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

(11) EP 1 564 342 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
17.08.2005 Bulletin 2005/33

(51) Int Cl.[7]: **E04D 3/35**, E04D 3/365

(21) Application number: **04447041.7**

(22) Date of filing: **13.02.2004**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PT RO SE SI SK TR
Designated Extension States:
AL LT LV MK

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(54) Isolating roofing element

(57) The invention relates to a roofing element (1), comprising an upper (2) and a lower (3) layer of sheet material, which are spaced apart from each other, and in between and bonded thereto, an intermediate layer (4) of an insulating material, and is characterized in that the intermediate layer (4) partly fills the space between the upper and lower layers, so as to form along a first side of the element, a first projection portion (5) on the lower layer for attaching the roofing element to the roof substructure, and a second projection portion (6) on the upper layer, which first and second projections (5) and (6) enclose an open space (7), said roofing element further comprising a protruding portion (8) at a second side of the element, which protruding portion (8) is engageable with open space (7) of a second shape-similar element to join the two roofing elements.

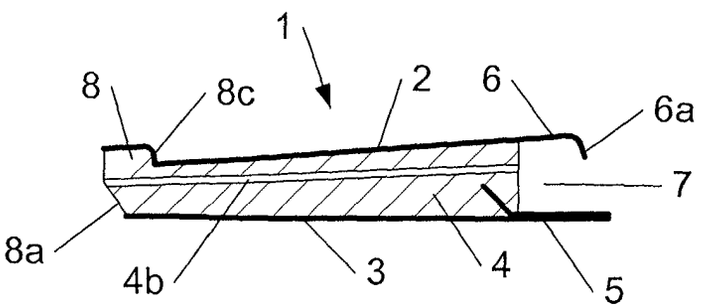

Fig. 2

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Description

[0001] The invention relates to a roofing element comprising an upper and a lower layer of sheet material, which are spaced apart from each other, and in between and bonded thereto, an intermediate layer of an insulating material.

[0002] Such a roofing element is known from WO 0015924. In WO 0015924, a roofing element is described comprising two metal skin layers and an insulating core of a plastic material. The known roofing material is made by pressing two metal sheets and the intermediate polymer layer together to form an element with the shape of one or a plurality of contiguous roof tiles. Such a roofing element may for instance be used in the construction of so called overlay roofs, i.e. roofs which are laid over an already existing roof, for example in cases where the existing roof shows leakage. The upper metal sheet may be covered with a coloured coating, having a rough surface, in order to imitate the appearance of a clay or slate roof tile.

[0003] When constructing an overlay roof, a wooden framework is typically applied over the existing roof, onto which framework the roofing elements are attached by nails. Due to the specific construction of the known roofing element the nails necessarily show on the outside of the placed element.

[0004] Besides being undesirable from a purely esthetical point of view, the places where the nails show through the surface are prone to attack from rain, wind and other corrosive agents. Deterioration and wear of the roofing elements therefore are likely to initiate at these locations. Moreover it has been found that in many circumstances the heat and sound isolating properties of the known roofing element are not at the desired level and therefore need improvement. In such cases, it is necessary to provide separate isolating material underneath the roof elements, or alternatively underneath the existing roof. Positioning this additional material means extra work and is therefore costly. Another disadvantage of the known roofing element is that it needs to be supported at its four sides by the substructure, in other words it is not possible to attach it to the substructure partly floating. If one attempts to do this, the resulting roof will be slack, will show undesirable undulation, and will be prone to wind cluttering.

[0005] The aim of the invention is therefore to provide a roofing element with improved isolating properties which can be attached to a roof substructure in such a way as to not show any nails on the outside when in place.

[0006] It has now been found that this aim can be achieved by a roofing element having the technical features of the characterizing part of claim 1. In the roofing element according to the invention the intermediate layer (4) partly fills the space between the upper and lower layers, so as to form along a first side of the element, a first projection portion (5) on the lower layer for attaching the roofing element to the roof substructure, and a second projection portion (6) on the upper layer, which first and second projections (5) and (6) enclose an open space (7), said roofing element further comprising a protruding portion (8) at a second side of the element, which protruding portion (8) is engageable with open space (7) of a second shape-similar element to join the two roofing elements.

