower material cost involve fastening elements that require the use of additional connectors such as screws, bolts, nails, or the like, for fastening the fastening element to the support structure. This is impractical as it demands from a user to tighten or insert the additional connectors in order to assemble the surface. It is time consuming to do so, and more importantly, access for the tooling needs to be provided to fasten the additional connectors. Consequently, the fastening elements cannot be used when it is desired to leave only a narrow space between adjacent boards. To provide access to the additional connector, typically a space of at least 6 mm needs to be provided. This may be conceived as aesthetically unattractive and may further require the use of additional products, for example rubber strips, to cover up the space between adjacent boards.

[0005] It would be desirable to provide a fastening element which at least partially addresses problems found in the prior art.

Summary of the invention

[0006] Therefore, according to a first aspect of the present invention there is provided a fastening element for fastening boards to a support profile to form a modular surface. In this context, the term "modular surface" is used to describe any surface formed by a plurality of boards or tiles, such as a floor, ceiling, fence, or wall. The fastening element comprises a central section, a board engaging section, and a support profile engaging section. The central section is formed of a single sheet of material and connects the support profile engaging section to the board engaging section, the board engaging section comprises at least two flanges extending in opposite directions with respect to the central section, each of the flanges configured to enter within a groove provided in a lateral surface of a board, and the support profile engaging section is configured to pass through a channel opening in a support profile in a first orientation and to lock the fastening element to the support profile upon rotating the fastening element to a second orientation.

[0007] In the first orientation the fastening element may be aligned with the channel opening extending in a first direction and rotated around a second direction perpendicular to the first direction to lock the fastening element to the support profile. Typically, the boards are elements that are substantially flat and elongate, and having a length of at least twice the width of a board, and at least ten times the thickness of a board. Each board has a support profile facing side and an outer surface forming side. The outer surface forming sides provide the modular surface, which may for instance be a floor, ceiling, or wall. Each board further has up to four lateral surfaces, wherein at least two lateral surfaces comprise a groove that may be used to fasten the board to the support profile using the fastening element according to the invention. The boards may for example be made of wood or a composite material.

[0008] To aid further description, the following directions are used. A direction along which the support profiles are placed is referred to as a longitudinal direction X. A direction perpendicular to the longitudinal direction X is referred to as a transversal direction Y. The boards may extend along the transversal direction Y. The longitudinal direction and the transversal direction Y define a plane being substantially parallel to the modular surface. For convenience, we refer to this plane as a horizontal plane, as this plane may be substantially horizontal in a modular floor or ceiling. A direction perpendicular to the horizontal plane is a vertical direction Z and a plane perpendicular to the horizontal plane is a vertical plane. It will be understood by the skilled person that even though the fastening element is discussed in relation to a horizontally laid modular surface, the fastening element may equally well be used for other systems that may extend in a vertical or inclined plane.

[0009] The support profiles typically have a form of a

joist with upwardly extending walls forming a channel with the channel opening extending along the joist and being bound by inwardly extending rims. The fastening element is configured to pass through the channel opening in the first orientation, and be locked within the channel of the support profile in the second orientation. In the first orientation the fastening element may be aligned with the channel opening extending in a first direction and rotated around a second direction perpendicular to the first direction to lock the fastening element to the support profile. For example, in a modular floor or ceiling system, the second direction substantially coincides with a vertical axis, and the fastening element is rotated around the vertical axis to lock it to the support profile.

[0010] Advantageously, the central section of the fastening element is formed from a single sheet of material. This results in a lower material consumption compared to traditional fastening elements having a U-shaped central section. Moreover, the fastening element according to the present invention can be locked to the support profile by rotating the fastening element placed within the channel of the support profile. The locking does not require any additional fixation means such as screws, nails, adhesives, or similar. The fastening element can be easily disengaged from the support profile by rotating the fastening element in the opposite direction, i.e. by reversing the original rotation. In this manner, the fastening element provides additional freedom to a user to re-use, re-position, and replace the fastening element while constructing the modular surface. Especially during the installation of the modular surface this is useful, as small mistakes can be quickly and easily corrected.

[0011] Preferably, the central section substantially extends in a single plane, typically a plane perpendicular to the modular surface. Advantageously, the single-sheeted central section may then extend between abutting lateral surfaces of adjacent boards. The central section then requires no significant space and consequently only a minimal spacing between adjacent boards suffices.

[0012] In an embodiment, the second orientation is substantially perpendicular to the first orientation. The fastening element may be designed to lock a board profile to a support profile after rotating the fastening element over an angle of approximately 90 degrees. Preferably, however, the fastening element fastening element is already locked to the board and support profile after rotating the fastening element over an angle of at least 30 degrees, at least 45 degrees, or at least 60 degrees. Advantageously, such fastening elements may also be used for modular surfaces wherein not all boards and support profiles are perpendicular to each other.

[0013] In an embodiment, an elongate direction of the support profile defines a longitudinal axis, and a transverse axis is defined perpendicular to the longitudinal axis, wherein the single plane of the central section is aligned with the longitudinal axis in the first orientation, and wherein the single plane makes an angle with the transverse axis in a range between -30° and 30° in the second orientation. Advantageously, locking is achieved over a range of orientations for the fastening element. As such, the fastening element according to the present invention can be used to fasten the boards having non-parallel lateral surfaces or more generally, the boards with the lateral surfaces that are not perpendicular to the support profile. Additionally, the fastening elements can be used to fasten the boards arranged over a plurality of support profiles which may be misaligned with respect to each other. Such a misalignment may occur during the assembly of the modular surface. In such a situation, the boards may be still parallelly aligned to form the modular surface while the fastening elements are locked to the support profile by rotating some fastening elements over a different angle than others.

[0014] In an embodiment, the fastening element is formed from a single sheet of material. Forming the entire fastening element from a single sheet of material makes the fastening element easy to manufacture. The fastening element may be completely produced on a single production line. Further, the fastening element may be serially produced, wherein cut-outs, notches, and bends are introduced to the sheet in a step-by-step fashion. This results in an easy production line setup and rapid production of the fastening elements. Preferably, the fastening elements are produced from a single type of material and therefore, can be easily recycled lowering negative environmental impact.

[0015] In an embodiment, the two flanges are spaced along the central section. In this context, "spaced along the central section" refers to a configuration wherein the flanges do not overlap along a length of the central section. The flanges are placed successively along the central section.

[0016] In an embodiment, the fastening element is substantially rotationally symmetric. In this context, "substantially" refers to a fastening element wherein at least the board engaging section and preferably also the support profile engaging section is rotationally symmetric. Rotational symmetry is typically provided around the vertical axis Z. Advantageously, the fastening element can be easily and quickly applied, as there cannot be any confusion as to how the fastening element should be inserted. The rotationally symmetrical fastening element allows a user to quickly connect it to the support profile without a need to properly orient the fastening element before engaging it with the support profile. This saves time and prevents construction faults due to improperly positioned fastening element. In addition, the rotational symmetry may in certain embodiments ease the production process. Nevertheless, in other embodiments the fastening element may also deviate from a rotationally symmetric design, for instance if it aids a specific production process.

[0017] In an embodiment, the groove has a groove height and a vertical height of the central section is configured to correspond to the groove height in order to

clampingly fasten the board to the support profile upon locking the fastening element to the support profile. The groove is bound in the vertical direction by a lower rim and an upper rim. The groove height is defined as a thickness of the lower rim abutting the support profile upon placing the board onto the support profile. The groove may be a linear groove extending along the lateral surface or alternatively the lateral surface may comprise one or more grooves placed at specific positions along the lateral surface. In the latter case, the fastening element is configured to be used in a board with the lower rim at varying positions.

[0018] In an embodiment, each of the flanges comprises a downwardly extending region configured to clampingly fasten a board to a support profile. The downwardly extending region has a slope defined by a height difference between a vertically highest point and a vertically lowest point of the downwardly extending region. The slope defines a clamping force applied to the board upon inserting the flange into the groove of the board in order to fasten the board to the support profile. The presence of the downwardly extending region allows using the fastening element for fastening boards of different groove height to the support profile. The generated clamping force will vary in this case such that higher groove heights result in higher clamping forces.

[0019] In an embodiment, each of the two flanges comprises an upwardly protruding lip along a free-standing end. The upwardly protruding lip facilitates insertion of the fastening elements into grooves of different shapes and/or sizes. In order to generate a sufficient clamping force to fasten the board to the support profile, the vertically lowest point of the downwardly extending region has to be located vertically below the groove. This may provide a problem when inserting the flange into the groove. Thus, the upwardly extending lip has been added to lift the free-standing ends of the flanges above the lower rim. Advantageously, the upwardly extending lip aids in placing the flange into the groove by promoting sliding of the flange over the lower rim and preventing traction of the free-standing ends over the lower rim.

