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(71) Applicant: **Lapwall Oyj**
92930 Pyhäntä (FI)

(72) Inventor: **PEKKARINEN, Jarmo**
92930 Pyhäntä (FI)

(74) Representative: **Berggren Oy**
P.O. Box 16
Eteläinen Rautatiekatu 10A
00101 Helsinki (FI)

(54) EXTERIOR WALL ELEMENT AND BUILDING

(57) An exterior wall element has a thermal insulation layer, which has a first surface and a second surface, a first surface plate (12), the material of which is metal, on the first surface of the thermal insulation layer, and a second surface plate (14) on the second surface of the thermal insulation layer. The water vapour permeability of

the second surface plate of the exterior wall element is substantially higher than the water vapour permeability of the first surface plate. The second surface plate can be a plaster board or wood fibre board suited as a windbreak plate of a building.

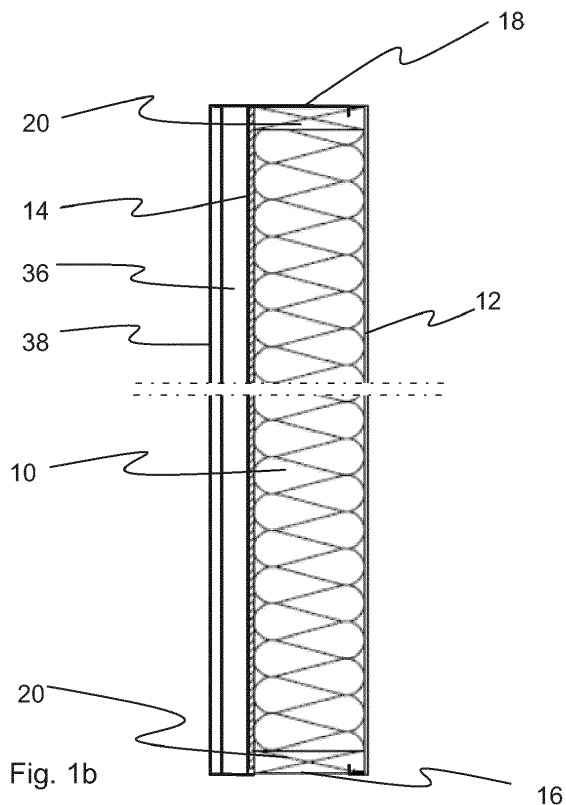


Fig. 1b

16

EP 4 567 219 A1

Description**Field of the invention**

5 **[0001]** The invention relates to an exterior wall element, which has a thermal insulation layer, which thermal insulation layer has a first surface and a second surface, a first surface plate, the material of which is metal, on the first surface of the thermal insulation layer, and a second surface plate on the second surface of the thermal insulation layer. The invention additionally relates to a building, which has an exterior wall, which exterior wall has exterior wall elements according to the invention.

Prior art

10 **[0002]** Especially in building exterior walls of industrial buildings, factory-made sandwich elements are generally used, which have ready a surface plate on the inside, a surface plate on the outside of the element, and a thermal insulation layer between the surface plates. The surface plates are thin metal plates, and they attach directly to the surface of the thermal insulation layer. The elements are installed in place on the exterior wall usually in a horizontal position, so that the long sides of elements on top of each other settle against each other. The surface plate on the inside and outside are surface treated by painting, whereby the exterior wall is in practice completed after the installation of the elements. The surface plate on the outside thus forms the outer cladding of the exterior wall and the surface plate on the inside forms the inner cladding of the wall. One such element system is described in publication EP2657426 B1.