[0007] The roofing element according to the invention can be placed on a roof very expediently. Moreover it has excellent heat and sound isolating properties, and results in a decreased condensation on the inside of the roof compared to the state of the art roofing element. Condensation on the lower layer of the roofing element is decreased since the intermediate layer effectively isolates the lower layer from the temperature conditions outside, as experienced by the upper layer.

[0008] Another advantage of the roofing element according to the invention is that it can be attached onto the substructure with one or more sides floating, due to its much higher rigidity than the known element.

[0009] With shape-similar elements are meant any two elements, which are identical in shape, and/or any two elements having substantially identical attachment means (5, 6, 7 and 8). The attachment means according to the invention comprise the first projection 5 and second projection 6 with their enclosed space 7, and protruding portion 8.

[0010] The first side of the roofing element is preferably defined as the side which, when in place on a tilted roof, faces downward to the rim of the roof (the front end of the element). This is also the side a person faces when standing on the ground and looking upwards to the roof. The second side is preferably defined as the side opposite to the first side. This corresponds to the rear end of the element, when the first side corresponds to the front end. When in place on a roof, this second side preferably faces the ridge of the roof.

[0011] The sheet material of the element according to the invention may be any material with sufficient flexural stiffness. Under sufficient flexural stiffness is understood a flexural stiffness comparable to the flexural stiffness of a metal sheet of about 50 μm. Suitable materials are plastic materials, for instance polyolefin polymers such as polyethylene and/or polypropylene, styrene polymers such as polystyrene and/or copolymers thereof such as acrylonitrile-butadiene-styrene (ABS), polyamides, polycarbonates and the like. Thermosetting materials may also be used such as for instance unsaturated polyester resins, epoxy resins, and polyurethanes. All of these polymeric materials may be reinforced with fibres, such as glass, aramid, carbon, and/or ultra high molecular weight polyethylene fibres. Sufficient flexural stiffness of the sheet material may also be achieved by providing the upper and lower layer of the roofing element with ribs. Preferably the sheet material of the element according to the invention is made of a metal. Suitable metals are for instance steel, aluminium, zinc, cop-

per or alloys thereof. Most preferred is steel. The steel sheet may be used as such, but preferably a steel sheet is used provided with a protecting zinc or aluminium coating. The metal sheet preferably has a thickness in the range of 50 μm - 2 cm, more preferably 100-800 μm, still more preferably 300 - 600 μm, in order to obtain a roofing element having sufficient strength and rigidity, the weight of which is not becoming excessively large. Metal sheet of a thickness between 300-600 μm may be easily moulded into the desired shape, without thereto having to heat the sheet or to use excessively high pressures. The upper and/or the lower layer of the element according to the invention preferably are made of a multilayer material comprising at least two metal sheets and in between a polymer film material, such as described in WO 0015924. This provides for an improved heat and/or sound isolation.

[0012] The roofing element of the invention may be provided with a coloured finishing coating if so desired, in order to give the element the appearance of a normal tiled roof as well as possible.

[0013] The insulating material of the intermediate layer of the invented roof element may be any material with heat and/or sound isolating properties. Suitable materials are for instance foams of polystyrene (PS), polyvinyl chloride (PVC), and/or polyurethane (PUR). Of these PUR is the preferred foam material, due to its particular properties and ease of application. It is also possible to use so called syntactic foams, i.e. polymeric materials filled with hollow particles, such as glass beads and the like.

[0014] The two sheet layers and the intermediate layer must be bonded to each other to provide the necessary properties. With 'bonded thereto' is understood that after a roofing element has been produced the intermediate layer has, at least where it filled the space between the upper and lower layers, an intimate contact with the two skin layers of the element, meaning that no substantial pockets or air (in the order of several cm) are present between skin and core. Bonding should be such as to allow skin and core to mechanically cooperate with each other. Of course the exact degree of bonding depends on other factors such as the specific chemistry of the foam material, the surface roughness and material of the skin sheets, specific processing circumstances, and the like.