[0020] In an embodiment, each of the two flanges further comprises a pair of perpendicular edges and wherein each perpendicular edge comprises a fixation region configured to prevent a movement of the board in a direction parallel to the groove of the board. Each of the fixation regions may be in a form of a notched area arranged, for instance, by applying a vertical force onto the flange area. The fixation regions may extend vertically below the lowest point of the downwardly extending region and may be configured to cut into the board when the flange is inserted into the groove. In this manner, the fixation prevents movement of the board in response to a transversal force trying to move the board along its elongate direction, i.e., the direction parallel to the groove of the board. Alternatively, the fastening element may have only two fixation regions arranged along outer perpendicular edges, wherein the outer perpendicular edges are the perpendicular edges of the flanges extending from distal ends of the central section.

[0021] In an embodiment, the channel opening is bound by a pair of inwardly extending rims, and wherein the support profile fastening section comprises a pair of recesses configured to accept the pair of inwardly extending rims in order to lock the fastening element to the support profile upon rotating the fastening element. In this manner, the fastening element can be locked to the support profile without use of any additional screws, nails, or similar fixation means. Additionally, the fastening element is easily removable from the support profile by rotating the fastening element in the opposite direction.

[0022] In an embodiment, the fastening element is configured to be freely rotatable in the channel of the support profile over a range of 360°. Advantageously, the fastening element may be rotated both clockwise or counterclockwise to fasten the board to the support profile in the second orientation.

[0023] In an embodiment, the support profile engaging section comprises a bottom strip with inwardly folded end portions configured to enable rotation of the fastening element around the first direction upon inserting the fastening element within the channel. Such a design of the support profile engaging section allows for a full rotation of the fastening element when inserted into the channel. The locking of the fastening element, on the other hand, only occurs for those locking angles for which the inwardly extending rims are at least partially placed with the pair of recesses.

[0024] In an embodiment, the fastening element further comprises a pair of spacers configured to space apart adjacent boards. Spaced apart adjacent boards are separated by an opening formed in between them. The opening can be used for ventilation, water drainage, and/or removal of dirt from the modular surface. The lateral surfaces may be arranged such to hide the fastening element from the modular surface while still maintaining the opening resulting in aesthetically more appealing modular surface. This is possible by using a board with asymmetrical lateral surfaces.

[0025] In an embodiment, the spacers are configured to space adjacent boards over a distance of less than 8 mm, preferably in a range between 3 and 5 mm. Previously, such a small spacing was not possible due to the construction of the central section. The central section of the fastening element according to the present invention allows for formation of extremely narrow openings as a width of the central section corresponds to a sheet thickness. The openings having a width in the above mentioned range are preferred in the construction of modular surfaces, as they are large enough to allow drainage of water and passage of dirt while small enough not to present a walking obstacle.

[0026] In an embodiment, the spacers are in a form of outwardly protruding regions extending from the central section. Optionally, the central section comprises two pairs of outwardly protruding spacers extending at oppo-

site sides of the central section.

[0027] In an embodiment, the fastening element further comprises one or more sliders arranged to facilitate sliding of the fastening element along a top surface of the support profile. The sliders may comprise upwardly folded ends to facilitate sliding of the fastening element along the support profile and to prevent abrasion, scaring and other types of mechanical degradation of the support profile and consequently, prolonging the life of the support profile.

[0028] In an embodiment, a length of the fastening element equals a width of the support profile. Advantageously, such a fastening element is configured to conceal the support profile from the modular surface making it more aesthetically appealing. In an embodiment, the length of the fastening element is between 30 and 50 mm, preferably around 40 mm and, optionally, wherein a width of the fastening element is between 15 and 21 mm, preferably around 18 mm.

[0029] In an embodiment, the central section comprises a reinforcement rib extending along the length of the central section. A reinforcement rib may be added to the central section, preferably, in a medial region of the central section. Since the fastening element is made of a single sheet of material, the medial region is more susceptible to buckling when applying force to connect or disconnect the fastening element from the board. The reinforcement rib is, thus, added to prevent this unwanted deformation of the fastening element during installation or removal procedure and allow re-use of the fastening element.

[0030] In an embodiment, the fastening element is made of metal, preferably stainless steel, and more preferably stainless spring steel. The material properties and the design features of the flanges provide sufficient clamping force for fastening boards of different sizes, weights, and edge profiles. Further, the stainless spring steel allows using thinner sheets for forming the fastening elements. In a further embodiment, a thickness of the sheet is in a range between 0.5 mm and 0.75 mm, preferably around 0.6 mm. This thickness is sufficient for forming resilient fastening element while allowing easy attachment to the board. The fastening element according to the present invention can be used for fastening boards made of different materials such as different types of wood including bamboo, composites, plastic materials, ceramics, and similar. Alternatively, the fastening element may be made of plastics, composites, or similar materials.

[0031] According to a second aspect of the invention, and in accordance with the advantages described herein above, there is provided a kit for installing a modular surface, the kit comprising a plurality of fastening elements and a plurality of support profiles configured to cooperate with a fastening element according to the invention.

[0032] In an embodiment, the support profile comprises a channel opening along a first direction, the channel opening being bound by a pair of inwardly extending rims, and wherein each of the inwardly extending rims comprises an anti-shedding protrusion along the first direction configured to prevent degradation of the support profile upon sliding the fastening element along the support profile.

[0033] In an embodiment, the support profile is made of metal, for instance aluminium, wood or plastic.

[0034] In an embodiment, the kit further comprises a plurality of boards configured to be placed in a sequence along the at least one support profile, wherein each of the boards comprises at least one lateral surface with a groove therein.

[0035] In an embodiment, the board engaging section of the at least one fastening element comprises two flanges configured to fit within the grooves of neighbouring boards placed in the sequence in order to fasten the neighbouring boards to the at least one support profile upon rotating the at least one fastening element around a second direction perpendicular to the first direction. This enables quick installation.

[0036] According to a third aspect of the invention, and in accordance with the advantages described herein above, there is provided a modular surface comprising a plurality of fastening elements according to the invention, or assembled using a kit according to the invention. For example, the modular surfaces may be a floor, a wall or a ceiling. However, the fastening element and the kit according to the present invention could be easily used for construction of other modular surfaces.

Brief description of drawings

[0037] The present invention will be discussed in more detail below, with reference to the attached drawings, in which:

Figure 1A depicts a perspective view of a modular surface according to a first embodiment of the present invention;

Figure 1B depicts a cross sectional side view of the modular surface of Figure 1A;

Figure 1C depicts a cross sectional front view of the modular surface of Figure 1A;

Figure 2A depicts in a perspective view a fastening element according to a first embodiment of the invention;

Figure 2B depicts in a top view the fastening element of Figure 2A;

Figure 2C depicts in a side view the fastening element of Figure 2A;

Figure 2D depicts in a perspective view the fastening element of Figure 2A as seen from below;

Figure 2E depicts in a front view the fastening element of Figure 2A;

Figure 3 depicts three steps of inserting a fastening element into a channel of a support profile, including a step prior to inserting the fastening element into a channel of a support profile, upon insertion, and upon rotating the fastening element to lock the fastening element to the support profile;

Figure 4 depicts in a schematic view a modular surface comprising a misaligned support profile;

Figure 5 depicts in a cross sectional side view a second embodiment of a modular surface according to the present invention;

Figure 6A depicts in a perspective view a second embodiment of a fastening element, which can be used to fasten boards in the modular surface according to the second embodiment in Figure 5;

Figure 6B depicts in a top view the fastening element of Figure 6A;

Figure 6C depicts in a side view the fastening element of Figure 6A; and

Figure 6D depicts in a front view the fastening element of Figure 6A.

[0038] The figures are meant for illustrative purposes only, and do not serve as restriction of the scope or the protection as laid down by the claims.

Description of embodiments

[0039] The invention will be explained in more detail below with reference to drawings in which illustrative embodiments thereof are shown. The drawings are intended exclusively for illustrative purposes and not as a restriction of the inventive concept which is to cover all modifications, equivalents, and alternatives falling within the scope of the present invention. The scope of the invention is only limited by the definitions presented in the appended claims.

[0040] Figure 1A shows a section of a modular surface 90 according to a first embodiment and formed using a plurality of boards 70 placed in a sequence along a plurality of support profiles 40 that are substantially parallel. The boards 70 are fixed to the support profiles 40 by fastening elements as shown further below. The support profiles 40 are elongate and extend along a longitudinal direction X. The boards 70 are also elongate and arranged along a transverse direction Y perpendicular to the longitudinal direction X. The space between adjacent boards 70 is relatively narrow, and consequently the fastening elements are entirely or almost concealed from view.