20 **[0003]** The above-mentioned structure of the sandwich elements is challenging with regard to the constructions physical function of the exterior wall. According to the building manner recommended in building codes, the water vapour resistance of the exterior wall structure should be the highest on the inner surface of the exterior wall and the water vapour resistance should diminish when moving from the inner surface toward the outer surface of the wall. Additionally, a ventilation gap is recommended to be used between the outer cladding of the exterior wall and the thermal insulation layer, via which ventilation gap moisture possibly passing through the thermal insulation layer can be ventilated out of the wall structure. In the above-described sandwich elements, these generally proven principles are not realized. Therefore, moisture possibly ending up inside the sandwich element cannot leave from inside the element, which causes moisture damages in the exterior wall and a decrease of the thermal insulation capacity. Moisture damages of the exterior walls increase repair and maintenance costs of the building and decrease the value of the building.

25 **[0004]** In known sandwich elements, adjacent elements attach to each other only with the aid of a tongue and groove structure at the edges of the elements. The airtightness of such a tongue and groove structure is usually weak, which weakens the airtightness of the entire building and increases the need for heating energy.

30 **[0005]** Publication US2021180309 A1 describes an exterior wall element with a wood frame, on the inner surface of which there is an interior building plate and on the outer surface of which there is a hard thermal insulation plate. Between the hard thermal insulation plate and the interior building plate there is a thermal insulation layer and on the outer surface of the thermal insulation layer there is a weatherproof film. On the surface of the interior building plate there is a vapour barrier film, which can be made of polyethylene or metal foil. The rigidity and mechanical sturdiness of the film-like vapour barrier is so weak that it necessarily requires behind it the interior building plate.

35 **[0006]** An object of the invention is to provide an exterior wall element and a building, by which the problems relating to the prior art can be reduced. The objects of the invention are obtained with an exterior wall element and a building, which are characterized by what is presented in the independent claims. Some advantageous embodiments of the invention are presented in the dependent claims.

Brief summary of the invention

40 **[0007]** The invention relates to an exterior wall element, which has a thermal insulation layer, which thermal insulation layer has a first surface and a second surface, a first surface plate, the material of which is metal, on the first surface of the thermal insulation layer, and a second surface plate on the second surface of the thermal insulation layer. The water vapour permeability of the second surface plate of the exterior wall element is substantially higher than the water vapour permeability of the first surface plate.

45 **[0008]** In one advantageous embodiment of the exterior wall element according to the invention, the second surface plate is made of a different material than the first surface plate. Advantageously, the second surface plate is a plaster board or wood fibre board suited as a windbreak plate of a building.

50 **[0009]** A second advantageous embodiment of the exterior wall element according to the invention has a first side edge and a second side edge, which side edges have an edge beam, and a first end edge and a second end edge, which end edges have an end beam. Advantageously, there is at least one intermediate beam in the direction of the end beam between the first end edge and the second end edge.

[0010] In still another advantageous embodiment of the exterior wall element according to the invention, the material of the edge beams, end beams and/or intermediate beams is wood.

[0011] In still another advantageous embodiment of the exterior wall element according to the invention, the edge beam has an outer flat surface, a first border settling against the surface of the first surface plate and a second border settling against the surface of the second surface plate.

[0012] In still another advantageous embodiment of the exterior wall element according to the invention, the edges of the first side plate attaching to the edge beam have an edge strip, which is substantially perpendicular to the plane of the middle part of the first surface plate, which settles against the outer flat surface of the edge beam and on the outer surface of which edge strip there is a flexible and compressible sealing tape. Advantageously, the free edge of the edge strip has an attaching edging, which is substantially perpendicular to the edge strip, and the outer flat surface of the edge beam has a groove, into which the attaching edging is arranged.

[0013] In still another advantageous embodiment of the exterior wall element according to the invention, the outer flat surface of the edge beam has a first batten and a second batten, between which first and second batten there is a gap, into which gap a positioning member of the exterior wall element, such as lower guiding rail of a foundation, can be fitted.

[0014] In still another advantageous embodiment of the exterior wall element according to the invention, the surface of the second surface plate has supporting rails at a distance from each other, to which supporting rails the outer cladding is attached.

[0015] A building according to the invention has an exterior wall, which has exterior wall elements as described above. Preferably, exterior wall elements are arranged on the exterior wall so that the side edges of the exterior wall elements are substantially horizontal.