[0015] The invention also relates to a method of exterior sheathing a roof with a plurality of roofing elements according to the invention onto a previously provided roofing element support structure, and comprises substantially of repeating the steps of positioning a first roofing element on the support structure, securing said element onto the support structure by attaching its first projection (5) onto the support structure, positioning a second roofing element by hooking protrusion (8) of the second element under a suitable angle under second projection (6) and into open space (7) of the first element, and rotating the second element into its final position, coplanar with the first element, whereby the final position is intermediate a first final position, corresponding to an engagement of overhang (6a) of the first element with surface (8c) of protrusion (8) of the second element, and a second final position, corresponding to an engagement of rear surface (8a) of the second element with the front surface (4a) of the first element, where after the second element is optionally secured to the support structure by attaching its protrusion portion (5) to the support structure.

[0016] The roofing element support structure may be any suitable structure able to be applied onto a roof. Suitable support structures may be continuous surfaces of wood and/or metal. A typical support structure consists for instance of a plurality of wooden beams running vertically from the ridge to the lower edge of the roof, and beams running horizontally to form a crosswise network of beams. The distance between the beams (and therefore the density of the beam network) is usually adapted to the dimensions of the roofing tiles or elements to be applied to the roof. An advantage of the roofing element according to the invention is that the density of the beam network can be low, thereby saving material and working time. Indeed the roofing element according to the invention has such low weight that it can have lateral (with respect to the roof) dimensions of up to 1 - 2 meters wide, incorporating the shape of up to 5 - 10 contiguous roof tiles. Moreover the roofing element according to the invention provides a stiffness, which allows to span distances of for instance 1 -2 meters easily. Therefore, even if one uses roofing elements of for instance 1 m wide, and a support structure with beams about 2 m apart, it is possible by overlapping the roofing elements over a part of their side surfaces to obtain a sturdy overlay roof.

[0017] Preferably the method of exterior sheathing a roof with a plurality of roofing elements according to the invention is characterized by not securing the second element to the support structure by attaching its protrusion portion (5) to the support structure. In this way substantial working time is saved. Also there is now no need to have a supporting horizontal beam at every securing position. Securing every roofing element is possible with the roofing elements of the invention since by 'clicking' every second element into a first element, all roofing elements will eventually form a continuous structural roof structure providing its own flexural stiffness.

[0018] The invention also relates to a process for the manufacture of a roofing element according to the invention, whereby a mould is provided with two separable and heatable mould halves with at least one inlet port for accepting foamable material and at least one venting port to allow air to escape from the mould, whereby at least two layers of preformed sheet material are laid into the mould with their protruding portions outside of the mould and such that an intermediate open space to accept the foamable material is created between them, where after the mould is closed, foamable

material is injected into the mould, the foamable material is allowed to expand and harden, where after the mould is opened and the finished roofing element is removed.

[0019] The heatable mould halves have substantially the same shape as the preformed sheet materials, although slight variations may be possible. Although not necessary, heating means may be provided to be able to harden out the foamable intermediate material more expediently. These heating means, which may be electrical, and/or based on circulating water, oil, or the like, are provided according to well-known practices. The mould is provided with at least one inlet port for receiving the stream of foamable material. At least one venting port is provided at a downstream location with respect to the inlet port. This venting port serves to evacuate substantially all air entrapped inside the mould prior to and during injection of the foamable material. Typically two layers of preformed sheet material are laid into the mould. However it is possible to provide more layers of sheet material if necessary. Preforming of the sheet materials is done in a separate well-known process step, described for instance in WO 0015924. Typically to perform the sheet material, it is cut to size from the roll and then heated in a furnace during a pre-determined time where after it is compression moulded in a press to the desired shape. After demoulding and optionally some edge trimming if necessary, the shaped sheet is ready to be processed further, according to the method of the invention.

[0020] A preferred process for the manufacture of a roofing element according to the invention is a process whereby the volume of the injected foam material is chosen such that its volume under free expansion is at least 5%, preferably 10% larger than the volume of the space to be filled by the foam material. In this way, a better bond between core and facing layers is obtained.

[0021] The roofing element and the method of exterior sheathing a roof with the roofing elements according to the invention are further elucidated by means of the attached figures, without however being limited thereto.

[0022] Figure 1 shows a top view of the roofing element of the invention;

[0023] Figure 2 shows a cross section of the roofing element of the invention, along the line X-X;

[0024] Figure 3 shows a cross section along the line X-X of two roofing elements of the invention, in a state to be engaged (Fig. 3a), and in the final engaged state (Fig. 3b and Fig. 3c).

