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(54) Title: A ROOF, WALL OR FAÇADE STRUCTURE

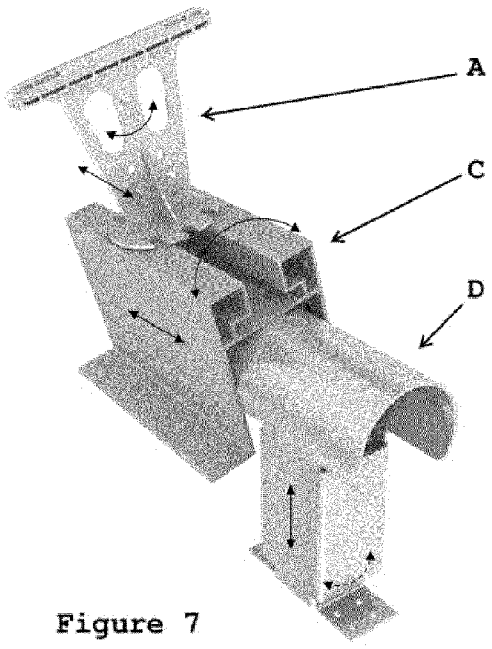


Figure 7

(57) Abstract: This invention relates to a roof, wall or façade structure, to a kit of parts for constructing for constructing said structure and a method for its constructiion, the structure essentially comprising a retaining element (A) having a head section (1) for engaging and holding at least one building sheet and a base section (3); a supporting rail (C) comprising a first profile section (4) for detachably receiving and holding the base section (3) of the retaining element (A) and a second profile section (5), wherein the base section (3), when positioned in the first profile section (4) is rotatable relative to the supporting rail (C) around the axis perpendicular to the supporting rail between a first position at which the base section (3) is freely detachable from the first profile section (4) of the supporting rail (C) and a second position at which the base section (3) is secured in the first profile section (4) of the supporting rail (C); and a mounting element (D) comprising a head portion (6) for receiving and holding the second profile section (5) of the supporting rail (4), a foot portion (7) spaced from the head portion (6) for mounting the mounting element (D) on a roof, wall or façade substructure (E).

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A ROOF, WALL OR FAÇADE STRUCTURE

This invention relates to a roof, wall or façade structure suitable for flat or pitched roofs, or renovation or reconstruction thereof, to a kit of parts for constructing, renovating or reconstructing a roof, wall or façade structure and a method for constructing, renovating or reconstructing a roof, wall or façade structure.

Roofs such as standing seam roofs, or alternative panel-type roofs, are flexible systems that are being used around the world for creating new buildings and also for renovation. When designing and creating a new building the versatility of the standing seam system, such as the Kalzip® standing seam system as supplied by Kalzip GmbH, allows complex structures including curved and/or tapered geometry to be covered.

In renovations however, the existing building dictates to a large extent the options for a replacement roof. This usually involves a lot of improvising by the renovators and this improvisation sometimes results in defective or untidy work which may, in time, lead to leakage, failure or unaesthetically looking constructions.

It is therefore an object of this invention to provide a system for renovating roof, wall or façade structures which is easy to install, quick to install, and to install without risking defective or untidy renovated structures.

It is also an object to provide a system for renovating roof, wall or façade structures with a minimum of different parts.

It is also an object to provide a system for renovating roof, wall or façade structures which uses a minimum of different parts which can moreover be made to fit easily, reproducibly and tidily.

One or more of these objects is reached by a roof, wall or façade structure comprising:

- a retaining element (A) having a head section (1) for engaging at least one building sheet (B) of a roof, wall or façade, by flanging a free end (9) of the building sheet (B) over the head section (1), a base section (3) spaced from the head section, and a connecting member (2) fixedly connecting the head section (1) and the base section (3), and
- a supporting rail (C) comprising a first profile section (4) for detachably receiving and holding the base section (3) of the retaining element (A) and a second profile section (5), wherein the base section (3), when positioned in the first profile section (4) is rotatable relative to the supporting rail (C) around the axis perpendicular to the supporting rail between a first position at which the base section (3) is freely detachable from the first profile section (4) of the supporting rail (C) and a second position at which the base section (3) is secured in the first profile section (4) of the supporting rail (C), the rotation

enabling the alignment of the longitudinal axis of the head section (1) of the retaining element (A) with the free end of the building sheet fixed to the head section (1), and

- a mounting element (D) comprising a head portion (6) for receiving and holding the second profile section (5) of the supporting rail (4), a foot portion (7) spaced from the head portion (6) for mounting the mounting element (D) on a roof, wall or façade substructure (E) and a connecting portion (8) connecting the foot portion (7) and the head portion (6), wherein the supporting rail (C) is rotatable around its longitudinal axis when held by the head portion (6) of the mounting element(D) to enable alignment of the longitudinal axis of the head section (1) of the retaining element (A) with the inclination of the wall, roof or façade.

In a preferred embodiment the head section (1) is elongate. Elongate within the context of this invention has its usual meaning, i.e. the head section is longer than it is wide, as seen from above, and the head section is longer than it is high, as seen from the side. By means of non-limiting examples: a torpedo or zeppelin shape is such an elongate shape. Figures 8 and 11 show examples of retaining elements with elongate head sections. Non-elongate head sections tend to result in higher local pressures on the building sheets, and may also result in a lower ability to retain the sheets in position, e.g. in the case of wind suction.

The invention will first be explained in more detail in reference to a standing seam roof, but as demonstrated herein below the invention can be applied equally well using alternative panel-type roofs. It should therefore be noted that the explanation given herein below for the standing seam roof is not intended to be limited to it.

The invention is embodied in a standing seam roof, wall or façade structure comprising:

- a retaining element (A) having an elongate head section (1) for engaging at least one building sheet (B) of a standing seam roof, wall or façade, by flanging a free end (9) of the building sheet (B) over the elongate head section (1), a base section (3) spaced from the elongate head section, and a connecting member (2) fixedly connecting the elongate head section (1) and the base section (3), and
- a supporting rail (C) comprising a first profile section (4) for detachably receiving and holding the base section (3) of the retaining element (A) and a second profile section (5), wherein the base section (3), when positioned in the first profile section (4) is rotatable relative to the supporting rail (C) around the axis perpendicular to the supporting rail between a first position at which the base section (3) is freely detachable from the first profile section (4) of the supporting rail (C) and a second position at which the base section (3) is secured in the first

profile section (4) of the supporting rail (C), the rotation enabling the alignment of the longitudinal axis of the elongate head section (1) of the retaining element (A) with the free end of the building sheet flanged, or to be flanged, over the elongate head section (1), and

- a mounting element (D) comprising a head portion (6) for receiving and holding the second profile section (5) of the supporting rail (4), a foot portion (7) spaced from the head portion (6) for mounting the mounting element (D) on a roof, wall or façade substructure (E) and a connecting portion (8) connecting the foot portion (7) and the head portion (6), wherein the supporting rail (C) is rotatable around its longitudinal axis when held by the head portion (6) of the mounting element(D) to enable alignment of the longitudinal axis of the elongate head section(1) of the retaining element (A) with the inclination of the wall, roof or façade.

The basis for the roof, wall or façade structure according to the invention is formed by three major components A, C and D in addition to the roof sheet B, which is a known standing seam roof sheet or sheets of the Kalzip® FC Rainscreen or steproof type, generally referred to as click-type systems. By means of example, and not limited to these, reference is made to the standing seam panels of the Kalzip system which are provided in varying profile widths, straight, tapered and/or curved and in different seam heights. The three major components are formed by a retaining element A, a supporting rail C and a mounting element D. The retaining element A has an head section 1 for engaging at least one building sheet B of a standing seam roof, wall or façade, by flanging a free end of the building sheet B over the head section (see Figure 3, which shows one standing seam 9 flanged over the head section). Optionally the flange is secured to the head section 1 of the retaining element, e.g. by one or more screws. The flange on the standing seam of the neighbouring building sheet would then be flanged over flange 9, thus seaming the flanges of two neighbouring building sheets over the head section. The length of the connecting member 2 is chosen depending on the height of the standing seam of the building sheet, and the amount of space needed below the building sheet, e.g. for insulation material. The length of the connecting member is preferably standardised to minimise the number of different retaining elements which have to be kept in stock.

The base section 3 of a retaining element A is mounted in a first profile section of a supporting rail C. The base section possesses the functionality of a bayonet catch in that it can be inserted into the first profile section in a first position and be taken out again, but after insertion of the base section into the first profile section in a first position and rotation of the retaining element around the axis perpendicular to the supporting rail to a second position, the retaining element is secured in the profile

section. In this second position the retaining element can still be moved freely along the length of the supporting rail, but the retaining element cannot be taken out without first rotating it back to the first position. The movement of the retaining element along the length of the supporting rail and the rotatability of the retaining element in the first profile section to choose a favourable second position with regard to the orientation and location of the standing seams of the building sheet allows easy installation. When the retaining element is in the right place and the desired second position, the retaining element may be fixed in place, if required, for example by a fixing element, such as a screw or small protrusions on the lower surface of the base section 3 of the retaining element A to increase the friction between the base section and the upper part of the supporting rail C, thereby preventing further movement, wobble, rattle and rotation of the base section in the first profile. The supporting rail is also provided with a second profile section 5 congruent with the head portion of mounting element D, so that the head portion can hold the supporting rail in place. The holding in place may be the result of a clamping force exerted by the second profile section on the head portion of mounting element, or the result of a fixing element, such as a screw, which secures the second profile section, and thus the supporting rail C, to the mounting element D. The second profile section is shaped such that it allows a rotation around the head portion of mounting element so that the inclination of the retaining elements in the first profile section can be adapted to the desired inclination of the standing seams, and thus of the wall, roof or façade. The mounting element is secured to the building.

As mentioned hereinabove, the invention is not only suitable in constructing, renovating or reconstructing roofs, walls or facades using standing seam panels, but also with other types of roof and wall panels, such as the Kalzip® FC Rainscreen system or a steproof system as depicted in Figure 11A and B. These types of roof can be generally referred to as click-type systems. The elements C and D are the same, but the retaining element has a different head section, with the head section being provided with a suitably shaped recess which is able to receive and hold suitably shaped flanges of building sheet panels. In the example in Figure 11 the head section is provided with a W-shaped recess which is able to receive and hold the shaped flanges of building sheet panels B. The use of these building sheets and retaining elements benefit from the degrees of freedom offered by the roof, wall or façade structure according to the invention.