[0041] Figure 1B shows a cross sectional side view of the modular surface 90 of Figure 1A comprising a plurality of fastening elements 10 according to the present invention. Each board 70 comprises a profile facing side 76, an outer surface forming side 78, and two lateral surfaces 80A, 80B. Each of the lateral surfaces 80A, 80B is provided with a groove 72 bound in a vertical direction Z by a lower rim 74A and an upper rim 74B. A groove height d, i.e., a thickness of the lower rim 74A, is 7 mm and a depth l of the groove is 9 mm. Nevertheless, the fastening element 10 may be used to fasten boards 70 having a groove height d in a range between 6 mm and 8.5 mm and a depth l in a range between 5 and 10 mm. The fastening element 10 comprises a central section 18, a board engaging section 12 having upper flanges 16A, 16B, and a support profile engaging section 14. The upper flanges 16A, 16B are configured to engage in the grooves 72 of a board 70 to clamp the boards 70 on the support profiles 40 and combine a plurality of boards 70 into a modular surface 90. The fastening element 10 is configured to form an opening 92 in the modular surface 90 between each two boards 70 placed in the sequence. The opening 92 allows for a ventilation but also drainage of water and dirt from the modular surface 90. An opening width t in the longitudinal direction X is around 4 mm. This is sufficiently narrow for the fastening element 10 to be invisible by a person standing on top of a board 70.

[0042] Figure 1C shows part of a cross sectional front view of the modular surface 90 in Fig. 1A. The support profiles 40 have a form of joists having a channel 42 that extends along the longitudinal direction X in between upwardly extending walls 41A, 41B and a pair of inwardly extending rims 44A, 44B defining a channel opening 43 at a top side of the support profile 40. The channel 42 may be characterized by an inner channel width Wi and a channel opening width Wc. The inner channel width Wi is measured as a transversal distance between the upwardly extending walls 41A, 41B. The channel opening width Wc, on the other hand, is defined as the distance between the inwardly extending rims 44A, 44B. The support profile engaging section 14 of the fastening element 10 is configured to be entered into the channel 42 through the channel opening 43 in a first orientation, and, after rotation of the fastening element 10 around the vertical direction Z, lock itself in the channel 42 in a second orientation. Specific details of the method for fastening the fastening element 10 are discussed in relation to Figure 3 below.

[0043] Each of the inwardly extending rims 44A, 44B includes an anti-shedding protrusion 46A, 46B extending along a channel facing side of each of the inwardly extending rim 44A, 44B to prevent degradation of the channel facing side of the support profile 40 due to sliding motion of the fastening element 10.

[0044] Figure 2A shows a perspective view of the fastening element 10 in the modular surface 90 in Fig. 1A-1C. The fastening element 10 is made of a single sheet

of stainless spring steel, which is cut into a specific shape and bent to form the sections 12, 14, 18. The board engaging section 12 is provided at an upper side of the central section 18, and the support profile engaging section 14 is provided at a lower side of the central section 18.

[0045] Figures 2B and 2C respectively show a top and side view of the fastening element 10. The central section 18 is formed by a flat portion of the sheet of stainless spring steel. The board engaging section 12 comprises at least two upper flanges 16A, 16B. The upper flanges 16A, 16B extend in opposite directions from the central section 18. The two flanges 16A, 16B are formed by cutting the sheet adjacent to the central section 18 to form two portions, followed by bending the two portions in opposite directions with respect to the central section 18. Consequently, the flanges 16A, 16B do not extend along the full length L of the central section 18. Instead, each of the flanges 16A, 16B extends along a flange length La, Lb of approximately half of the length L of the central section 18. The skilled person will understand that other ratios of flange lengths La, Lb are possible, and that in embodiments also more than two flanges may be provided. Preferably, the flange lengths of all flanges sum to the total length L. This allows the fastening element to be manufactured by bending a single sheet of material.

[0046] Even though the flanges 16A, 16B do not extend along the whole length L of the fastening element 10, the fastening performance of the fastening element 10 is sufficient. Advantageously, the manner in which the flanges and the central section are produced, i.e. by cutting a single sheet of material significantly reduces the material usage when manufacturing the fastening elements compared to similar fastening elements having the flanges along the whole length of the fastening element and/or having a multi-layered central section and flanges that extend from different layers of the central section. Furthermore, the length L is chosen to agree with a width of the support profile 40 in order to conceal the support profile 40 from the modular surface 90 making it more aesthetically appealing.

[0047] As shown in Figure 2C, each of the flanges 16A, 16B has a free standing end 29A, 29B, and further comprises a downwardly extending region 22A, 22B and an upwardly protruding lip 24A, 24B between the central section 18 and the free standing end 29A, 29B. The downwardly extending region 22A, 22B is used to create a clamping force for fastening a board to a support profile 40 when the fastening element 10 is in use. The downwardly extending region 22A, 22B extends from the central section 18. The flanges 16A,16B have a maximal flange height hc defined as the distance between a top of the flange 16A, 16B near the free standing end 29A, 29B and a lower edge 17 of the central section. The flanges 16A, 16B have a minimal flange height hf, measured between the downwardly extending region 22A, 22B and the lower edge 17 of the central section 18. The difference between the two heights generates a clamping force upon inserting the flange 16A, 16B into the groove 72 of the board 70.

[0048] In the depicted embodiment the minimal flange height hf is between 5 and 5.5 mm. As such, the fastening element 10 can be used to fasten boards having a groove height d of at least 6 mm and up 8.5 mm. The flexibility to use a fastening element in boards 70 having different groove heights is further facilitated by the upwardly protruding lips 24A, 24B extending from the downwardly extending regions 22A, 22B up to free-standing ends 29A, 29B of the flanges 16A, 16B. A flange width W, as best seen in Fig. 2B, may be defined as the distance between the plane of the central section 18 and the free-standing end 29A, 29B of each flange 16A, 16B.

[0049] Each flange 16A, 16B may have one or more fixation regions arranged to cut into the board in response to a transversal force trying to move the board in the transversal direction Y and in this way prevent movement of the board in this direction. Such fixation regions may be located around perpendicular edges 27A, 27B, 27C, 27D of the flanges 16A, 16B in a region having the minimal flange height hf, for example at a position indicated as 36A, 36B, 36C, 36D.

[0050] The central section 18 substantially extends in a single plane, yet comprises a pair of end spacers 28A, 28B, a pair of medial spacers 30A, 30B protruding from it and arranged to create a longitudinal distance between neighbouring boards fastened to the support profile. In this context, the term "substantially" is used to indicate that the central section 18 may comprise portions protruding from the single plane. The central section 18 further comprises a pair of sliders 26A, 26B protruding from the central section 18.

[0051] Figure 2D shows a perspective view of the fastening element 10 from below. Figure 2E shows a front view. The end spacers 28A, 28B are located at opposite ends of the central section 18 along the length of the fastening element and protrude to opposite sides of the central section 18. The medial spacers 30A, 30B are located away from the ends of the central section 18, and similarly to the end spacers 28A, 28B, protrude to opposite sides of the central section 18. In such a way two spacers 28A, 30A protrude to one side of the central section 18 and the other two spacers 28B, 30B protrude to the other side of the central section 18. The role of the spacers 28A, 28B, 30A, 30B is to block further penetration of the lower rim 74A under the flange 16A, 16B when fastening the fastening element 10 to the board 70 to form the opening 92. Thus, the opening width t corresponds to a spacers protrusion width ts as shown in Figure 2C. Advantageous to the presence of the spacers 28A, 28B, 30A, 30B, is that the opening width t between adjacent boards 70 is controlled, leading to a constant opening width t across all boards 70. This is aesthetically attractive.

[0052] Along the lower edge 17 of the central section 18, the fastening element 10 has two sliders 26A, 26B arranged on opposite sides of the central section 18. The sliders 26A, 26B have upwardly folded ends to facilitate

sliding of the fastening element 10 along the support profile 40 and to prevent abrasion, scaring, and other types of mechanical degradation of the support profile 40. A reinforcement rib 32 is added to the central section 18 around a mid-point of the central section 18. Since the fastening element 10 is made of a single sheet of material, a medial region of the fastening element 10 is susceptible to buckling when applying force to connect or disconnect the fastening element 10 from the board 70. The reinforcement rib 32 is, thus, added to prevent this unwanted deformation of the fastening element 10 during installation or removal procedure and allow re-use of the fastening element 10.

[0053] The support profile engaging section 14 includes a bottom strip 21 extending substantially vertically and having inwardly folded end portions 23A, 23B. The inwardly folded end portions 23 A,B are folded in opposite sides of the bottom strip 21. Such a shape of the support profile engaging section 14 facilitates a rotational degree of freedom of the fastening element 10 within the channel 42. A folded ends width Wf (see Fig. 2C) may be defined as a distance between free-standing ends of the inwardly folded end portions 23A, 23B as measured along a first direction. Additionally, a bottom strip width Wb (see Fig. 2E) may be defined as a width of the bottom strip 21 along a second direction perpendicular to the first direction. The folded ends width Wf is arranged to be smaller than both the bottom strip width Wb and the channel opening width Wc. As such, the support profile engaging section 18 of the fastening element 10 is configured to pass through the channel opening in the support profile in a first orientation of the fastening element. The bottom strip width Wb is arranged to be larger than the channel opening width Wc and the support profile engaging section 14 further comprises two recesses 34A, 34B forming a region with narrowed width Wr between them. Widths of the features of the support profile engaging section 14 are arranged such that the folded ends width Wf is smaller or similar to the recessed region width Wr and the recessed region width Wr is smaller than the bottom strip width Wb. As such, the support profile engaging section 18 of the fastening element is configured to lock the fastening element 10 to the support profile 40 upon rotation of the fastening element to a second orientation.