[0025] Referring now to Fig. 1 and 2, a roofing element 1 is shown which comprises an upper layer 2 and a lower layer 3 which are made of metal sheet. The upper layer 2 is defined as the visible layer, facing the sky, when the roofing element 1 is in place on a roof. This upper layer 2 preferably has the shape of a plurality of contiguous roof tiles, as shown in Fig. 1. The upper layer 2 and lower layer 3 can be made of the same material or of different materials, but they are preferably made of the same material. The upper layer 2 and lower layer 3 are preferably made of steel sheet, which is provided on the roll. Preferably the steel sheet is on one side provided with a protective coat in order to inhibit or at least delay corrosion. Between the upper layer 2 and lower layer 3 an intermediate layer 4 of a polyurethane foam is present. The two layers 2 and 3 are bonded to the polyurethane foam material, preferably without leaving any air pockets of substantial size between them. The bond may for example be effected by means of an adhesive, applied between the foam material 4 and the two layers 2 and 3. However direct chemical and/or physical bonding between the polyurethane foam material 4 and the steel layers 2 and 3, is preferred. The polyurethane intermediate layer 4 partly fills the space between the upper and lower layers 2 and 3, so as to form a first projection portion 5 on the lower layer and a second projection portion 6 on the upper layer. The polyurethane foam material 4 may extend over the entire width to both sides AB and CD of the roofing element 1 (Fig. 1). However as indicated in Fig. 1 it is preferred to also partly fill the space between upper and lower layer in the width direction (area DEFG) so as to leave an open space (substantially formed by the area AGF'B). This open space at at least one side of the roofing element can advantageously be used to engage in overlapping arrangement a second roofing element. In this way two elements support each other mechanically in the lateral direction of the roof, which improves the sturdiness of the overlay roof as a whole. Preferably, the inner layer 4 is profiled along the side GF such that a second similar element can engage with a first element along this side in an interlocking manner. To this end the inner foam layer may for instance have a Z-shaped profile on the side GF, into which a second element having an inverse Z-profile on the side may interlock. Other solutions are also possible.

[0026] The first and second projection portions 5 and 6 preferably extend over substantially the entire width of the element. However it is also possible that they extend over part of the width of the element only. It is likewise possible that the first and/or the second projection portion actually form a plurality of first and second projection portions with limited width, spaced along the width direction of the roofing element.

[0027] First and second projection portions 5 and 6 enclose an open space 7 between the two layers 2 and 3, which open space 7 is to receive the rear part of a second roofing element according to the invention, in order to interlock the two elements. The rear part of the roofing element according to the invention comprises a protruding portion 8 with a front surface 8c. The second projection portion 6 of the front part of an element is preferably provided with an overhang 6a, which can cooperate with surface 8c to provide a fit of two adjacent elements. The first projection portion 5 of lower layer 3 is used to attach the roofing element to the roof substructure. First projection portion 5 is preferably formed by folding back the lower layer of sheet metal over some

distance from its free edge onto itself and folding the rim at least over some distance upwards to form an upstanding part 5a. This part 5a preferably extends into the foam core and secures a solid connection between lower layer 3 and the foam core 4. Also, in this way the first projection portion 5 forms a solid connection of the roofing element to the roof substructure. The roofing element can be secured to the roof substructure by all possible attaching means. It is for instance possible to glue the roofing element with its first projection portion 5 onto the roof substructure. Nailing the roofing element with its first projection portion 5 onto the roof substructure however is the preferred method.