In a preferred embodiment the head of the retaining element is elongate, so as to enable a larger contact area in (in case of the standing seam roof type) or with (in case of the click-type roof) the flanges of the building sheets. This geometry of the head prevents the occurrence of tension in the building sheet when the sheet

thermally expands or shrinks, because the elongate head allows movement of the flanged sheet over the head.

In order for the flanges of the standing seam building sheets to move as easily as possible over the elongate head section of the retaining element during installation of the structure, the head section comprises a middle section which is substantially of constant cross-section along its longitudinal axis and two partially dome-shaped end sections 1a and 1c, one at either end. The simplest shape of the middle section would be cylindrical or substantially cylindrical. This could be described as a torpedo like shape, when seen from the side as in Figure 2A. The embodiment shown in Figure 2A shows a head section which, from a side view, has a torpedo shape, but of which the perpendicular cross section (in a front view as depicted in figure 2B) is not circular, but rather is of a spades like shape. So while the general side view remains torpedo like, the cross section of the torpedo may be circular, spades like, or any other suitable form. The length of the head section determines the maximum pull-out force of the mounted building sheet B. The longer the head, the higher the pull-out force.

In a preferred embodiment of the invention the head section also has a torpedo like shape in a top view (i.e. perpendicular to the side view of Figure 2A and the front view of Figure 2B). With this torpedo like shape the standing seam building sheets move as easily as possible over the elongate head section of the retaining element during installation of the structure, whereas the perpendicular cross section can be given a shape which e.g. allows easy fixing of the standing seam sheet to the head section, or allows saving of material by not using a fully circular cross-section, but a spades like or other suitable cross section instead.

The inventors found that retaining elements wherein the elongate head section comprises a middle section which has substantially the same shape in cross-section along its longitudinal axis and two dome-shaped end sections, but wherein the size of the cross-section of the middle section is not constant, has advantages in some cases. An example of such a middle section is the case where the diameter of the middle section increases starting at the end of the first dome section towards a maximum diameter in the middle of the middle section, and decreases again towards the other dome section, comparable to the shape of the 'Hindenburg' airship (without the tailfins). This shape means that there is a smaller contact area between the seams and the head section, which has benefits in some cases. The location of the maximum diameter may be in the middle of the middle section, but it may also be nearer one end section.

In a preferable embodiment the length of the connecting portion 8 of the mounting elements D is variable. This allows the distance between the head portion 6 and the foot portion 7 of the mounting element to be adapted to a desired distance

when constructing the roof, wall or façade structure. After determining the desired distance the length of the connecting portion is fixable to keep the desired distance between the head portion and the foot portion 7 after construction. This way it is possible to increase or decrease the inclination of a structure by progressively adapting the distance between the head portion and the foot portion of the mounting elements. This also allows installers to compensate for local differences in height of the building onto which the roof, wall or façade is to be mounted. In a preferable embodiment the connecting portion has an adjustable length e.g. by having two or more telescoping segments translatable longitudinally relative to each other to adjust the length of the connecting portion. Upon selecting the desired length of the connecting portion the length can be fixed by one or more fixing elements, such as screws.

In another embodiment of the invention the connecting portion 8 of the mounting elements D is provided in the form of a length of profile or tube to which the head portion 6 and the foot portion 7 are attached. In this embodiment the head and foot portion are standardized parts which are designed to be attachable to the connecting portion on the installation site. This allows each mounting element D to have a bespoke length by cutting the length of the connecting portion 8 to the desired length, preferably on the building site, but elsewhere if required. The profile or tube can be cut to length from a long length.

In an embodiment of the invention the foot portion 7 is provided with inclination means 11 to allow the mounting element D to be mounted to a substructure in a direction which is not perpendicular to the substructure. In particular when the substructure is inclined at a different angle than the renovated roof, it is important that the mounting elements are mounted in a substantially vertical direction to direct the forces acting on the roof to the substructure. It is particularly beneficial if the foot portion is also provided with the potential to rotate the mounting element around its longitudinal axis so that orientation of the head portion is facilitated.

Preferably the inclination means are provided in the form of a ball-and-socket joint. These ball-and-socket joints allow movement in all directions and also allow rotation. It is preferable that the ball part of the joint 12 is fixed to the connecting portion, and the socket part 13 is fixed to the substructure. Preferably the ball part is designed such that it can be fixed to the connecting portion. The socket part is fixed to the substructure, and a pad 15 may be provided between the socket part and the substructure, e.g. for thermal insulation. An insert piece 14 may be provided in the socket part to complete the socket or the socket may be an integral part of the socket part. The parts 13 and 14 can be produced from the same materials and by the same method. Part 14 may be produced form a suitable polymer like polyamide or the like.

The inventors found that a maximum inclination angle of 20° of the ball-and-socket joint is adequate for most cases. More preferably the maximum angle is 15°. The ball-and-socket joint allows a 360° rotation along the longitudinal axis of the mounting element D.

In an embodiment of the invention the head portion 6 of the mounting element D is provided in the form of a separate element that can be fixed to the upper end of the connecting portion. Preferably the head portion is designed in such a way that it can be fixed to the connecting portion at a selected position, where the position depends on the desired length of the entire mounting elements D. This flexibility enables the installers to work with a degree of tolerance in the length of the connecting portion, and also allows correction of unexpected deviations in the flatness of the substructure without having to cut a new connecting portion. The function of the head portion is to hold the supporting rail C in the right position and orientation.

When providing the mounting element with the ball-and-socket joint it is preferable that the ball part and the socket part remain unconnected. This means that the socket part can be mounted to the substructure with care and precision. The mounting element can then be inserted into the socket, for instance sideways, through a hole which is sufficiently large to allow the ball, which may be flattened on both side edges to facilitate this (see Figure 12B and 13), to pass and then turned upwards in which position the ball is secure in the joint. In this position it can still be moved and rotated, but the ball cannot be dislocated from the joint. It should be noted that the invention is not limited to this particular ball-and socket-joint but that any other joint allowing a similar combination of inclination and rotation is considered part of the invention.

It is preferable that after erecting the mounting element with the ball-and-socket joint and rotating it in the desired direction, that the mounting element is fixed in this position by securing means 18 provided in the ball-and-socket joint.

In cases where the old substructure is horizontal the ball-and-socket joint may not be needed because as depicted in Figure 10 the mounting elements is already vertical.

In an embodiment the retaining elements A are produced by die-casting. Although the retaining elements could, in principle, be produced by extrusion and cutting to length, the inventors found that it is preferable to produce the retaining elements by die-casting or equivalent production processes. This type of production allows the head sections to have the dome-shaped end sections. It also allows the connecting member to be constructed with weight-saving holes, stiffening ribs and, if so desired, with a non-constant width of the connecting member for instance so as to be smaller at the base section and wider at the elongate head section.

The material from which the retaining elements are produced preferably consist of die-cast metal, such as zinc or a zinc alloy, aluminium or an aluminium alloy, or a suitable die-cast polymer such as polyamide or glass-fibre reinforced polyamide. The retaining elements may also be produced by 3D-printing from a suitable material, either off site, or on site.

In a preferable embodiment the supporting rail C consists of an extruded profile, either from a suitable metal, such as aluminium or aluminium alloys, or a suitable polymer, such as polyamide, or a roll-formed material such as (galvanized) steel or aluminium. This allows the profile to be produced at standard lengths, which can be made to fit on the building site, with a minimum of loss of material, and a minimum of logistical issues. The supporting rails may also be produced by 3D-printing from a suitable material, either off site, or on site.

The mounting element D, preferably comprises or consists of a metal such as (galvanized) steel or aluminium or a polymer, preferably polyamide, and may be produced by die-casting or 3D-printing from a suitable material. The 3D-printing may be carried out off site or on site.

In the embodiment where the mounting element D comprises a tubular connecting part 8 and add-on head portions 6 and foot portions 7, the tubular connecting part may be an extruded profile, either from a suitable metal, such as aluminium or aluminium alloys, or a suitable polymer, such as polyamide, or a roll-formed material such as (galvanized) steel or aluminium. This allows the part to be produced at standard lengths, which can be made to fit on the building site, with a minimum of loss of material, and a minimum of logistical issues. The add-on head portions 6 and foot portions 7 may be produced by die-casting. This type of production allows the head portions and foot portions to have intricate shapes to produce the ball and socket joints 12, 13 and 14. It also allows the parts to be provided with weight-saving holes, stiffening ribs and, if so desired, with a different wall thickness as and when desired. In the examples and the figures the cross section of the connecting part is square with grooves at either sides, rendering the cross section H-shaped. However, the cross section may also be circular or any other suitable shape with a groove at either side.

The material from which the add-on head portions and foot portions are produced preferably consist of die-cast metal, such as zinc or a zinc alloy, aluminium or an aluminium alloy, or a suitable die-cast polymer such as polyamide or glass-fibre reinforced polyamide. The parts may also be produced by 3D-printing from a suitable material, either off site, or on site.

According to a second aspect, the invention is also embodied in a kit of parts for constructing or reconstructing a roof, wall or façade structure according to any one

of claim 1 to 13 comprising one or more retaining elements A, one or more supporting rails C and one or more mounting elements D. The kit of parts may also comprise one or more building sheets B suitable for forming a roof, wall or façade of the standing-seam type or the click type.

Using this kit of parts the construction, reconstruction or renovation of a roof, wall or façade can be achieved according to the description and figures.

According to a third aspect, the invention is also embodied in a method of constructing, reconstructing or renovating a roof, wall or façade structure using the kit of parts according to the invention.

The method using this kit of parts allows the construction, reconstruction or renovation of a roof, wall or façade to be achieved according to the description and figures. The invention will now be further explained by means of the following, non-limitative drawings:

Figure 1 shows the basic elements of the system and elements of the kit of parts: retaining element A, supporting rail C and mounting element D.

Figure 2A shows a retaining element A with elongate head section 1, connecting member 2 and base section 3, and a head section comprising a middle section 1b and two substantially dome-shaped end sections 1a and 1c. This embodiment shows the optional non-constant width of the connecting member 2 which is smaller at the base section and wider at the elongate head section.

Figure 2B shows retaining element A of Figure 2A with elongate head section 1, connecting member 2 and base section 3 rotated about its vertical axis through 90° compared to Figure 2A. The base section 3 clearly shows the functionality of a bayonet catch for cooperating with the first profile section of supporting rail C. The optional weight saving holes and stiffening ribs are present in this particular embodiment.

Figure 3 shows a retaining element A mounted in the supporting rail C with at least one building sheet B with a free end 9 flanged over the elongate head section 1 of the retaining element.