[0016] In an advantageous embodiment of the building according to the invention, the exterior wall has on top of each other at least two exterior wall elements, so that the second side edge of the lower exterior wall element settles against the first side edge of the upper exterior wall element, and the edge beams in the side edges settling against each other are attached together with mechanical attaching members, such as screws.

[0017] A second advantageous embodiment of the building according to the invention has a frame, which comprises at least two vertical load-bearing construction parts, such as pillars, which load-bearing construction parts are at a distance from each other, and the edge beams of said exterior wall elements are attached at their first end to the first construction part and at their second end to the second construction part.

[0018] An advantage of the exterior wall element according to the invention is that with its aid, exterior walls can be built, which function correctly with regards to moisture technology. The invention thus reduces the number of moisture damages and reduces service and reparation costs for buildings.

[0019] An advantage of one embodiment of the invention is that it increases bending resistance of the exterior wall element, which makes it possible to increase the length of the elements.

[0020] A second advantage of one embodiment of the invention is that it makes possible connecting elements on top of each other together in an easy and reliable way.

Brief description of the drawings

[0021] In the following, the invention will be described in detail. In the description, reference is made to the enclosed drawings, in which

figure 1a shows as an example an exterior wall element according to the invention seen from the side,

figure 1b shows the exterior wall element shown in figure 1a as a cross-sectional view,

figure 1c shows a partial magnification of the cross-section of the exterior wall element by the second side edge,

figure 2 shows as an example a building according to the invention seen diagonally from above,

figure 3a shows as an example two exterior wall elements installed on top of each other in the building of figure 2 as a cross-sectional view,

figure 3b shows a partial magnification of the cross-sections of two exterior wall elements installed on top of each other by the side edges,

figure 3c shows a partial magnification of the cross-section of one embodiment of the exterior wall element by the first side edge and

figure 3d shows as an example the joint between the exterior wall element and foundation of the building of figure 2 as a cross-sectional view.

Detailed description of the invention

[0022] Figure 1a shows as an example an exterior wall element according to the invention seen from the side and figures 1b and 1c show the same exterior wall element as a cross-sectional view. In the following all the above-mentioned figures are described simultaneously.

[0023] The exterior wall element is a plate-like construction part, which has two substantially parallel side edges, a first side edge 16 and a second side edge 18, and two substantially parallel end edges, a first end edge 17 and a second end edge 19. The side edges are substantially longer than the end edges, i.e. the exterior wall element has a rectangular shape. The width of the exterior wall element, i.e. the distance between the side edges, is advantageously 1200 mm. The length of the exterior wall element, i.e. the distance between the end edges, can be selected on a case by case basis. Typically, the length of the exterior wall element is 3,500 mm-10,000 mm, but the exterior wall element can also be over 20,000 mm long.

[0024] The side edges of the exterior wall element have edge beams 20, which extend from the first end edge 17 to the second end edge 19. The material of the edge beams is wood or a wood-based material. Between the edge beams there is a thermal insulation layer 10. The width and thickness of the edge beams can be selected as desired, based on the thermal insulation capacity required of the exterior wall element and/or the bending resistance required of the exterior wall element. The width of the edge beam can be for example 98 mm, 148 mm or 198 mm. The thickness of the edge beam can be 36-48 mm. Preferably, the thickness of the edge beam is 42 mm. Both end edges 17, 19 of the exterior wall element have end beams 31, and between the end beams there are a number of intermediate beams 33 at a distance from each other. The end beams and intermediate beams are attached at their first end to the edge beam in the first side edge 16 and at their second end to the edge beam in the second side edge 18. The spacing interval k/k of the end beams is advantageously 600 mm. The edge beams, end beams and intermediate beams advantageously have them same cross-sectional dimensions.

The connected edge beams, end beams and intermediate beams form a stiff frame of the exterior wall element.