[0028] A suitable and preferred manner by which two elements 1 and 2 are attached on the roof and to each other is illustrated in Fig. 3. For clarity the roofing elements 1 and 2 are depicted horizontally. It is however understood that in normal operation the roofing elements are tilted over some angle to follow the pitch of the roof. First a roofing element support structure is provided onto the roof. This is usually a truss work of horizontally and vertically installed wooden or steel beams. The first element 1 is laid onto the roof in such a manner that its first projection portion 5 extends along a beam 9 of the support structure. The first projection portion 5 is then secured to the beam 9 of the support structure, preferably by driving nails 10 into beam 9 intermittently over some distance in the width direction of the roofing element. Thereafter a second roofing element 2 is positioned with its rear protruded portion 8 in close vicinity of the front rim 6a of the first already secured element 1. The second element 2 is hold at such angle (in normal operation the second element is hold preferably in a substantial horizontal position) that protrusion 8 can be hooked under second projection portion 6 of the upper layer of first element 1, such as shown in Fig. 3a. Thereafter second element 2 is rotated in the indicated direction R around approximately point O until its final position is reached, which is substantially coplanar with first element 1. It is to be understood that the dimensions of protrusion 8, open space 7, projecting portions 5 and 6, and optional overhang 6a and surface 8c should be adapted to be able to perform the hooking and rotating operation described above. It is however quite apparent to the person skilled in the art how this can be accomplished. For instance the distance left by the under rim of optional overhang 6a and the bottom layer first projection portion 5 should be larger than the height of the rear part, just before protrusion 8. Also open space 7 should be large enough in order to be able to enclose protruded portion 8 completely. Also the rotation around point O should be possible. There are several obvious options to the skilled person to achieve this. One option is to use compliant intermediate layer material 4, which can be compressed during the rotation. Another preferred solution is to round off the rear surface 8a of protruded portion 8, such as indicated in Fig. 3, forming a multi-faceted rear surface 8a. The rear surface of the roofing element is defined by edge AD (Fig. 1). This surface is facing the ridge of the roof when properly in place. The front surface is defined by edge BC, which is facing the lower edge of the roof, when properly in place. The side surfaces of the roofing element are defined by edges AB and CD on Fig. 1.

[0029] Fig. 3b and 3c show two roofing elements 1 and 2 according to the invention in an engaged final position. In Fig. 3b a first final position is depicted, corresponding to an engagement of overhang (6a) of the first element 1 with surface (8c) of protrusion (8) of the second element 2. In Fig. 3c a second final position is depicted, corresponding to an engagement of rear surface (8a) of the second element with the front surface (4a) of the first element. In the first final position an open space is left open between the two elements which extends between surfaces 4a of the first and 8a of the second element, and substantially over the entire width of the elements. This left open space may act as a heat or sound leak, which is less preferred. The intermediate polyurethane foam layer therefore is preferably provided with open channels 4b, which extend from the rear surface 8a to the front surface 4a. Through these channels additional foamable material is preferably injected into the left open space once a first row of roofing elements has been secured onto the roof, thereby substantially filling said left open space with isolating material. A roof laid with roofing tiles engaged to each other according to the second final position does not have this drawback. Although a left open space is now defined by surfaces 8c and 6a and extends substantially over the entire width of the elements, this left open space does not act as a heat and/or sound leak, since said space is suitably isolated from the inside protruded portion 8. The second final position is therefore preferred. The roofing element according to the invention has the additional advantage that slight variations in the dimensions of the support structure truss work can easily be accommodated by attaching a first row of elements to a second row of elements in positions intermediate the first and second final position. This is not possible with the known roofing element since these elements are necessarily attached to each other and to the roof support structure by nailing cooperating protruded parts of two elements.

[0030] After securing a second element 2 onto a first element 1 as described above the second element is optionally secured to the support structure by attaching its protrusion portion 5 to the support structure. Attaching the second element to the roof structure is optional since the specific way the roofing elements of the invention are secured to each other allows locking the second element substantially free into the first element.

[0031] According to this invention, the term roofing element relates not only to the element corresponding to a roof tile, and intended for the construction of a roofing, as described above, but also to any additional and related accessories, such as for example the upper tile, the ridge tile, the sidings, etc.