[0054] The fastening element 10 has rotational symmetry in the horizontal plane. This is convenient from an installation point of view as the rotationally symmetrical fastening element allows a user to quickly connect it to the support profile without need to properly orient the fastening element before engaging it with the support profile. This saves time and prevents construction faults due to improperly positioned fastening element.

[0055] Fig. 3 illustrates a method for installing the fastening element 10 in a support profile 40. In Step 1, the fastening element 10 is in a first orientation having the central section 18 of the fastening element 10 aligned with the channel 42. The folded ends width Wf is smaller than the channel opening width Wc and the bottom strip 21 can therefore be placed within the channel 42 such that the recesses 34A, 34B of the fastening element 10 are levelled with the inwardly extending rims 44A, 44B of the support profile 40 as shown in Step 2. In Step 3, a rotation R of the fastening element 10 around the vertical direction Z is performed by an angle of approximately 90° to bring the fastening element 10 to a second orientation. The fastening element 10 in Step 3 is oriented substantially perpendicular to the fastening element 10 in Step 1. By doing so, the inwardly extending rims 44A, 44B are placed within the recesses 34A, 34B thereby locking the fastening element 10 to the support profile 40. A vertical width of the recesses 34A, 34B is slightly larger than a thickness of the inwardly extending rims 44A, 44B for a smooth sliding of the fastening element 10 along the support profile 40 and towards the board 70. Nonetheless, when in the locked position, a minimal vertical distance between the support profile 40 and the flange 16A, 16B will correspond to the minimal flange height hf. The sliding of the fastening element 10 is additionally facilitated by insertion of the sliders 26A, 26B. After engaging a fastening element 10 to a support profile 40, a board 70 may be pushed toward the fastening element 10 to fasten the board 70 to the support profile 40.

[0056] It should be noted that the recessed region width Wr and the bottom strip width Wb may be arranged to allow locking of the fastening element to the support profile 40 upon rotating the fastening element 10 also over an angle different to 90 degrees. Typically, the central section 18 is approximately parallel to the longitudinal axis X in the first orientation, and makes an angle with the transverse axis Y in a range between -30° and 30° in the second orientation. This is advantageous, as it allows for misalignments between a plurality of support profiles 40.

[0057] This is further illustrated in Figure 4 showing a top view of a section of the modular surface 90. The modular surface 90 is formed by parallelly aligning two support profiles 40A, 40B with a third support profile 40C being misaligned with the other two support profiles by a misalignment angle α. Nonetheless, the fastening element 10 according to the present invention is capable of overcoming this situation and fastening the boards 70 even to the misaligned third support profile 40C. The following procedure is used. The boards 70 are placed over the support profiles 40A, 40B, 40C by perpendicularly aligning lateral surfaces 80A, 80B with the two aligned support profiles 40A, 40B and fasten to them using fastening elements 10, similarly as shown in Figures 1A-1C. Each of the fastening elements 10 is arranged in the first orientation and inserted into the channel 42 of each of the support profiles 40A, 40B, 40C and rotated to a second orientation to lock the fastening element to the support profile 40A, 40B, 40C. Upon rotation, the central section 18 encloses a locking angle β between the support profile 40A, 40B, 40C and the fastening element 10. For the two aligned support profiles 40A, 40B, a first locking angle $\beta 1$ is approximately 90° and the fastening element

10 in the second orientation is perpendicular to the fastening element 10 in the first orientation. For the third support profile 40C, the fastening element 10 in the first orientation has to be rotated by a second locking angle $\beta 2$ equal to the first locking angle $\beta 1$ adjusted by the misalignment angle α. Advantageously, the fastening element 10 according to the present invention is able to fasten the board 70 to the misaligned support profile 40C by adjusting the rotation to the second orientation by an angle in a range between approximately -30° and 30°. Note that the adjustment angle corresponds to the misalignment angle α. This is achieved by designing the support profile engaging section 14 in a form of a substantially vertical strip with an inwardly folded end portions 23A, 23B enabling 360° rotation of the fastening element 10 within the channel 42. The locking angle β is then determined based on the channel opening width Wc and the inner channel width Wi or, in other words, as long as the inwardly extending rims 44A, 44B are within the recesses 34A, 34B.

[0058] Although the modular surface 90 shown in Figures 1A-1C has only narrow openings 92 between the boards 70, different boards may be used configured to completely hide the fastening element 10 and the support profile 40 when the modular surface 90 is in use while leaving the opening for ventilation and drainage. Figure 5 shows one such modular surface 190 according to another embodiment of the present invention. Features in the modular surface or fastening element that have already been described above with reference to the previous embodiment shown in Figures 1-4 above may also be present in the modular surface 190 and fastening element 110 shown in Figures 5 and 6, and will not all be discussed here again. Like features are designated with similar reference numerals preceded by 100, to distinguish the embodiments.

[0059] Figure 5 shows a section of the modular surface 190 formed using the fastening elements 110, the support profile 140, and two boards 170 placed in a sequence. Unlike the board shown in Figures 1A-1C, the boards 170 have asymmetric lateral surfaces 180A, 180B. A first lateral surface 180A comprises a first lower rim 174C, a first upper rim 174D, and a first groove 172A therebetween. A second lateral surface 180B comprises a second lower rim 174A, a second upper rim 174B, and a second groove 172B therebetween. In both lateral surfaces 180A, 180B, the lower rim 174A, 174C has a different length than the upper rim 174B, 174D. The first lower rim 174C and the second lower rim 174A are similar and resemble the lower rims 74A of the boards 70 according to the previous embodiment. The first upper rim 174D and the second upper rim 174B extend over the first lower rim 174C and the second lower rim 174A, respectively, and have complementary rim shapes configured to keep the fastening element 110 hidden when seen from the modular surface 190 and, consequently, aesthetically more appealable to a user. This is achieved by positioning a periphery 182B of the second upper rim 174B of a board 170 vertically below a periphery 182A of the first upper rim 174D of the next board 170 placed in the sequence. The two peripheries 182A, 182B are separated by the opening 192 upon fastening the neighbouring boards 170 to the support profile 140 using fastening elements 110.

[0060] A different board profile as depicted in Fig. 5 only requires minor adjustments to the fastening element. Typically, such adjustments are significantly minor that a fastening element could be made using the same machines as for the fastening element according to the first embodiment, albeit using different machine settings. Alternatively, separate machines may be used.

[0061] Figures 6A-6D show the fastening element 110 according to a second embodiment of the present invention. The flange 116A, 116B comprises three regions: a perpendicular flange region 125A, 125B connected to the central section 118, the upwardly protruding lip 124A, 124B along the free-standing end 129A, 129B of the flange 116A, 116B, and the downwardly extending region 122A, 122B in between them. The spacers 128A,128B, 130A, 130B are arranged differently compared to the previous embodiment. The spacers 128A,128B, 130A, 130B are all arranged along the bottom edge 117 of the central region 118. Additionally, the two end spacers 128A,128B are folded to protrude from the same side of the central section 118 while the two medial spacers 130A, 130B are both folded to protrude from other side of the central region 118. It will be understood by the skilled person, however, that other positions and folding configurations are possible, in particular, the configuration described in the previous embodiment and as shown in Figures 2A-E.

[0062] A free-standing end of each of the spacers 128A, 128B, 130A, 130B is folded upwardly to facilitate sliding of the fastening element 110 along a support profile 140, similarly as achieved by the sliders 26 A, B shown in Figures 2A-2E. It should be noted that due difference in the rims 174A-174D of the boards 170, the flange width W of the fastening element 110 is larger compared to the flange width W of the fastening element 10 according to the previous embodiment. Consequently, the perpendicular regions 125A, 125B are added to flanges 116A, 116B in order to maintain slope of the downwardly extending regions 122A, 122B and the clamping force generated upon fastening the board 170 as in the previous embodiment and at the same time to keep the difference between the maximal flange height hc and the minimal flange height hf in a reasonable range in order to fit the flange 116A, 116B into the groove 172A, 172B. Otherwise, a large increase of this difference would require increase of a thickness of the board. The depicted embodiment has a reinforcement rib 132, but would not need to have one as it is also sufficiently strong without it, mainly due to the perpendicular regions 125A, 125B.