Figure 4 shows a perpendicular view of Figure 3. The dashed circle schematically represents the head portion 6 of a mounting element D. The circle also illustrates the ability of the supporting rail C to be rotated with its centre of rotation being the centre of the circle. An example of this rotation is clearly shown in Figure 7. The rotatability of supporting rail C allows easy adapting of the pitch of the flanges of the building sheets with respect to the building onto which the system is mounted.

Figure 5 shows an embodiment of the supporting rail C with a first profile section 4 into which the base section 3 of a retaining element A can be slotted, and a second profile section 5 designed to cooperate with the head portion of mounting

element D. However, if so desired, the profile section can be installed directly onto the building without the use of a mounting element D.

Figure 6 shows a schematic representation of the mounting element D where the head portion 6 is shaped to cooperate with the second profile section of a supporting rail C, and allow rotatability of the supporting rail C around the centre of the head portion. The connecting portion 8 of the mounting element is presented in this embodiment as being of an adjustable length so as to allow the height of the structure comprising the retaining element A, supporting rail C and mounting element D to be adjusted to the correct height to allow the correct pitch of the roof, wall or façade to be obtained. After adjusting the connecting portion to the correct length, its length may be fixed by using fixing means such as screws. The embodiment presented here shows a telescopic version of the connecting portion, but alternative ways are also encompassed by the invention. The foot portion 7 is used to fix the mounting element to the building.

Figure 7 the arrows demonstrate the degrees of freedom offered by the interplay between retaining element A, supporting rail C and mounting element D. Retaining element can be rotated along the axis perpendicular to the supporting rail C, and supporting rail C can be rotated along the centre of the head portion of mounting element D, and the length of the connecting portion 8 can be adjusted. If the connecting portion 8 would be provided in a circular tubular form, and not in a rectangular form as in this figure, there would be an additional rotatability (indicated by the dashed arrow) of the system around the longitudinal axis of the connecting portion 8.

Figure 8A shows the retaining element A after inserting the base section 3 in the first position in the first profile section 4 of a supporting rail C, and **Figure 8B** shows the retaining element A in a second position in the first profile section of supporting rail C, i.e. after rotating the retaining element A from the first position of Figure 8A to the second position in Figure 8B.

Figure 9 shows an example of an existing structure E renovated with a roof B mounted on top using the elements A, C and D of the system according to the invention. The foot portion of the mounting element D is fixed onto the old roof E, in this example in an additional U-shaped profile which is mounted onto the existing structure E. Insulation 10 may be provided between the roof B and the existing structure E, as well as between the mounting element D and the existing structure E if required. Mounting element D may also be provided with a base part 19 to spread the load across a greater surface area of the existing structure E. The base part, shown here in the form of a u-shaped profile, ensures that the load is spread over the tops of the trapezium-shaped structure E. The base part has to be able to spread the load,

and for that it needs sufficient stiffness. Although not restricted to this particular shape, the u-shaped profile is effective in achieving this and be relatively lightweight at the same time. The profile can e.g. consist of an extruded profile, either from a suitable metal, such as aluminium or aluminium alloys, or a suitable polymer, such as polyamide, or a roll-formed material such as (galvanized) steel or aluminium. This allows the profile to be produced at standard lengths, which can be made to fit on the building site, with a minimum of loss of material, and a minimum of logistical issues.

This way it is possible to increase or decrease the inclination of a structure by progressively adapting the distance between the head portion and the foot portion of the mounting elements.

Figure 10 shows a schematical representation of the use of the system to change the pitch of a roof of an existing building using the elements of the system according to the invention.

Figure 11A shows retaining element A of Figure 11B rotated about its vertical axis through 90° compared to Figure 11B. In Figure 11A the retaining element can be lifted out of the first profile section of supporting rail C.

Figure 11B shows a retaining element A with a head section provided with a W-shaped recess which is able to receive and hold suitably shaped flanges of building sheet panels B. The connecting member 2 and base section 3 have the same function as those for the retaining element depicted in Figure 8. In Figure 11B the retaining element can not be lifted out of the first profile section of supporting rail C. The edge 9 of two neighbouring building sheets B are shown in the position where they are held in the W-shaped recess in the head section 1 of the retaining element A. The supporting rail C is described in Figure 5.

Figure 12A shows a head portion 6 of mounting element D which is designed to slide over the connecting portion 8 as depicted in figure 14A, 15A and 15B. The downwardly protruding parts of head portion 6 fit into the grooves of connecting portion 8 and can be fixed to the connecting portion 8, e.g. by screws after having determined the correct position to obtain the correct length of mounting element D.

Figure 12B shows the ball portion 12 of the ball-and-socket joint which, together with the socket part 13 and the insert piece 14 of Figure 13 form the foot portion of mounting element D. The upwardly protruding parts of ball portion 12 fit into the grooves of connecting portion 8 and can be fixed to the connecting portion 8, e.g. by screws after having determined the correct position to obtain the correct length of mounting element D. In most cases the (in this example) square ball portion 12 will be flush with the lower end of the connecting portion 8, and the length will be mainly adjusted by means of the positioning of head portion 6.

Figure 13 shows the socket portion 13 and the insert piece 14 which, together with the ball part 12 of Figure 12B and the connecting portion 8 provides the lower end of the mounting element D as presented in **Figure 14A.** Figure 13 also shows the orientation of the ball-part in the socket immediately after introducing the ball part into the socket. When turning the ball-part upwardly the movement of the ball part is restricted by the annular opening on top of the socket part, indicated with 16 in Figure 13. By flattening the ball slightly (see Figure 12B) the circumference is changed such that it can enter through the hole 17 in Figure 13 when held in the direction as depicted in Figure 13, but it cannot slip out of the socket when turned upright.

Figure 14B shows the level of flexibility in using the ball-and-socket joint An inclination of 15° is shown by means of example, and the connecting portion 8 can be rotated 360° (a rotation of 90° is shown) in figure 14B. The H-shaped cross section of the connecting member 8 is shown as well, with the grooves for receiving the protrusions in ball-part 12 and head portion 6.

Figure 15A shows an exploded view of all the elements of the structure. The screws and bolts are not numbered. All elements A to D are shown in the embodiment with the ball-and-socket joint and the head portion 6 which can move up and down in the grooves in the connecting portion 8 of mounting element D. Figure 15B shows the assembled structure.

Figure 16 shows a different embodiment of the ball-and-socket joint in the foot portion 7 of mounting element D. The socket part is formed by combining parts 20 and 21. 21 comprises a lower portion of the socket to receive the ball portion 12, and 20 is a cover part which can be placed in part 21 from above. To enable this straight edges are provided to the cover part 20 to allow dropping it in part 21 from above. Once dropped into place in part 21 and appropriately positioned as depicted in Figure 16 I and II the ball portion 12 can be lowered along the dashed line through the decentrally placed hole and locked into place by sliding it to the central hole (II). Once located in the central hole the ball portion 12 cannot be lifted up, but it can be inclined (see **Figure 17**, middle picture), and rotated if so desired. By rotating the cover part 20 (V→VI) the ball portion is also fixed in the central hole, because it can no longer move sideways due to the shape of part 21. The cover portion can be secured, e.g. by screws, as depicted with the exclamation mark in VI, and Figure 17, middle picture. The lower part of part 21 is shaped so as to potentially cooperate with part 22. Part 21 can be used as a load distribution part instead of base part 19 in Figure 15A. Part 22 functions e.g. as a thermal break. However, part 21 can also be directly mounted in base part 19. Part 22 may (e.g.) be produced by extrusion from polyamide or from any other material with adequate insulating properties. Cover part 20 may be produced from a die-cast metal, such as zinc or a zinc alloy, or a suitable

polymer such as polyamide or glass-fibre reinforced polyamide. Part 21 is preferably produced by extrusion aluminium or an aluminium alloy and subsequent machining to provide the securing holes. In the embodiment depicted in Figure 17 the parts 21 and 22 have interlocking portions. However, this is not crucial. The bottom part of 21 and the top part of 22 may also be flat or any other suitable shape, as long as they are secured to the substructure. In this latter case, part can also be a rubber-like material or any other flat material having insulating properties. The ball portion 12, and thereby the connecting portion 8 and head portion 6 can be inclined, and rotated, as depicted in Figure 17, middle picture.

Figure 18 shows still another embodiment of the ball-and-socket joint in the foot portion 7 of mounting element D. In this embodiment part 21 is shaped so as to include a longitudinally shaped channel which is able to receive and hold the ball portion of part 12 by sliding it into the channel from the end. Once part 12 is in the desired position, it is locked in place by means of a securing element 23 which prevents the ball portion from sliding along the channel. The securing element 23 is fastened, e.g. by one or more screws as depicted in Figures 18 and 19. Optional notches in part 21 and securing element 23 help properly position the securing element before fastening it with the desired fastening means. Figure 19 shows a 3D-sketch of this embodiment, in this case without part 22.

It is noted that the figures show structures with a standing seam roof. It should be noted that for use of the invention with another type of panel such as the FC-rainscreen or steproof the only change that is needed is the head section 1 of the retaining element A.

CLAIMS

1. A roof, wall or façade structure comprising:
   - a retaining element (A) having a head section (1) for engaging and holding at least one building sheet (B) of a roof, wall or façade, a base section (3) spaced from the head section, and a connecting member (2) fixedly connecting the head section (1) and the base section (3), and
   - a supporting rail (C) comprising a first profile section (4) for detachably receiving and holding the base section (3) of the retaining element (A) and a second profile section (5), wherein the base section (3), when positioned in the first profile section (4) is rotatable relative to the supporting rail (C) around the axis perpendicular to the supporting rail between a first position at which the base section (3) is freely detachable from the first profile section (4) of the supporting rail (C) and a second position at which the base section (3) is secured in the first profile section (4) of the supporting rail (C), the rotation enabling the alignment of the longitudinal axis of the head section (1) of the retaining element (A) with the flanged edges of the building sheet, and
   - a mounting element (D) comprising a head portion (6) for receiving and holding the second profile section (5) of the supporting rail (4), a foot portion (7) spaced from the head portion (6) for mounting the mounting element (D) on a roof, wall or façade substructure (E) and a connecting portion (8) connecting the foot portion (7) and the head portion (6), wherein the supporting rail (C) is rotatable around its longitudinal axis when held by the head portion (6) of the mounting element(D) to enable alignment of the longitudinal axis of the elongate head section(1) of the retaining element (A) with the inclination of the wall, roof or façade.