[0025] The edge beams have an inner flat surface 21 toward the thermal insulation layer, an outer flat surface 22 defining the level of the side edge of the element, and a first border 24 and second border 26. The thermal insulation layer can be any material suited as thermal insulation of a building, such as mineral wool, glass wool, wood fibre insulation or plastic-based insulation material. The first surface of the thermal insulation layer has a first surface plate 12, so that the first border of the edge beam 20 settles against the surface of the first surface plate. Preferably, there are no construction parts affecting the sturdiness or construction physical function of the exterior wall element between the thermal insulation layer and the first surface plate, whereby the first surface of the thermal insulation layer is substantially over its entirety in direct contact with the first surface plate. The first surface plate is a thin metal plate, advantageously a steel plate. The thickness of the first surface plate can be 0.4-1.0 mm, preferably 0.45 mm. The thin metallic first surface plate is as a separate plate flexible, but when burdened in the direction of the plane of the plate and when attached to the frame of the exterior wall element, it is very rigid and can well withstand mechanical stress. The first surface plate extends as a uniform plate from the first side edge to the second side edge and from the first end edge to the second end edge. The first surface plate is already surface-treated, whereby it functions as a cladding plate on the inner surface of the exterior wall element, forming the innermost surface layer of the exterior wall element. The surface plate manufactured from metal has a very large water vapour resistance, so it functions in the exterior wall element simultaneously as an efficient vapour barrier layer.

[0026] The edges of the first surface plate in the direction of the edge beams have an edge strip 13, which is substantially at a perpendicular angle to the plane of the middle part of the first surface plate 12 and which settles against the outer flat surface 22 of the edge beam 20. The free edge of the edge strip has an attaching edging 15 bending from the plane of the edge strip to a perpendicular angle toward the edge beam. The outer flat surface of the edge beam has a groove 27, inside which the attaching edging settles. The first surface plate is attached to the borders of the edge beam, end beams and intermediate beams with glue. The glue can be any glue or insulation material containing glue substance, such as polyurethane foam, suitable for gluing wood and metal. Additionally, the first surface plate is attached by both edges to the edge beams and by both ends to the end beams by nailing. Preferably, the nails used for attaching the edges are placed in the edge strip part of the first surface plate, whereby the heads of the nails do not remain visible in the exterior wall element installed in place in a building.

[0027] The second surface of the thermal insulation layer has at least one second surface plate 14, so that the second border 26 of the edge beam 20 settles against the surface of the second surface plate. The second surface plate is made of some plate material suitable as a windbreak plate for exterior walls, such as plaster board or porous wood fibre board, so its water vapour resistance is substantially smaller than that of the first surface plate. Typically, the length of the exterior wall element is many times the length of a conventional windbreak plate, whereby the second surface of the thermal insulation layer usually has in line several second surface plates, which are attached together at their ends with a butt joint, so that the second surface plates cover the area delimited by the side edges and end edges substantially completely. The second surface plates are attached by their long side edges to the second border of the edge beams and by their end edges to the

end beam and/or intermediate beam. The second surface plates are also attached to those intermediate beams that are covered by the second surface plates. The attaching of the second surface plates to the beams can be done with nails, screws or preferably with staples. The thermal insulation layer 10 substantially completely fills the space delimited by the first and second surface plate, edge beams and end beams.

[0028] Supporting rails 36 are attached to the surface of the second surface plate 14 of the exterior wall element at a distance from each other, to which supporting rails the outer cladding 38 is attached. The distance between adjacent supporting rails can be 400-600 mm. The length of the supporting rails is substantially the same as the length of the exterior wall element, and the supporting rails are attached at their ends with a nail attachment to the edge beams 20. The outer cladding can be a panel cladding, a cladding made up of façade boards or a cladding made up of a corrugated or flat metal sheet. The outer cladding can be attached in place already at the element factory, or it can be attached to the wall element after the wall elements have been attached in place on the building.

[0029] Figure 2 shows as an example a building according to the invention seen diagonally from above. The building is an industrial hall building, which comprises a rectangular foundation 50 manufactured from reinforced concrete and exterior walls 100 rising from the upper edge of the foundation. Inside the exterior walls there is a load-bearing frame of the building, which supports the ceiling structures and roof 104. The load-bearing frame comprises pillars 102 at a distance from each other on the long side of the building.