[0063] As mentioned above, the fastening elements 10, 110 according to both embodiments of the present invention can be produced using the same machinery by carrying out small adjustments. Additionally, the same

tools can be used for attaching the two fastening elements 10, 110 to the support profile and for removing them from the board 70, 170 when disassembling the modular surface 90, 190. A suitable tool may have a crawbar-like first end for removing of the fastening element 10, 110 from the board 70, 170 and a second end may be configured for delivering force to the fastening element 10, 110 when attaching it to the board 70, 170.

[0064] The fastening element 10, 110 according to both embodiments is made of a single sheet of stainless spring steel, which is cut into a specific shape and bent to form its sections. This results in an easy manufacturing of the fastening element 10 without a need for a use of a complex machinery or a time-consuming manufacturing process. The fastening element can be completely manufactured on a single production line or on a single machine wherein the fastening elements 10, 110 are serially produced in a step-by-step fashion. As the fastening element 10, 110 is made from a single type of material, it is also easy to recycle it at the end of its life cycle.

[0065] Although not shown, the modular surfaces 90, 190 may comprise end fasteners placed before a first board and after a last board placed in the sequence. The end fasteners provide additional stability to the modular surfaces 90, 190 and prevent movement of the board in the longitudinal direction X. Additionally, the end fasteners may be placed along transversal ends of the modular surface 90, 190 prevent transversal movement of the boards. To further suppress the transversal movement of the boards, optionally one or more fixation regions 36A, 36B, 36C, 36D may be applied as discussed in relation to Figure 2 above.

[0066] The present invention may be embodied in other specific forms without departing from its essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive to the inventive concept. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. It will be apparent to the person skilled in the art that alternative and equivalent embodiments of the invention can be conceived and reduced to practice. In addition, many modifications may be made to adapt a particular configuration or material to the teachings of the invention without departing from the essential scope thereof.

[0067] All modifications which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

Claims

1. A fastening element for fastening boards to a support profile to form a modular surface, the fastening element comprising a central section, a board engaging section, and a support profile engaging section,

   wherein the central section is formed of a single sheet of material and connects the support profile engaging section to the board engaging section,

   wherein the board engaging section comprises at least two flanges extending in opposite directions with respect to the central section, each of the flanges configured to enter within a groove provided in a lateral surface of a board, and

   wherein the support profile engaging section is configured to pass through a channel opening in a support profile in a first orientation and to lock the fastening element to the support profile upon rotating the fastening element to a second orientation.

2. The fastening element according to claim 1, wherein the second orientation is substantially perpendicular to the first orientation, and/or wherein the fastening element is locked after rotating the fastening element over an angle of at least 30 degrees, at least 45 degrees, or at least 60 degrees.

3. The fastening element according to any of the preceding claims, wherein the central section substantially extends in a single plane, preferably wherein an elongate direction of the support profile defines a longitudinal axis, and a transverse axis is defined perpendicular to the longitudinal axis, wherein the single plane of the central section is aligned with the longitudinal axis in the first orientation, and wherein the single plane makes an angle with the transverse axis in a range between -30° and 30° in the second orientation.

4. The fastening element according to any of the preceding claims, wherein the fastening element is formed from a single sheet of material.

5. The fastening element according to any of the preceding claims, wherein the two flanges are spaced along the central section.

6. The fastening element according to any one of the preceding claims, wherein the groove has a groove height and wherein a vertical height of the central section is configured to correspond to the groove height in order to clampingly fasten the board to the support profile upon locking the fastening element to the support profile.

7. The fastening element according to any of the preceding claims, wherein each of the flanges comprises

   - a downwardly extending region configured to clampingly fasten a board to a support profile, and/or
   - an upwardly protruding lip along a free-stand-

ing end, and/or
- a pair of perpendicular edges and wherein each perpendicular edge comprises a fixation region configured to prevent a movement of the board in a direction parallel to the groove of the board.

8. The fastening element according to any of the preceding claims, wherein the channel is bound by a pair of inwardly extending rims, and wherein the support profile fastening section comprises a pair of recesses configured to accept the pair of inwardly extending rims in order to lock the fastening element to the support profile upon rotating the fastening element.

9. The fastening element according to any of the preceding claims, wherein the fastening element is configured to be freely rotatable in the channel of the support profile over a range of 360 degrees, preferably wherein the support profile engaging portion comprises a bottom strip with inwardly folded end portions configured to enable rotation of the fastening element to the second orientation upon inserting the fastening element within the channel.

10. The fastening element according to any of the preceding claims, further comprising a pair of spacers configured to space apart adjacent boards, preferably wherein the spacers are configured to space adjacent boards over a distance of less than 8 mm, more preferably in a range between 3 and 5 mm, and/or
wherein the spacers are in a form of outwardly protruding regions extending from the central section and optionally, wherein the central section comprises two pairs of outwardly protruding spacers extending at opposite sides of the central section.

11. The fastening element according to any of the preceding claims, wherein the fastening element further comprises one or more sliders arranged to facilitate sliding of the fastening element along a top surface of the support profile.

12. A kit for installing a modular surface, the kit comprising a plurality of fastening elements according to any of the preceding claims and a plurality of support profiles configured to cooperate with a fastening element according to any one of the preceding claims for installing the modular surface.

13. The kit according to claim 12, wherein the support profile comprises a channel opening along a first direction, the channel opening being bound by a pair of inwardly extending rims, and wherein each of the inwardly extending rims comprises an anti-shedding protrusion along the first direction configured to prevent degradation of the support profile upon sliding the fastening element along the support profile.

14. The kit according to claim any one of claims 12 or 13, wherein the kit further comprises a plurality of boards configured to be placed in a sequence along the at least one support profile, wherein each of the boards comprises at least two lateral surfaces with a groove therein.

15. A modular surface comprising a plurality of fastening elements according to any one of claims 1-11, or assembled using a kit according to any one of claims 12-14, preferably wherein the modular surface is a floor, a wall, a fence, or a ceiling.

Fig. 1A

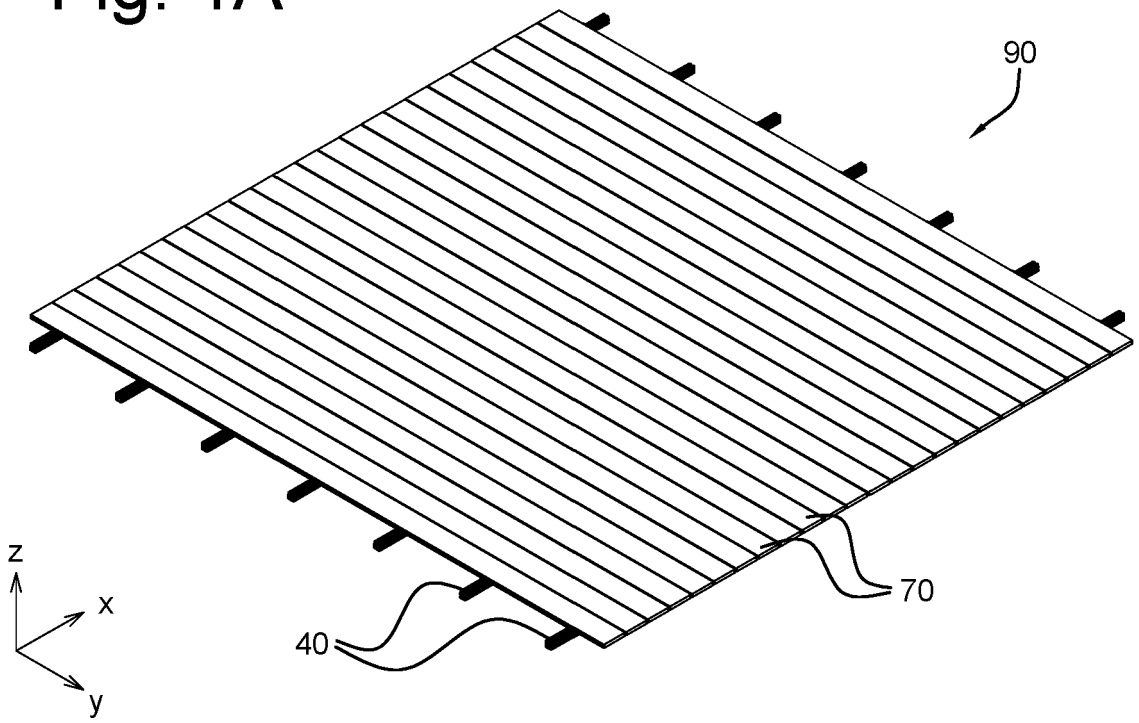
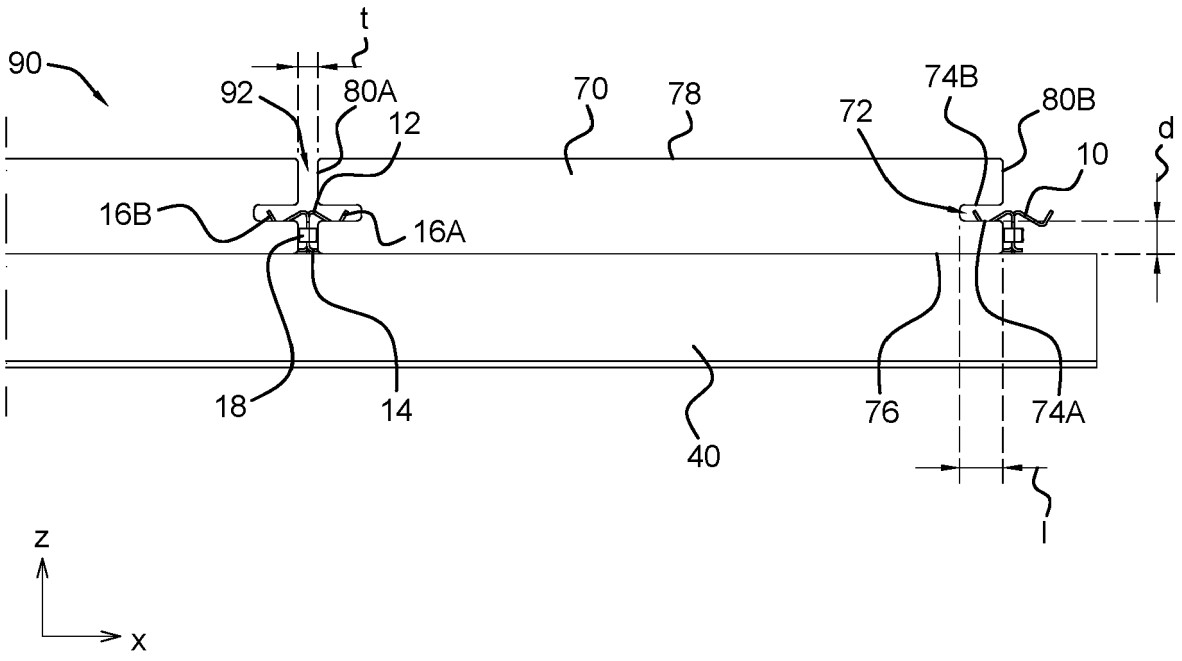