2. A roof, wall or façade structure according to claim 1 wherein the head section of the retaining element (A) is elongate (1) for engaging at least one building sheet (B) of a standing seam roof, wall or façade, by flanging a free end (9) of the building sheet (B) over the elongate head section.

3. A standing seam roof, wall or façade structure according to claim 1 comprising:
   - a retaining element (A) having an elongate head section (1) for engaging at least one building sheet (B) of a standing seam roof, wall or façade, by flanging a free end (9) of the building sheet (B) over the elongate head section (1), a base section (3) spaced from the elongate head section, and

a connecting member (2) fixedly connecting the elongate head section (1) and the base section (3), and

- a supporting rail (C) comprising a first profile section (4) for detachably receiving and holding the base section (3) of the retaining element (A) and a second profile section (5), wherein the base section (3), when positioned in the first profile section (4) is rotatable relative to the supporting rail (C) around the axis perpendicular to the supporting rail between a first position at which the base section (3) is freely detachable from the first profile section (4) of the supporting rail (C) and a second position at which the base section (3) is secured in the first profile section (4) of the supporting rail (C), the rotation enabling the alignment of the longitudinal axis of the elongate head section (1) of the retaining element (A) with the free end of the building sheet flanged, or to be flanged, over the elongate head section (1), and
- a mounting element (D) comprising a head portion (6) for receiving and holding the second profile section (5) of the supporting rail (4), a foot portion (7) spaced from the head portion (6) for mounting the mounting element (D) on a roof, wall or façade substructure (E) and a connecting portion (8) connecting the foot portion (7) and the head portion (6), wherein the supporting rail (C) is rotatable around its longitudinal axis when held by the head portion (6) of the mounting element(D) to enable alignment of the longitudinal axis of the elongate head section(1) of the retaining element (A) with the inclination of the wall, roof or façade.

4. A roof, wall or façade structure according to any one of the preceding claims wherein the retaining element (A) can be moved in the longitudinal direction of the first profile section (5) to adjust the position of the retaining element with respect to the free end (9) of the building sheet (B).

5. A roof, wall or façade structure according to any one of claims 2 to 4 comprising one or more retaining elements (A) wherein the elongate head section (1) comprises a middle section (1b) and two dome-shaped end sections (1a, 1c), preferably wherein the middle section is substantially rotationally symmetric along its longitudinal axis.

6. A roof, wall or façade structure according to any one of claims 2 to 5 comprising one or more retaining elements (A) wherein the elongate head section (1) comprises a middle section (1b) and two dome-shaped end sections

(1a, 1c), and wherein the diameter of the middle section is not constant, preferably wherein the middle section is substantially rotationally symmetric along its longitudinal axis.

7. A roof, wall or façade structure according to any one of the preceding claims comprising one or more mounting elements (D) wherein the length of the connecting portion (8) of the mounting elements (D) is variable to allow the distance between the head portion (6) and the foot portion (7) to be adapted to a desired distance when constructing the roof, wall or façade structure, and wherein the length of the connecting portion is fixable to keep the desired distance between the head portion (6) and the foot portion (7) after construction.

8. A roof, wall or façade structure according to any one of the preceding claims comprising one or more mounting elements (D) wherein the length of the connecting portion (8) of the mounting elements (D) is variable to allow the distance between the head portion (6) and the foot portion (7) to be adapted to a desired distance when constructing the roof, wall or façade structure, and connecting portion (8) comprises a telescoping section, wherein one part of the telescoping section is fixedly attached to the head portion (6), and wherein another part of the telescoping section is fixedly attached to the foot portion (7).

9. A roof, wall or façade structure according to any one of the preceding claims wherein the retaining element (A) is fixedly connected to the supporting rail (C) in the second position.

10. A roof, wall or façade structure according to any one of the preceding claims comprising one or more retaining elements (A) produced by die-casting.

11. A roof, wall or façade structure according to any one of the preceding claims comprising one or more retaining elements (A) consisting of die-cast metal, such as zinc or a zinc alloy, or a suitable polymer such as polyamide or glass-fibre reinforced polyamide.

12. A roof, wall or façade structure according to any one of the preceding claims wherein one or more of the mounting elements D comprise a tubular connecting portion (8), a head portion (6) releasably fixed thereto on one end,

and a foot portion (7) releasably fixed thereto on the other end, preferably wherein the foot portion comprises a ball-and-socket joint.

13. A roof, wall or façade structure according to any one of the preceding claims wherein the supporting rail (C) and/or the mounting element (D) comprise or consist of metal such as steel or aluminium or a polymer, preferably of polyamide.

14. A kit of parts for constructing or reconstructing a roof, wall or façade structure according to any one of claim 1 to 13 comprising one or more retaining elements (A), one or more supporting rails (C) and one or more mounting elements (D), the kit of parts optionally also comprising one or more building sheets (B) for forming a roof, wall or façade.

15. A method of constructing or reconstructing a roof, wall or façade structure using the kit of parts according to claim 14.