[0030] The exterior walls 100 of the building are manufactured from exterior wall elements according to the invention, which elements are installed on top of each other on the upper edge of the building foundation, so that the side edges 16, 18 of the exterior wall elements settle substantially horizontally and the side edges of the exterior wall elements on top of each other settle against each other. In the joining point, the edge beams of exterior wall elements settling on top of each other are attached to each other with screws. The edge beams are similarly attached at their ends to the pillars with a screw attachment.

[0031] Figure 3a shows as an example two exterior wall elements installed on top of each other in the building of figure 2 as a cross-sectional view, and figure 3b shows partial magnifications of the cross-sections of two exterior wall elements installed on top of each other by the side edges 16, 18. In the following, both above-mentioned figures are described simultaneously.

[0032] The exterior wall elements are installed in place in the horizontal position so that the first side edge 16 of the upper exterior wall element, i.e. the lower edge, settles against the second side 18 of the lower exterior wall element, i.e. the upper edge. The edge beams 20 in the side edges of the exterior wall elements thus settle on top of each other, so that their outer flat surfaces 22 settle against each other. Between the flat surfaces settling against each other, a sealing strip 42 the length of the flat surface substantially the width of the entire flat surface is installed, which can be made of mineral wool or cellular plastic. In the surface of the edge strip 13 of the second side edge of the lower exterior wall element there is a flexible and compressible sealing tape 34, which extends from the first end edge of the exterior wall element to the second end edge (figure 3b). The sealing strip and sealing tape remain pressed between the edge beams of the exterior wall elements on top of each other, whereby the seam between the exterior wall elements becomes substantially airtight. Elements on top of each other are attached together with screws 40, which are screwed from the direction of the second surface plate 14 of the exterior wall element, so that the screws pass diagonally from the upper edge beam to the lower edge beam, attaching the edge beams together. After the exterior wall elements are installed in place, the outer cladding 38 is attached to their outer surface.

[0033] Figure 3c shows a partial magnification of the cross-section of one embodiment of the exterior wall element by the first side edge 16. In this embodiment, the first side edge of the exterior wall element, which in the exterior wall element installed in place is the lower horizontal side edge, is equipped with two battens in the longitudinal direction of the edge beam 20; a first batten 28 and a second batten 29. Both battens are the same kind of wood batten with a square-shaped cross-section, which are attached with nails to the outer flat surface 22 of the edge beam 20. The first batten is attached to the first edge of the edge beam, so that the side surface of the first batten settles against the first surface plate 12, and the second batten 29 is attached to the second edge of the edge beam, so that its side surface settles against the surface of the second surface plate 14. In this embodiment, the edge beam of the second side edge is placed at a distance as large as the height of the cross-section of the batten toward the thermal insulation layer, so that the width of the exterior wall element equipped with the battens is substantially as large as an exterior wall element without battens. The lowest surface of the first batten has a corresponding groove 27a to the one in the outer flat surface of the edge beam of the second side edge, and the attaching edging 15 of the first surface plate is fitted into the groove.

[0034] The combined width of the first and second batten is substantially smaller than the width of the outer flat surface 22 of the edge beam 20, whereby a gap 30 in the longitudinal direction of the edge beam is left between the battens. This gap functions as a space, which receives a positioning member which aids in installing the exterior wall elements in place. The positioning member can for example be a lower guiding rail 32 attached to the upper surface of the foundation (figure 3d). A beam-like positioning member corresponding to the lower guiding rail can be arranged also on the outer flat surface of the edge beam in the second edge of the exterior wall element. Thus, there is a tongue and groove joint formed by the positioning member and the battens in the seams between exterior wall elements on top of each other.