[0032] To manufacture the roofing element according to the invention, mostly a steel sheet rolled into a bobbin is used for one or both of the skin layers 2 and 3. The steel sheets are typically first preformed into their desired shape by heating and compression moulding according to well-known practice. Suitable shapes for the upper layer of sheet material include substantially flat and corrugated shapes, which may extend parallel to the lower layer or have some angle with respect to the lower layer of the element. A preferred shape for the upper layer is a plurality of contiguous roof tiles with side portions engageable upon each other, such as shown in Fig. 1. The shape of the lower layer may be identical or similar to the upper layer, except for the attachment means. A preferred shape of the lower layer is a substantially flat shape with an edge part folded back onto itself over some distance from its free edge with a rim folded upwards at least over some distance to form an upstanding part 5a. The to be moulded foam core preferably extends to and encloses part 5a in order to secure a solid connection between lower layer and the foam core. The preformed steel sheets are subsequently brought into a heatable mould in such a way that the parts, which will, after moulding, form the protruded parts (5) and (6) of the roofing element, extend outside the mould. By resting these parts onto the edge of the mould halves, the necessary distance between upper and lower layer is secured automatically. An alternative is to provide the inner space of the mould with distance keepers, which may, for instance, be in the form of pins protruding from the inner wall of the mould. After placement of both skin layers the mould halves are closed and secured to be able to withstand the processing pressure. An injection tube is then attached to the inlet port of the mould and a predetermined amount of foamable material is injected into the cavity formed by the upper and lower skin layer. It may be necessary to provide the mould surfaces with a suitable release agent. It is also possible to use release film or foil. The mould is then held at a suitable temperature for a predetermined period of time, to allow the foamable material to expand into a foam, to harden, and to form a suitable bond with the skin layers. It is advantageous to turn the mould during hardening of the foamable material to be able to dispose of any entrapped and/or formed air pockets between skins and core. Preferably the mould is held such that the upper surface of the roofing element faces upward while the foamable material expands and hardens. After the hardening time recommended by the supplier of the foamable material has expired, the mould is opened and the roofing element removed from the mould where after it is cooled to room temperature.

[0033] Another suitable method to manufacture the roofing element according to the invention comprises all steps as described above. To create the channels 4b in the foamed core of the sandwich, metal pins are inserted into the mould from the outside through the mould wall at the desired locations. Prior to demoulding these pins are first removed.

[0034] Another suitable method to manufacture the roofing element according to the invention comprises providing at least two skin layers of shape and nature, as described above, and a preformed core foam, with an upper face shaped to coincide with the upper layer shape, and a lower face shaped to accommodate the lower layer, and with overall length and width dimensions smaller than those of upper and lower skin, as to form the attachment means according to the invention. The foam core is then bonded to either upper or lower layer with a suitable adhesive, where after the as yet unbonded skin layer is bonded to the foam core.

Example

[0035] Two preformed steel sheets, each having a thickness of 0.3 mm and being coated with a zinc-aluminium coating are placed into a mould with their coating facing the mould surface. Components A and B of polyurethane foamable material supplied by Nestaan Holland BV of Tholen, The Netherlands, is prepared according to the instructions of the supplier by mixing 100 parts of A and 100 parts of B. The mixed polyurethane foamable material is injected into the closed mould at a temperature of 25 °C (room temperature), using a common injection unit, at an injection speed of 300 g/min. After about 5 minutes the mould is opened and the finished roofing element removed from the mould. The polyurethane foam had a density in the formed panel of about 45 kg/m3. The dimensions of the moulded panel were approximately 37 cm wide and 150 cm high. The distance between upper and lower sheet varied linearly from 2,5 cm at the rear end to 5,5 cm at the front end.

Claims

1. Roofing element (1), comprising an upper (2) and a lower (3) layer of sheet material, which are spaced apart from each other, and in between and bonded thereto, an intermediate layer (4) of an insulating material, **characterized in that** the intermediate layer (4) partly fills the space between the upper and lower layers, so as to form along a first side of the element, a first projection portion (5) on the lower layer for attaching the roofing element to the roof substructure, and a second projection portion (6) on the upper layer, which first and second projections (5) and (6) enclose an open space (7), said roofing element further comprising a protruding portion (8) at a second side of the element, which protruding portion (8) is engageable with open space (7) of a second shape-similar element to join the two roofing elements.

2. Roofing element according to claim 1, **characterized in that** the second projection portion

(6) on the upper layer has an overhang (6a), pointing towards the first projection portion (5).

3. Roofing element according to claim 1 or 2, **characterized in that** the rear surface (8a) of protruding portion (8) is rounded off to form a multifaceted surface.

4. Roofing element according to any one of claims 1 -3, **characterized in that** the material of the intermediate layer is a polyurethane foam.

5. Roofing element according to any one of claims 2 - 4, **characterized in that** the surface (4a) of the intermediate layer adjacent to open space (7) has the same geometrical shape as surface (8a) of the protruding portion (8), such that surface (4a) can form a mating surface with surface (8a) of a second adjacent shape-similar element.

6. Roofing element according to any one of claims 1 - 5, **characterized in that** it contains at least one open channel (4b), running through the intermediate layer and connecting surfaces (4a) and (8a).