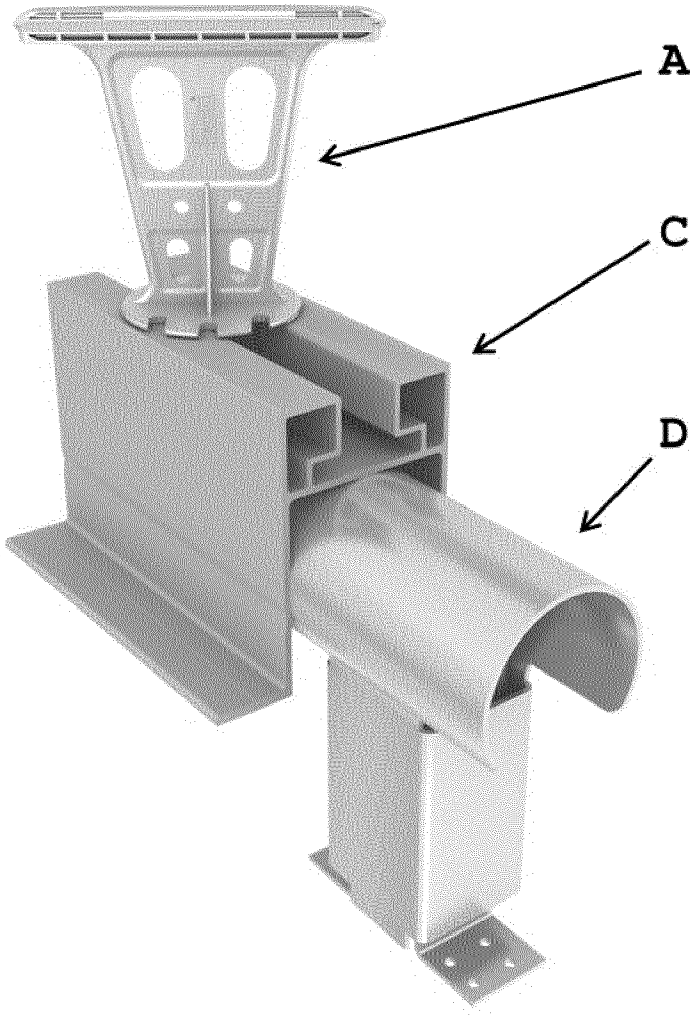


Figure 1

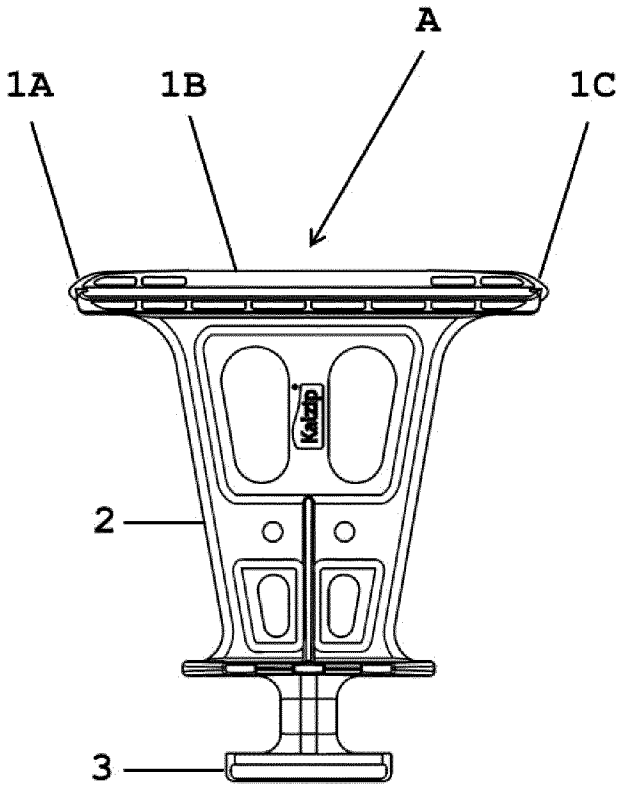


Figure 2A

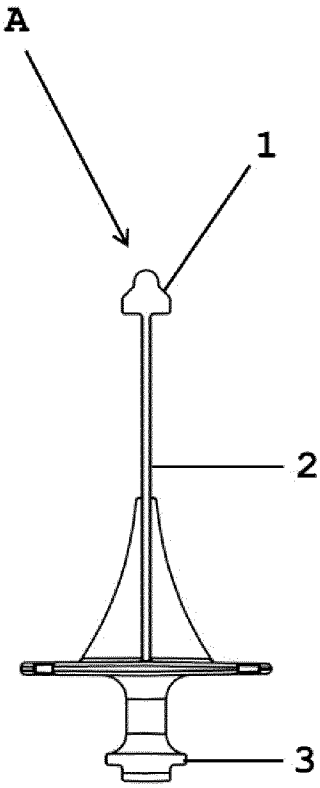


Figure 2B

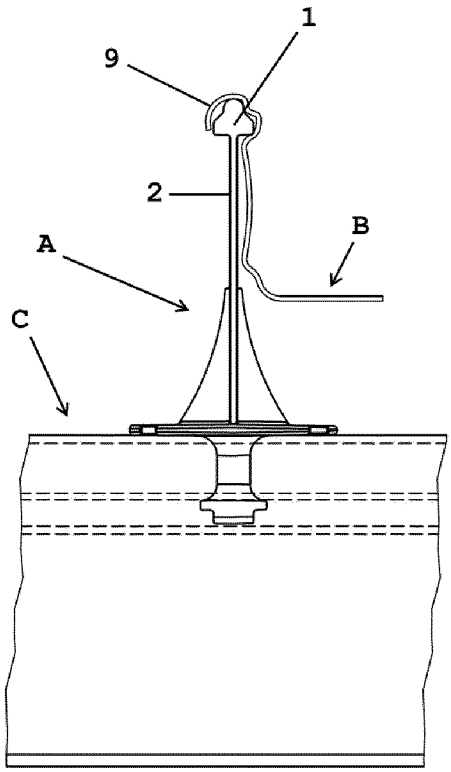


Figure 3

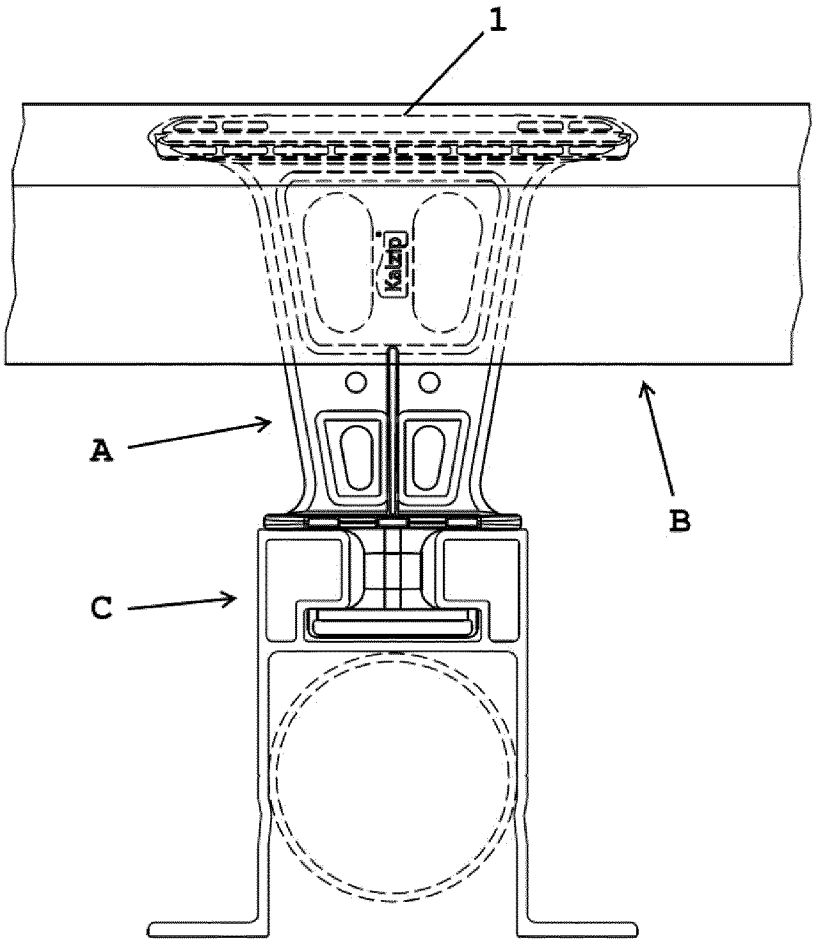


Figure 4

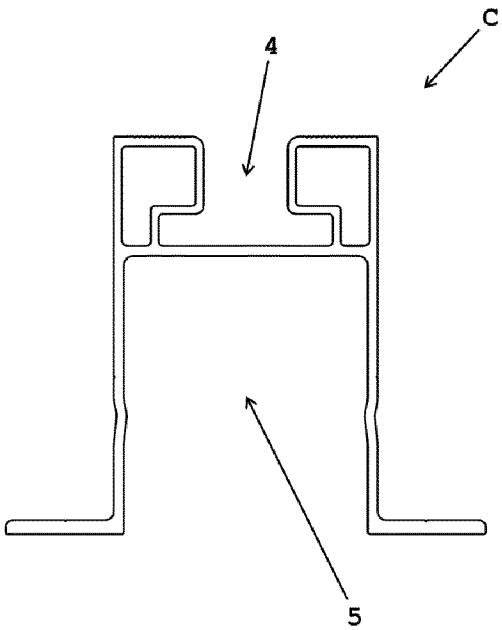


Figure 5

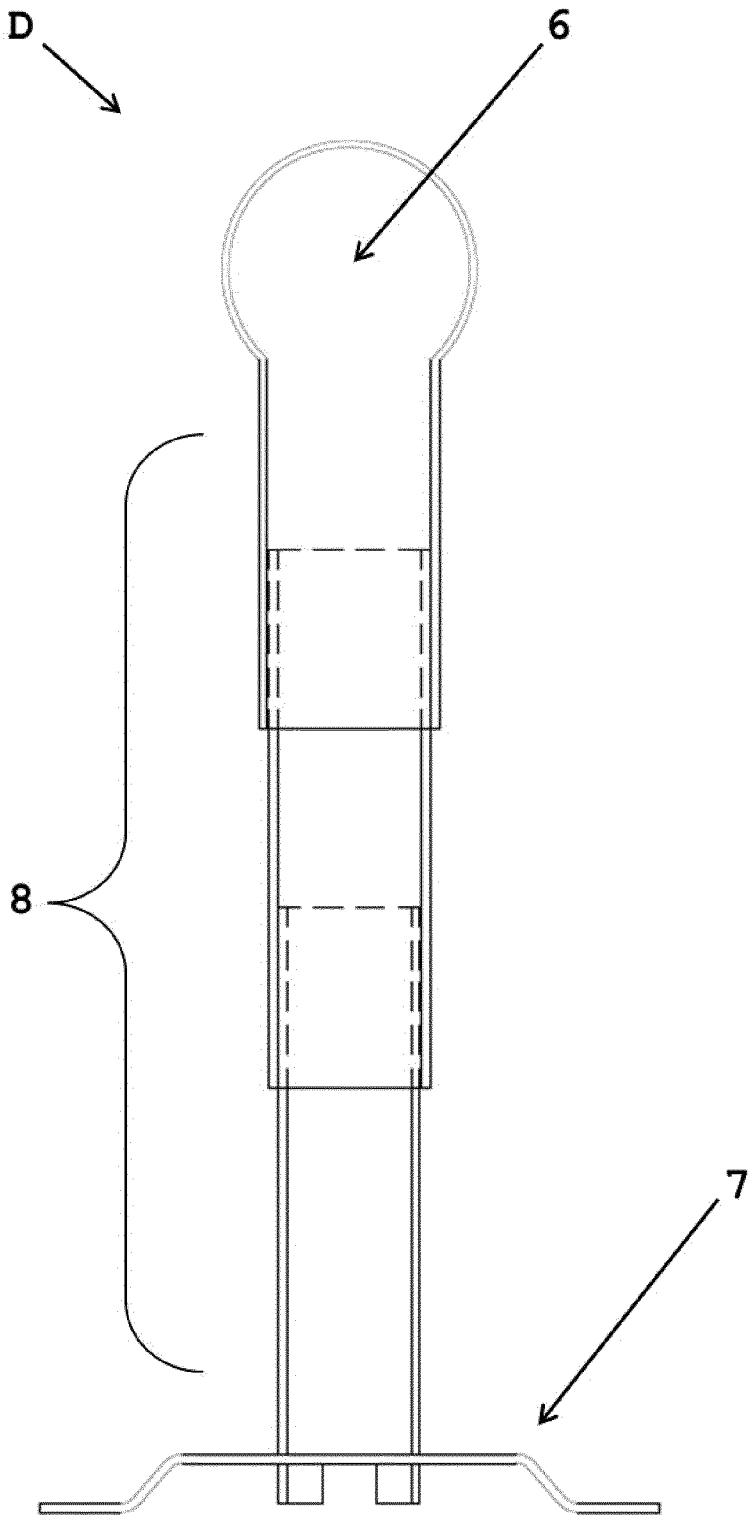


Figure 6

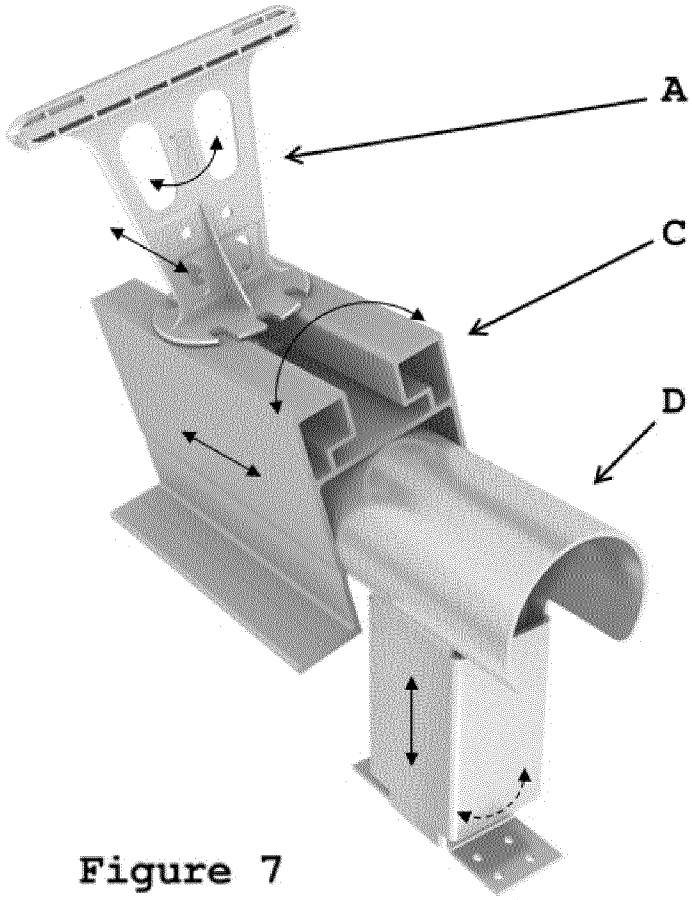


Figure 7

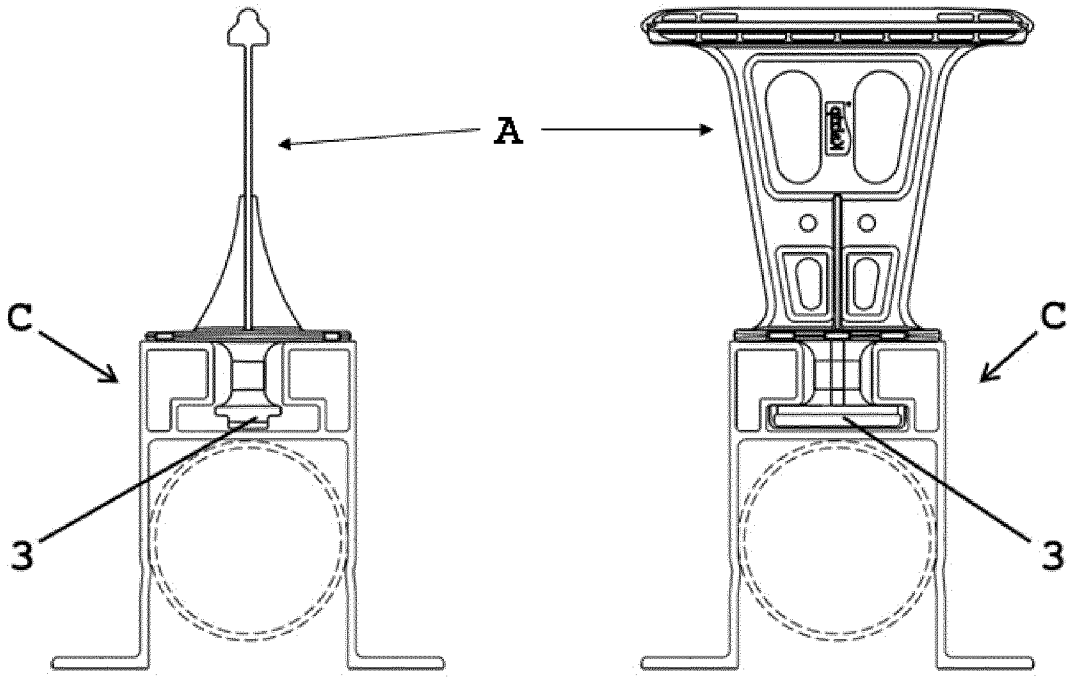


Figure 8A

Figure 8B

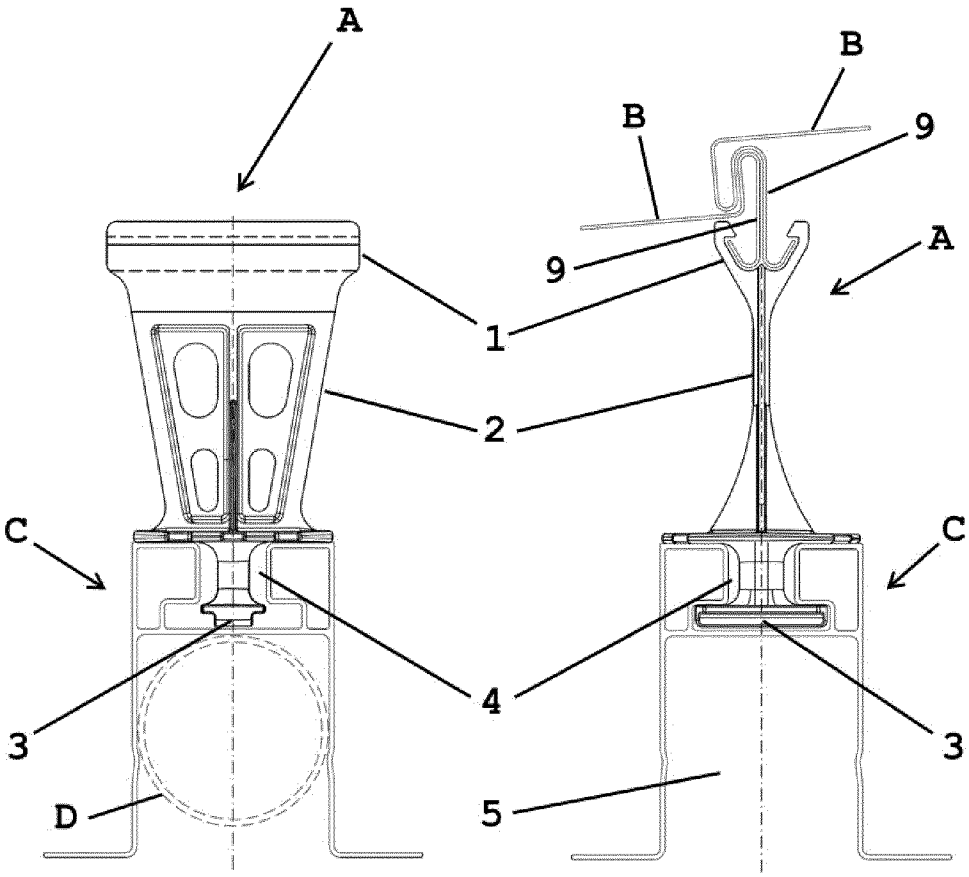