90
70
40
z
x
y

Fig. 1B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12
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d
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16A
18
14
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74A
l
z
x

Fig. 1C

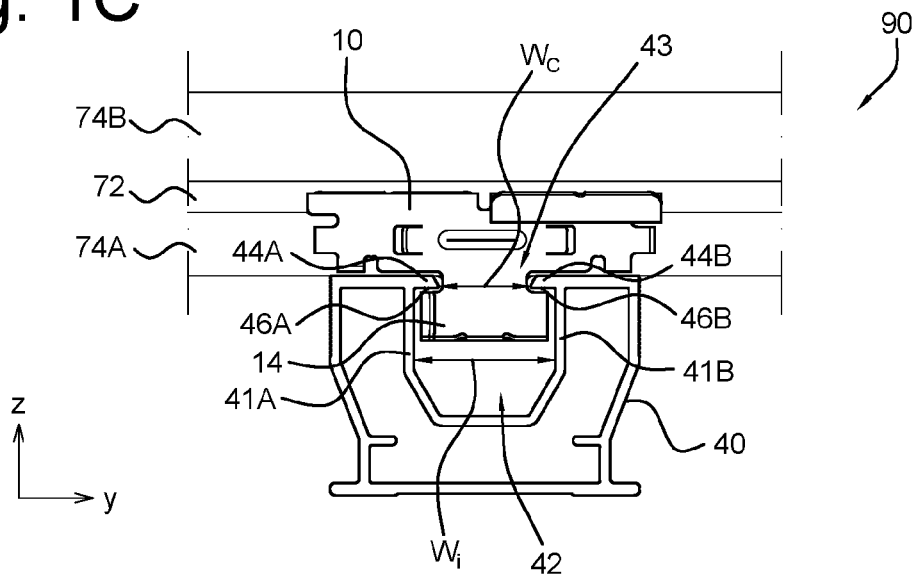


Fig. 2A

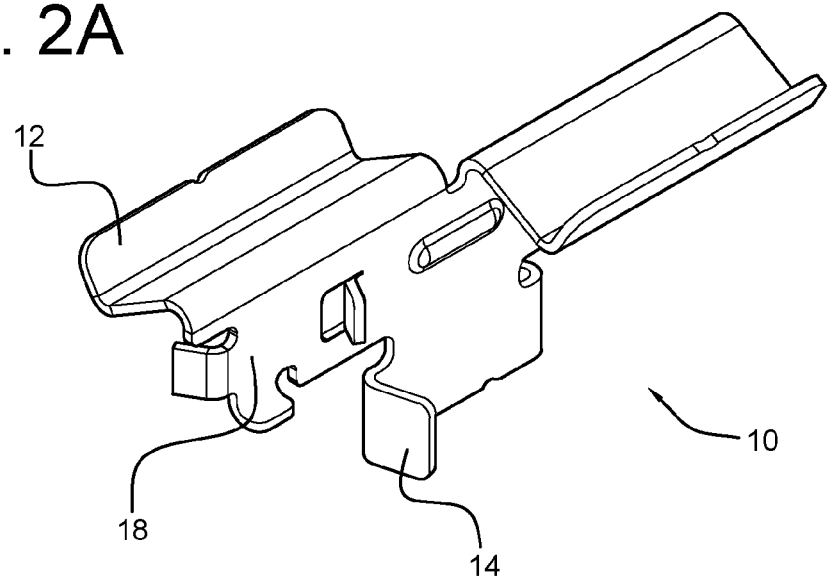


Fig. 2B

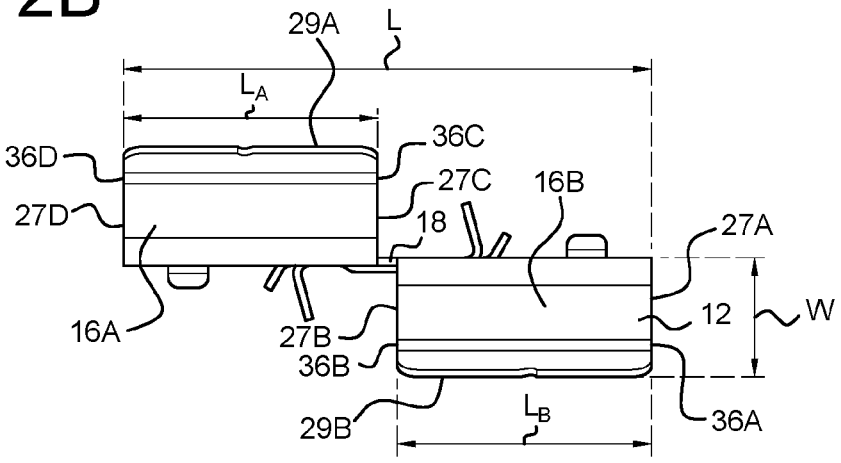


Fig. 2C

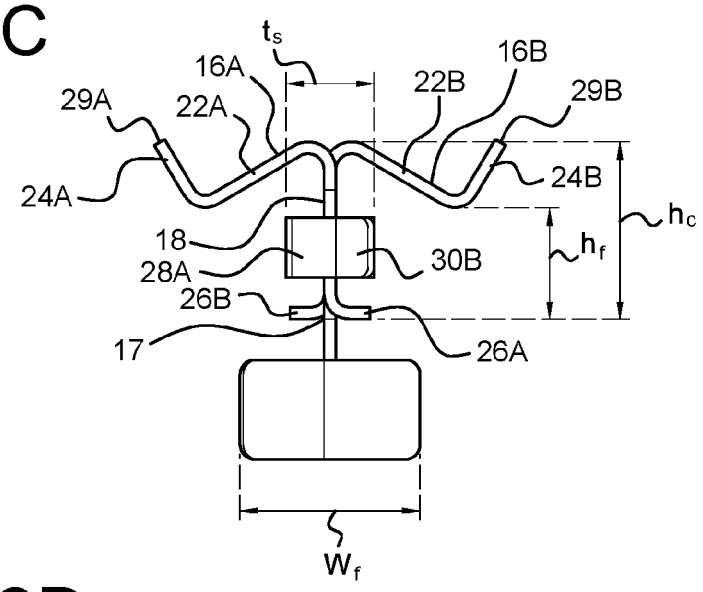


Fig. 2D

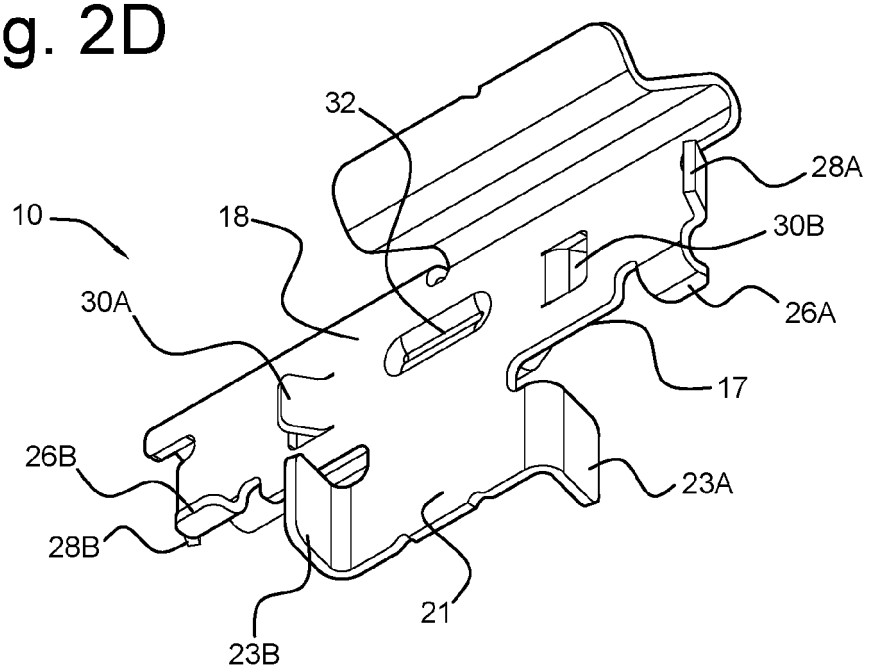


Fig. 2E

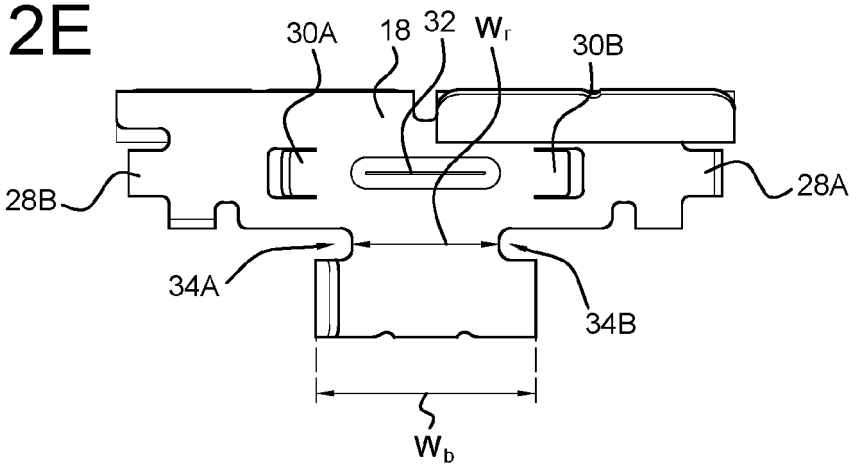


Fig. 3

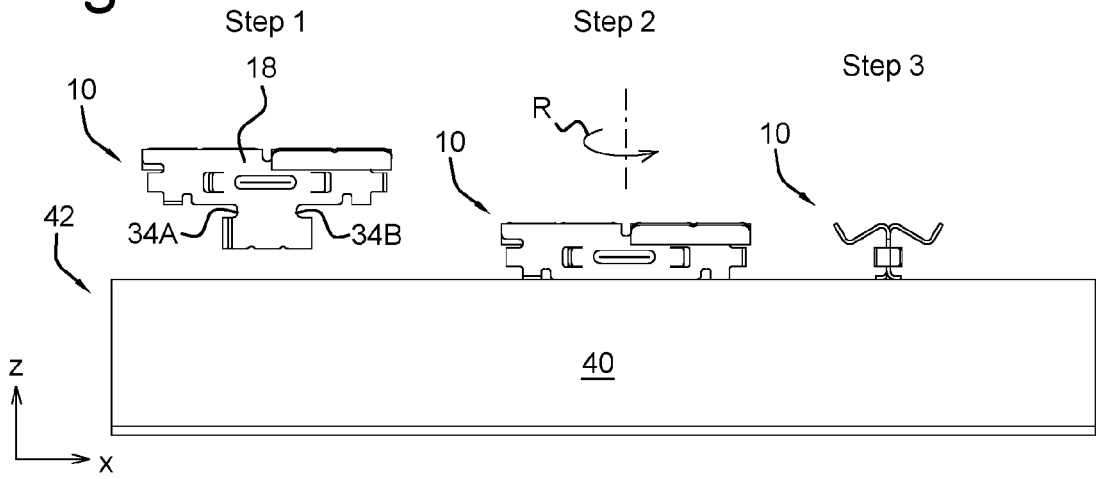


Fig. 4

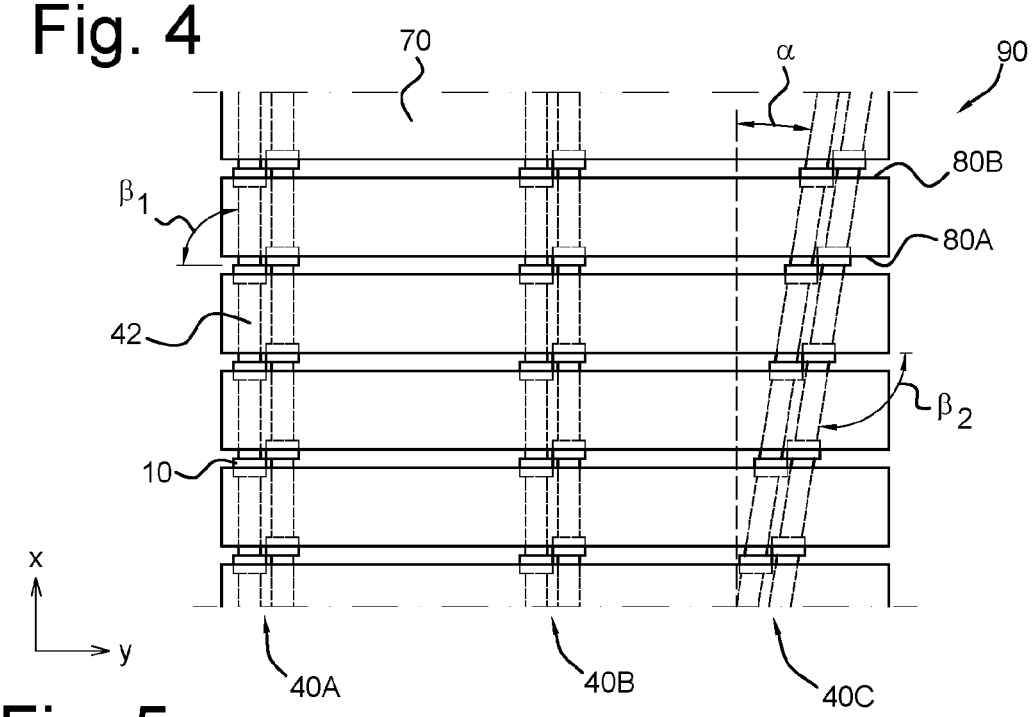


Fig. 5

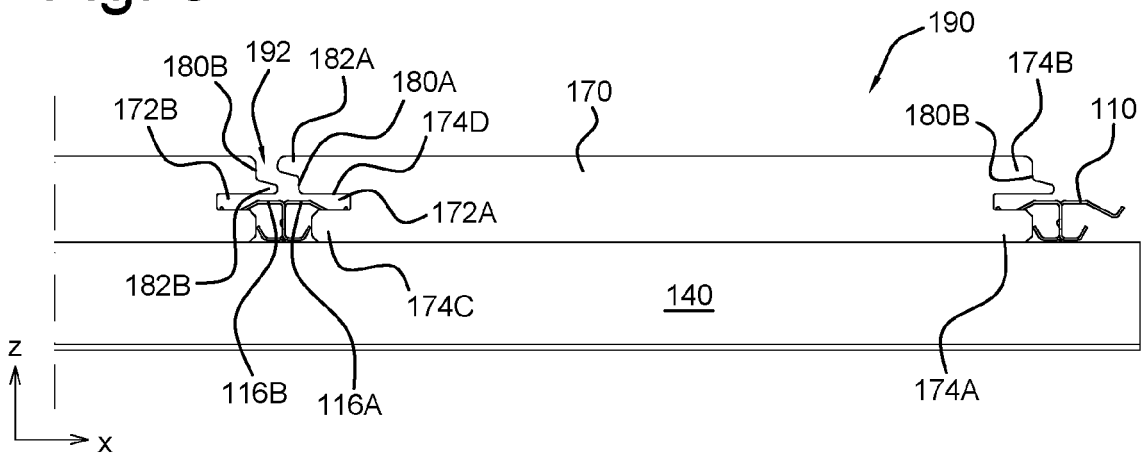


Fig. 6A

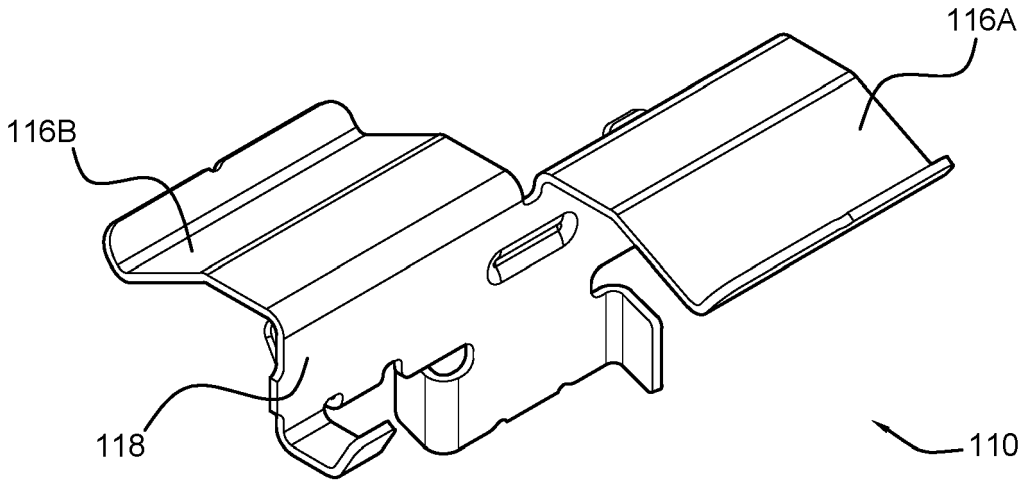