7. Method of exterior sheathing a roof with a plurality of roofing elements as claimed in any one of claims 1 - 6 onto a previously provided roofing element support structure, comprising substantially of repeating the steps of positioning a first roofing element on the support structure, securing said element onto the support structure by attaching its first projection (5) onto the support structure, positioning a second roofing element by hooking protrusion (8) of the second element under a suitable angle under second projection (6) and into open space (7) of the first element, and rotating the second element into its final position, substantially coplanar with the first element, whereby the final position is intermediate a first final position, corresponding to an engagement of overhang (6a) of the first element with surface (8c) of protrusion (8) of the second element, and a second final position, corresponding to an engagement of rear surface (8a) of the second element with the front surface (4a) of the first element, where after the second element is optionally secured to the support structure by attaching its first projection portion (5) to the support structure.

8. Method of exterior sheathing a roof according to claim 7, **characterized in that** the second element is positioned into the second final position by pushing it upward to engage its rear surface (8a) with the element

9. Process for the manufacture of a roofing element according to any one of claims 1 - 6, whereby a mould is provided with two separable and heatable mould halves with at least one inlet port for accepting foamable material and at least one venting port to allow air to escape from the mould, whereby at least two layers of preformed sheet material are laid into the mould with their protruding portions outside of the mould and such that an intermediate open space to accept the foamable material is created between them, where after the mould is closed, the foamable material is injected into the mould, the foamable material is allowed to expand and harden, where after the mould is opened and the finished roofing element is removed.

10. Process according to claim 9, whereby the volume of the injected foamable material is chosen such that its volume under free expansion is at least 5%, preferably 10% larger than the volume of the space to be filled by the foam material.