Figure 11A Figure 11B

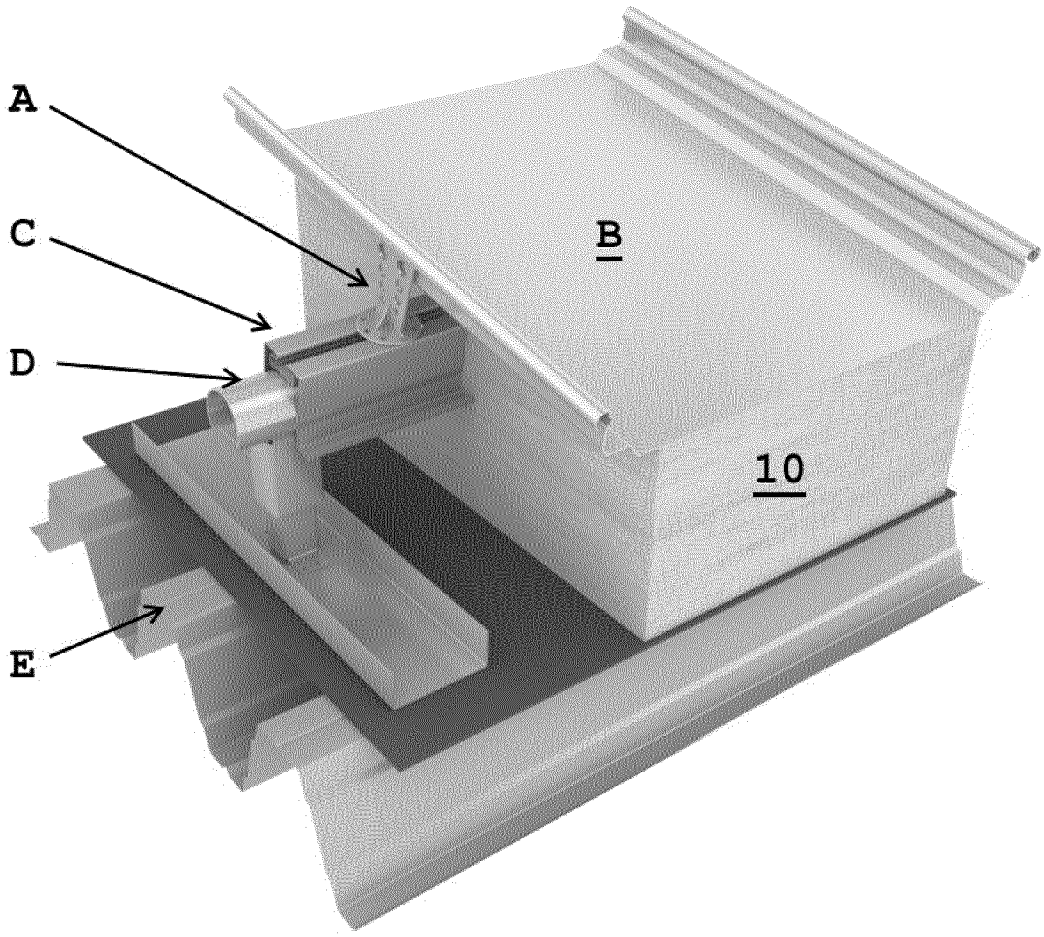


Figure 9

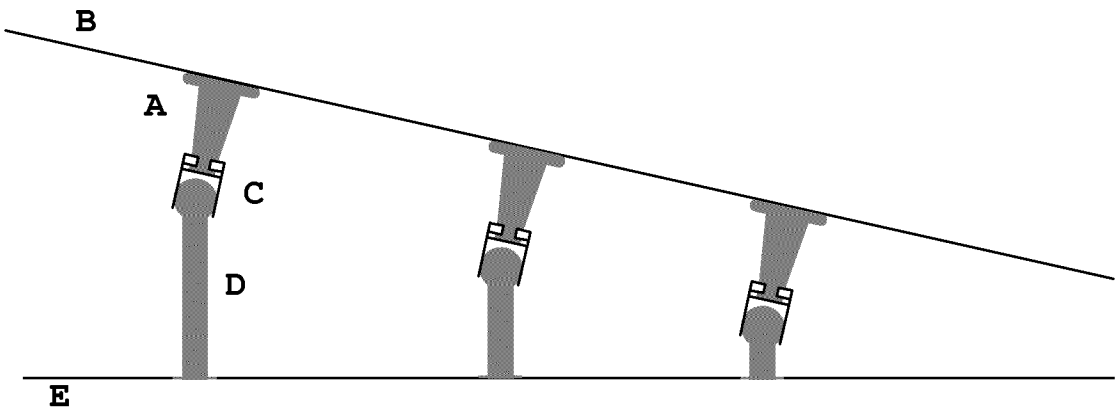


Figure 10



Figure 12A

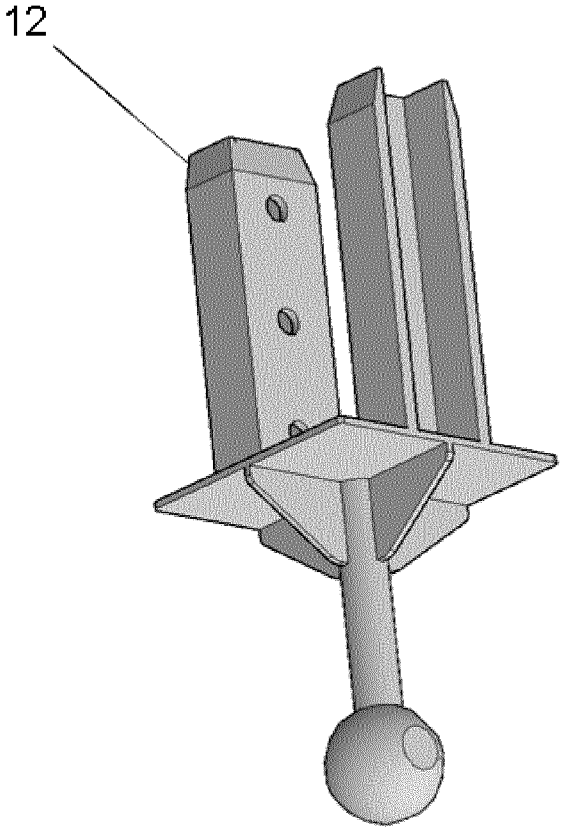


Figure 12B

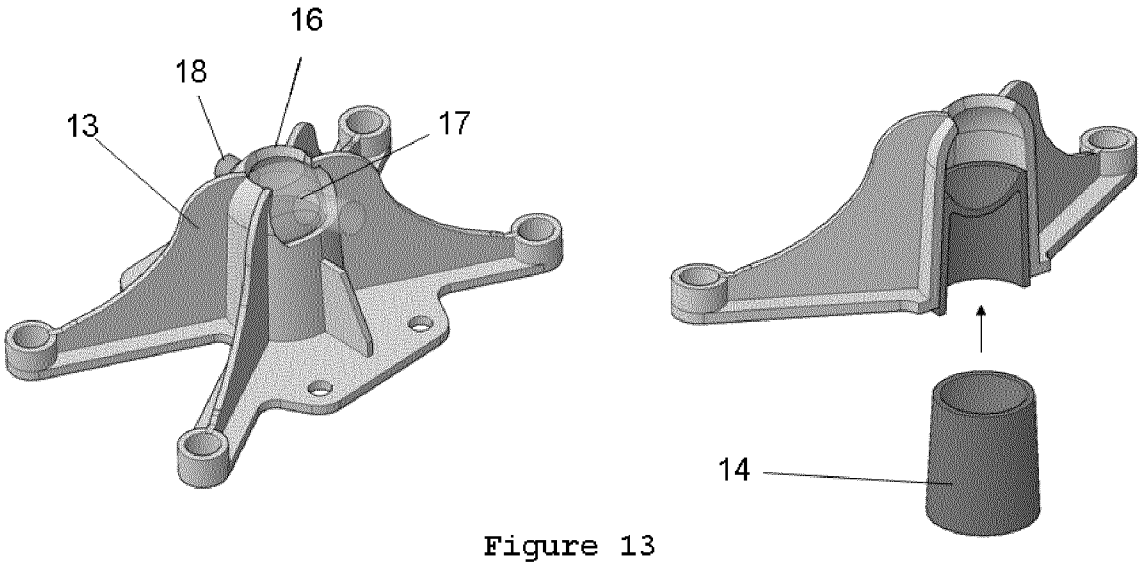


Figure 13

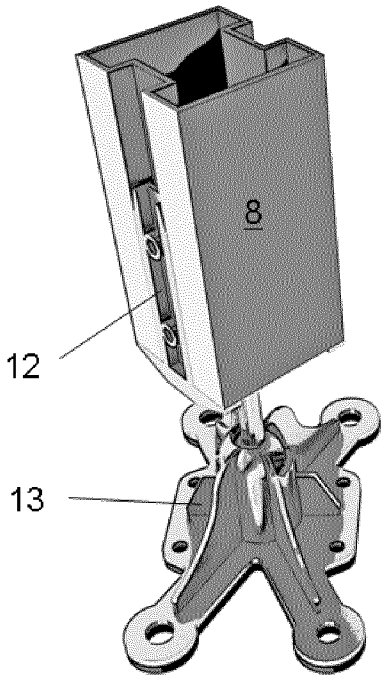


Figure 14A

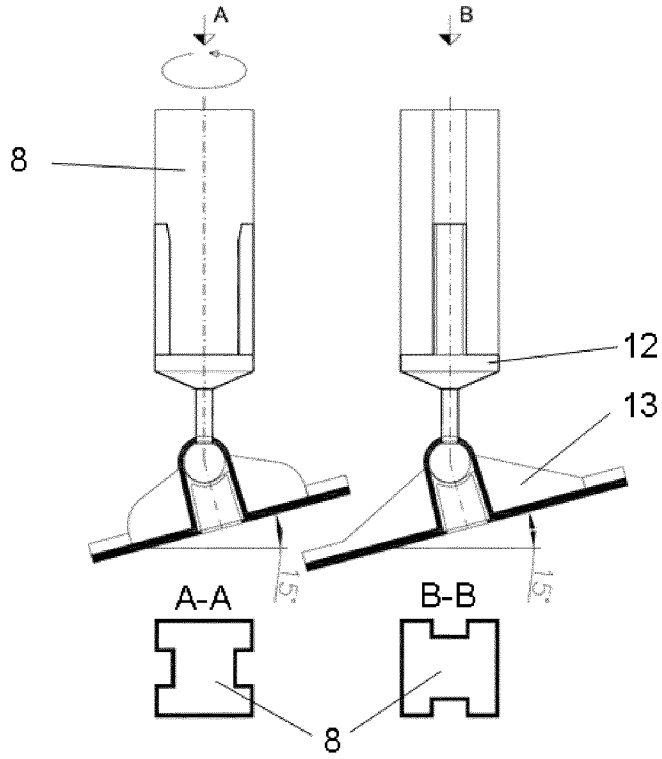


Figure 14B

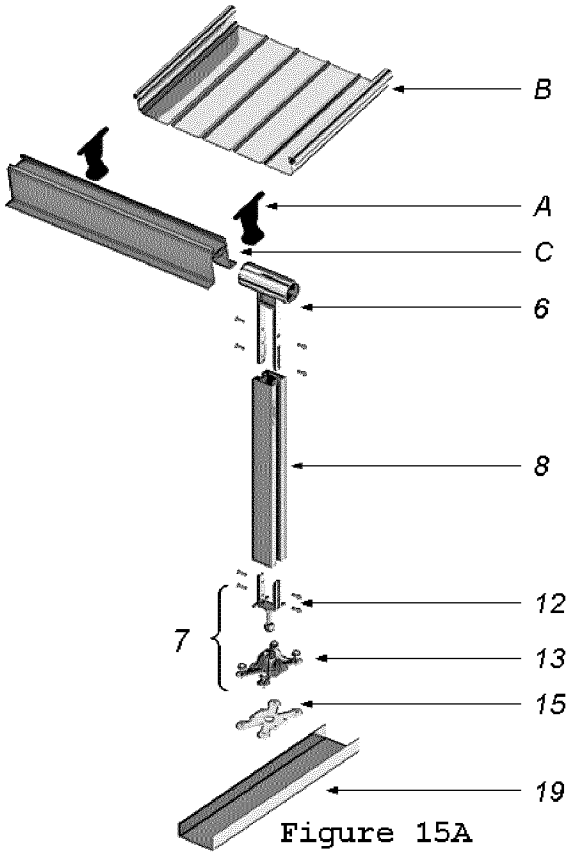


Figure 15A

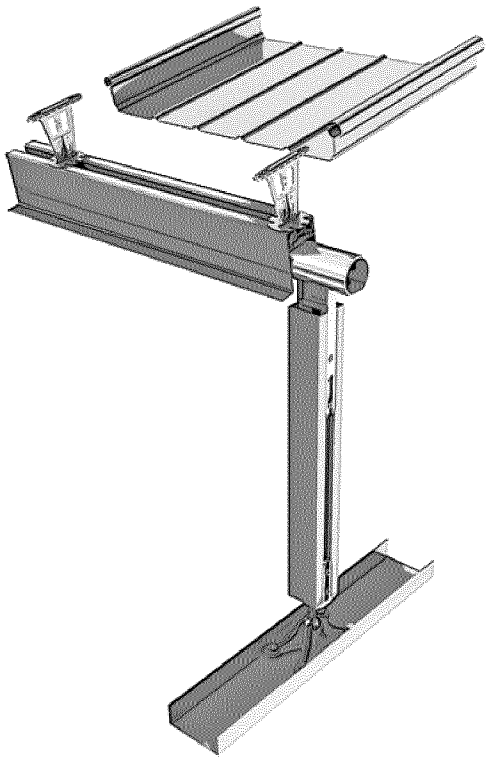


Figure 15B

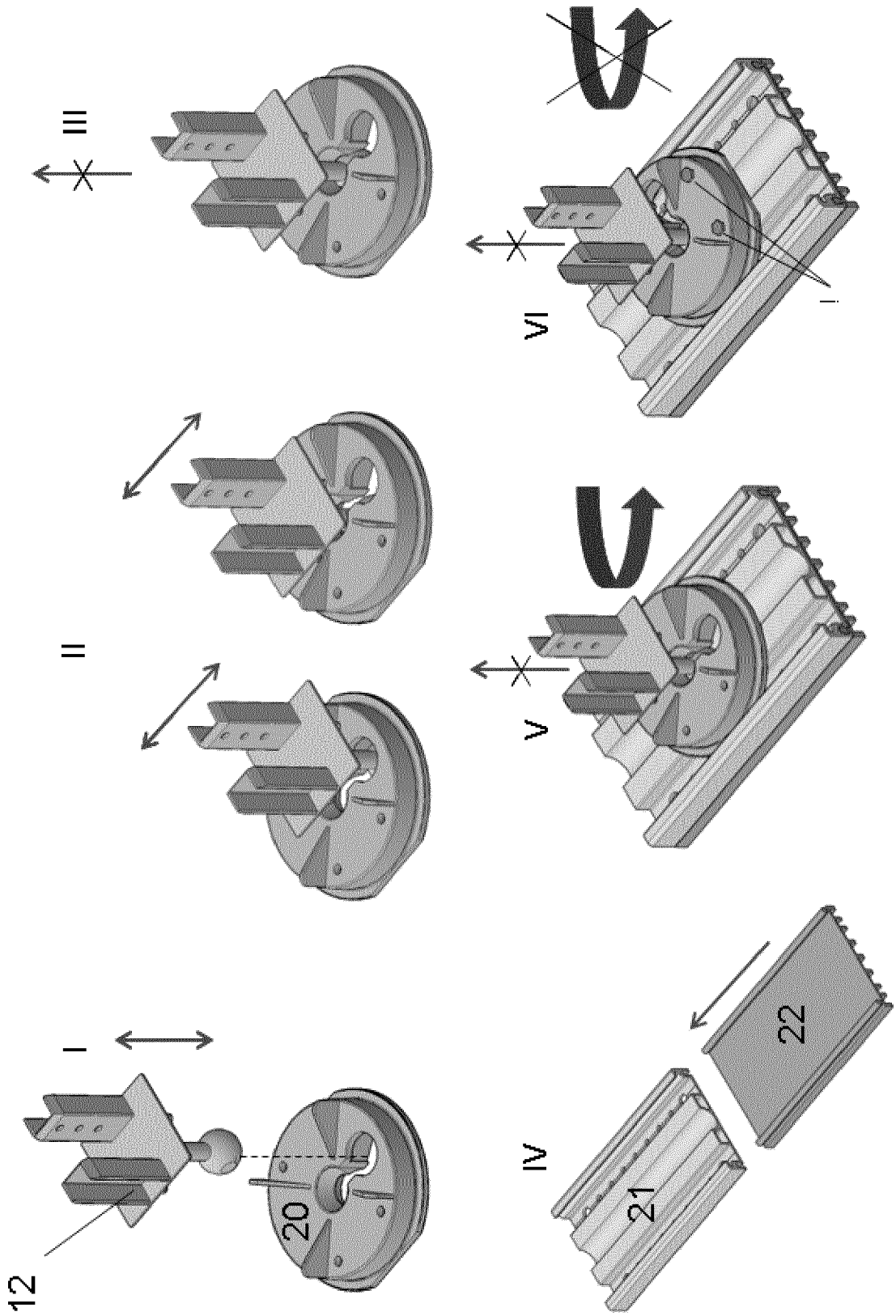


Figure 16