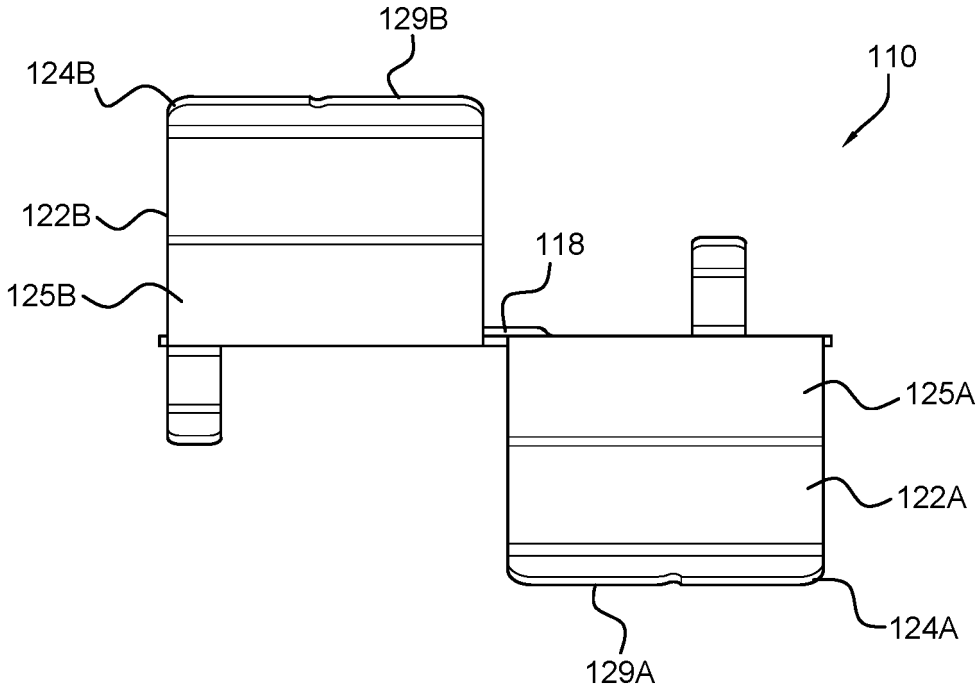

116A
116B
118
110

Fig. 6B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122B
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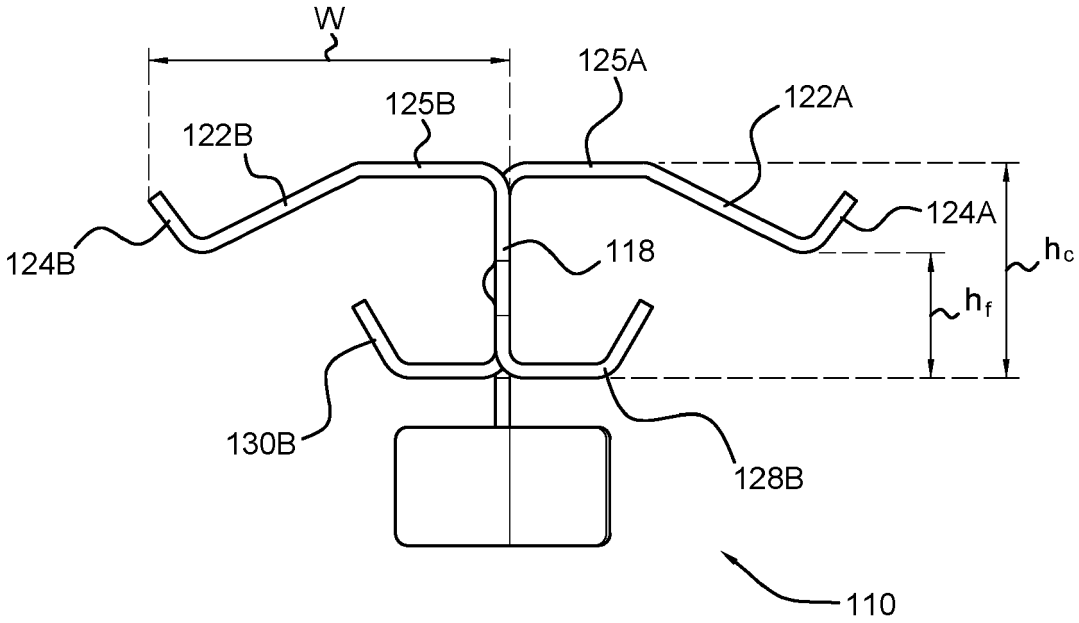
125B
125A
122A
124A
129A

Fig. 6C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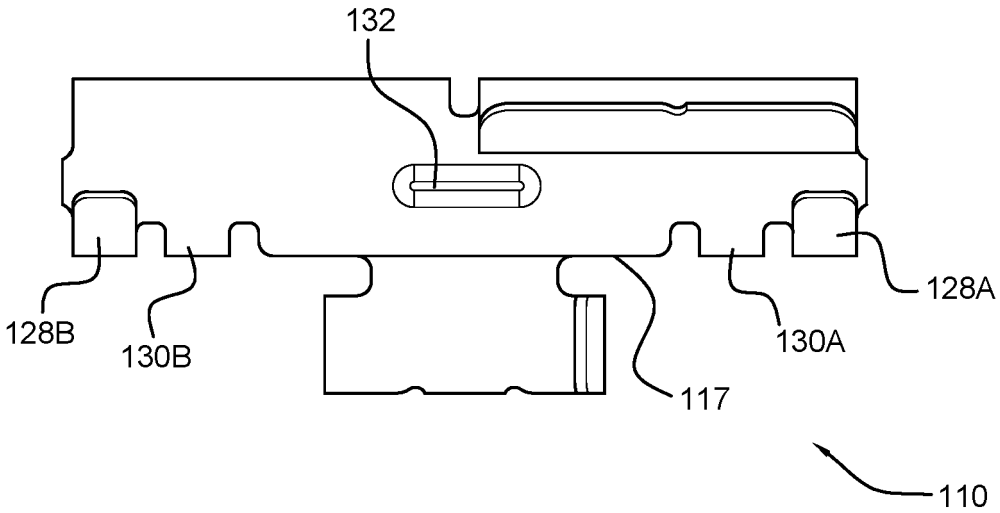
122A
122B
124A
124B
118
h_c
h_f
130B
128B
110

Fig. 6D


132
128A
128B
130B
130A
117
110

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EUROPEAN SEARCH REPORT

Application Number
EP 23 19 6157

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 Y	US 3 267 630 A (OMHOLT RAY E) 23 August 1966 (1966-08-23) * figures 1-4 * * column 1, line 62 - column 2, line 10 * * column 2, line 15 - line 29 * * column 3, line 17 - line 23 *	1-6,8,9, 12,14,15 7,10,11, 13	INV. E04F15/02 E04F13/08
Y	WO 2018/158149 A1 (BOLE OUE [EE]; SILVERNET GROUP OUE [EE]) 7 September 2018 (2018-09-07) * figures 1-3,9 * * paragraph [0039] - paragraph [0040] *	7	
Y	JP 2008 106556 A (FUSAYA KK) 8 May 2008 (2008-05-08) * figures 1,2,11,13 * * paragraph [0011] * * paragraph [0014] *	10	
Y	DE 20 2007 002282 U1 (MOELLER GMBH & CO KG [DE]) 19 June 2008 (2008-06-19) * figures 5-6 * * paragraph [0051] *	11	TECHNICAL FIELDS SEARCHED (IPC) E04F
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	14 September 2023	Estorgues, Marlène

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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14-09-2023

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