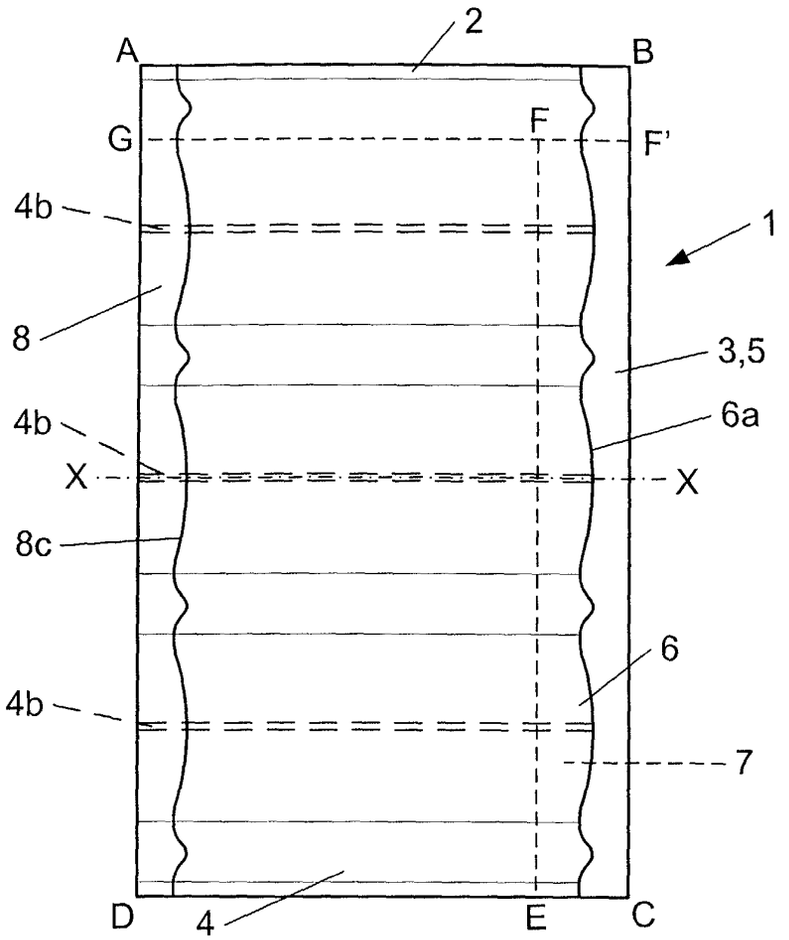

Fig. 1

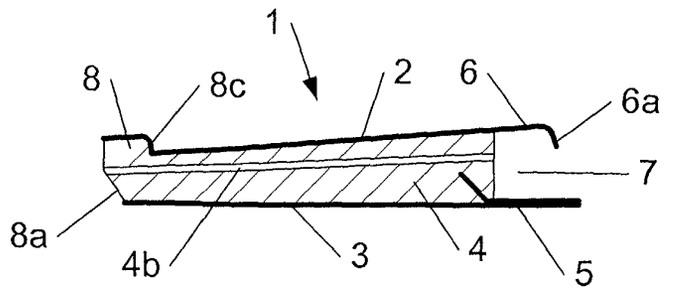

Fig. 2

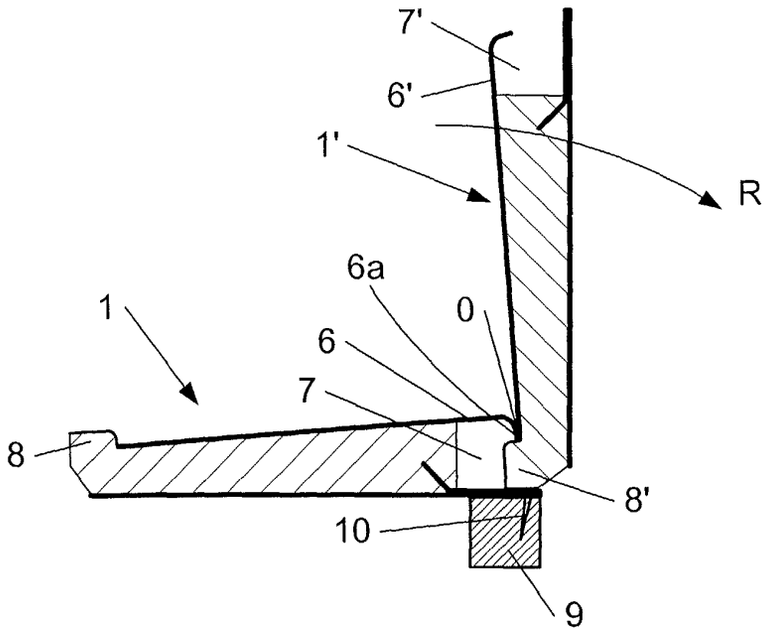

Fig. 3 a

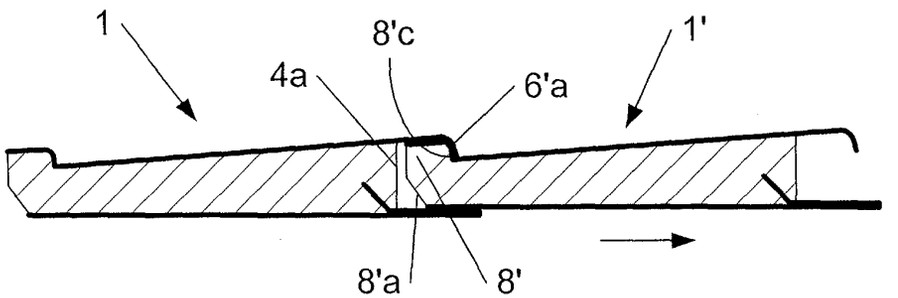

Fig. 3 b

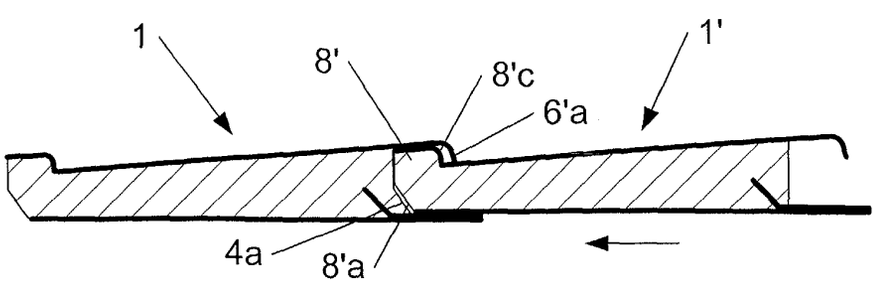

Fig. 3 c

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Application Number
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The present search report has been drawn up for all claims

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The Hague	23 July 2004	Demeester, J

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