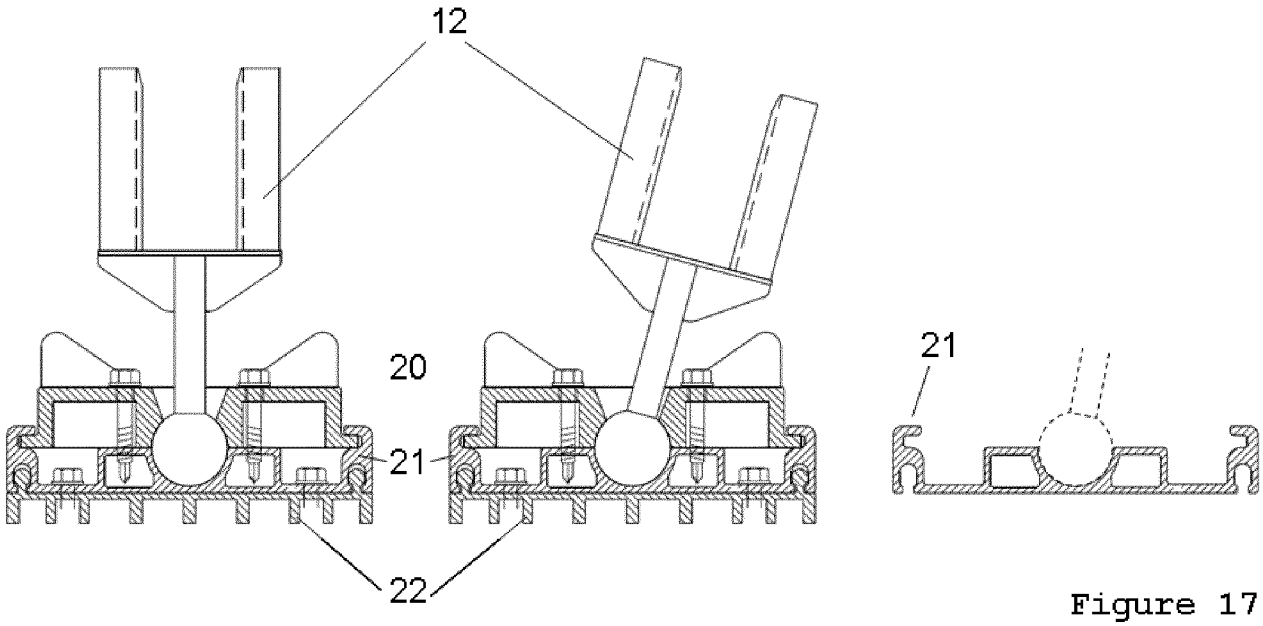


Figure 17

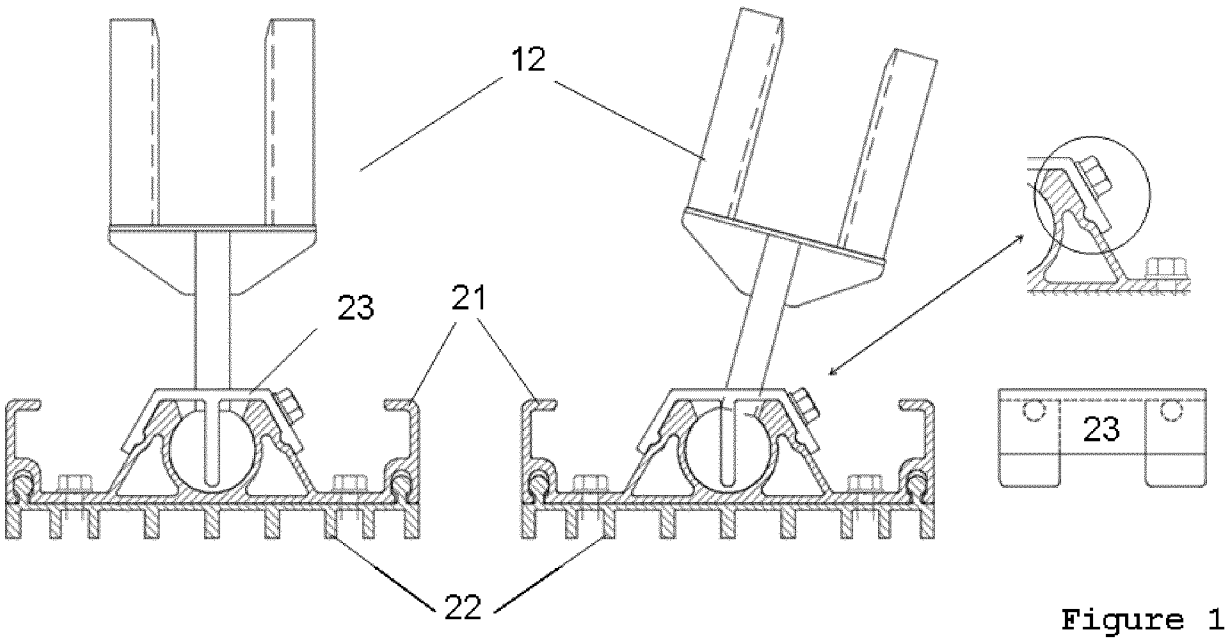


Figure 18

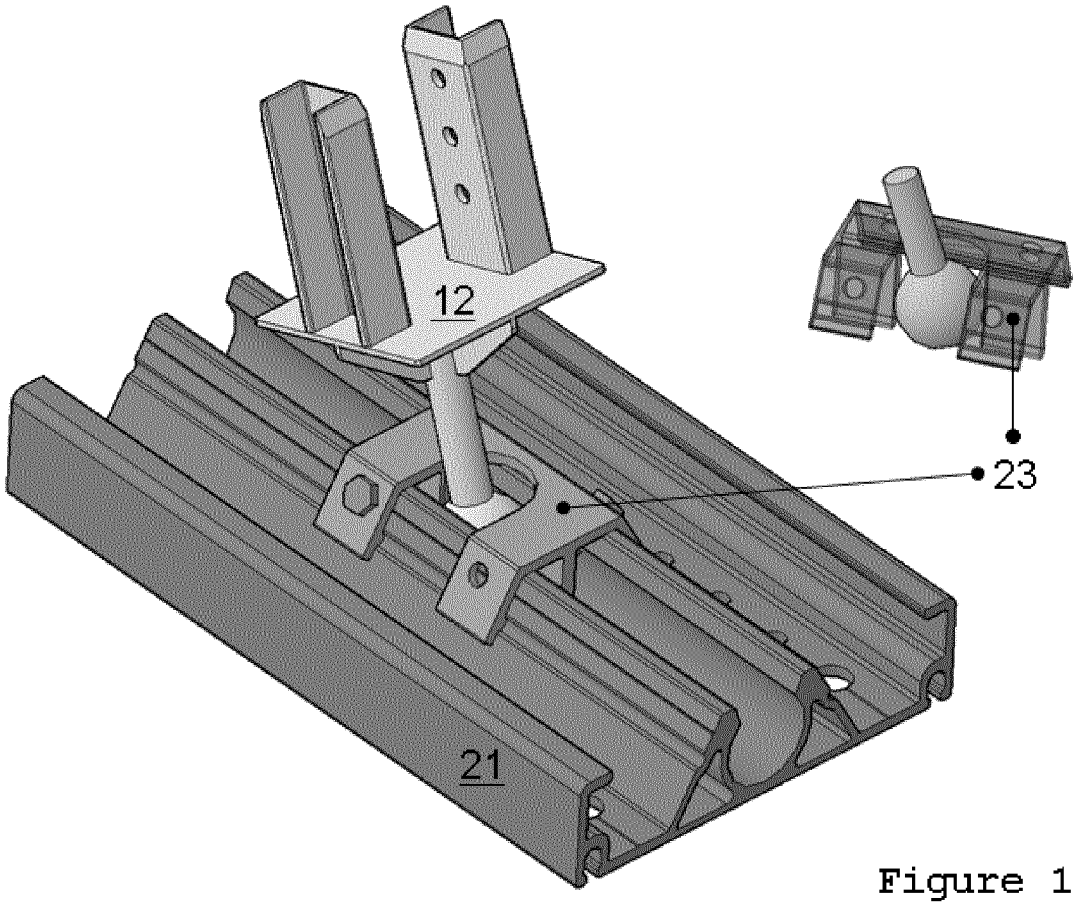


Figure 19

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2016/082217

A. CLASSIFICATION OF SUBJECT MATTER
INV. E04F13/08 E04D3/362 E04D3/361 E04F13/12
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E04F E04D

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2 448 411 A (TOY JOHN [GB]) 15 October 2008 (2008-10-15) abstract; figures 1-5	1-15
A	DE 27 08 699 A1 (VKI RHEINHOLD & MAHLA AG) 7 September 1978 (1978-09-07) claim 1; figures 1-10	1-15
A	DE 90 04 887 U1 (STRUKTUR FASSADEN- UND KUNSTSTOFFTECHNIK GMBH) 12 July 1990 (1990-07-12) figures 1,2	1-15

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
4 April 2017	25/04/2017

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

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2016/082217

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2448411 A	15-10-2008	NONE	
DE 2708699 A1	07-09-1978	BE 864371 A2	16-06-1978
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