[0035] Figure 3d shows as an example the joint between the exterior wall elements and foundation 50 of the building of figure 2 as a cross-sectional view. The foundation shown in the figure is a reinforced concrete foundation with a rectangular cross-section commonly used in house construction, the inner surface of which foundation has a thermal insulation plate 52. The thermal insulation plate is made of some hard thermal insulation material, such as extruded polystyrene. Inside the area delimited by the foundation there is the reinforced concrete floor tile 54 of the building and below it the thermal insulation 56 of the floor. The lower guiding rail 32 of the exterior wall elements is attached to the upper surface of the foundation with screws 40. The width of the lower guiding rail is slightly smaller than the gap between the first and second batten 28, 29 of the exterior wall element. The lowest exterior wall element of the exterior wall of the building is installed in place on the foundation so that the lower guiding rail is placed in the gap between the battens in the manner shown in figure 3d. Before the exterior wall element is lowered into place, a felt-like sealing strip is installed on the lower guiding rail, and a sealing tape 34 is installed on the upper edge of the thermal insulation plate, by means of which the airtightness of the joint is secured. The exterior wall elements are attached to the lower guiding rail with screws 40, which are screwed from the direction of the outside of the building through the second batten 29 so that their tip sinks into the lower guiding rail.

[0036] Some advantageous embodiments of the exterior wall element and building according to the invention have been described above. The invention is not limited to the solutions described above, but the inventive idea can be applied in different ways within the scope of the claims.

List of reference numbers:

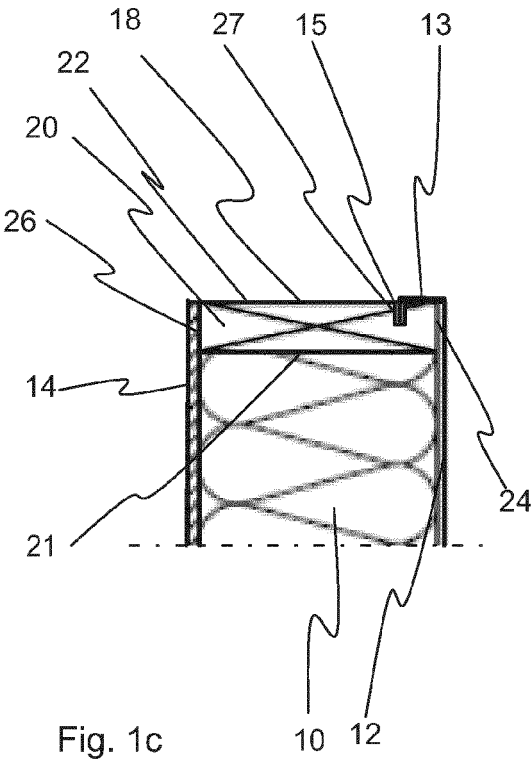
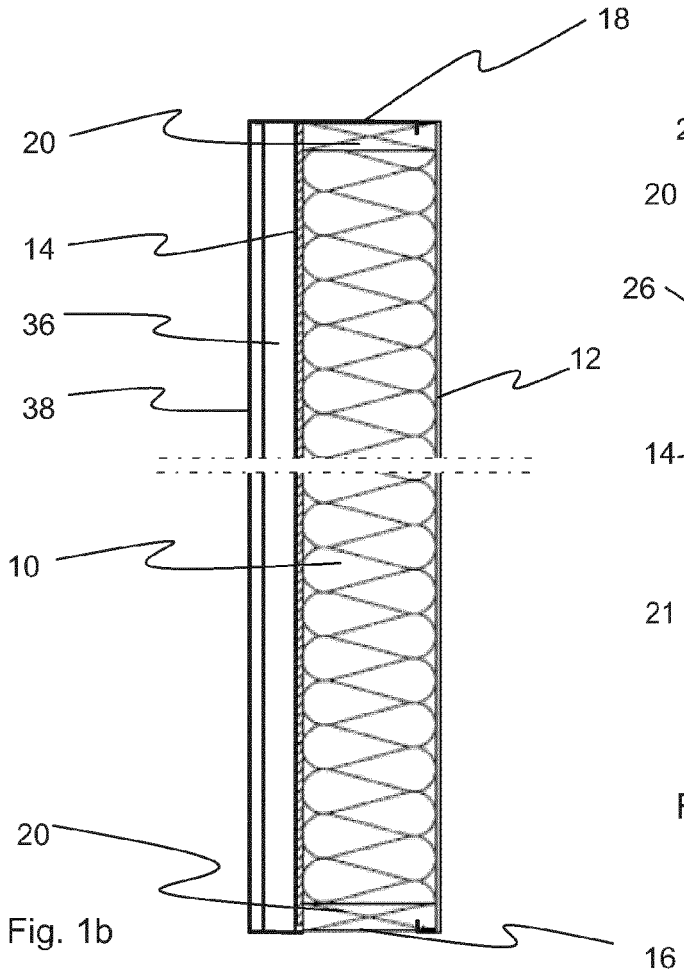
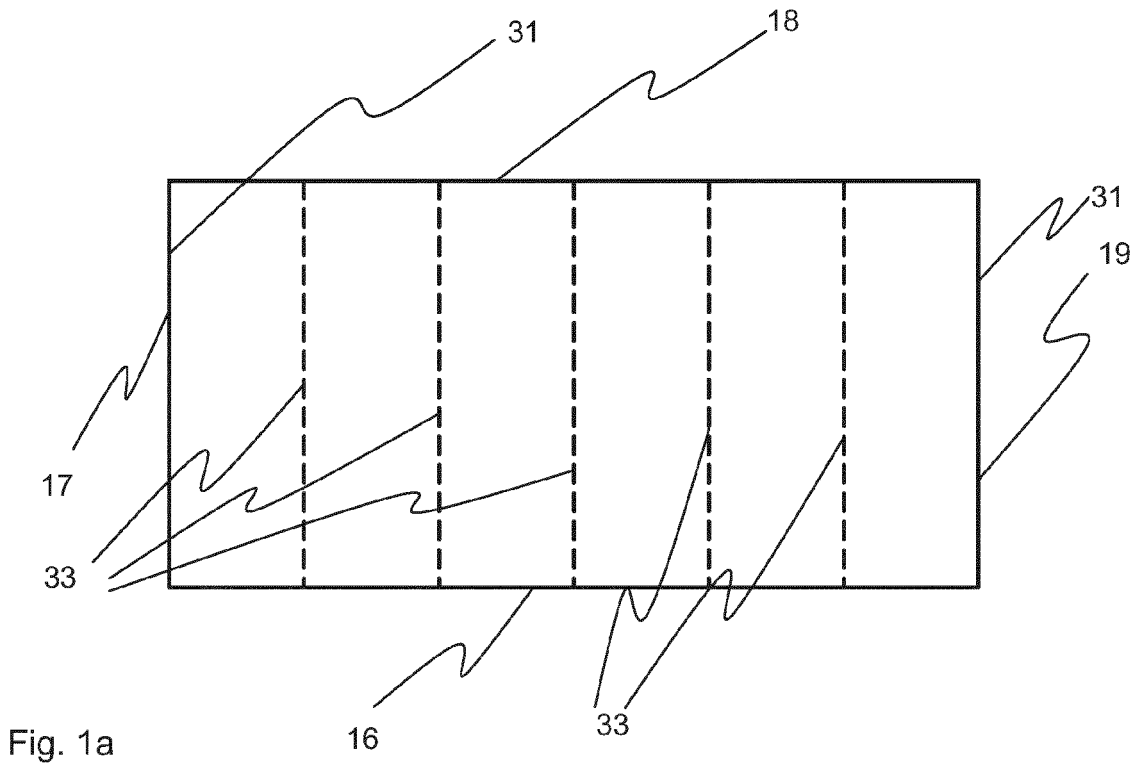
[0037]

10	thermal insulation layer	36	supporting rail
12	first surface plate	38	outer cladding
13	edge strip	40	screw
14	second surface plate	42	sealing strip
15	attaching edging	50	foundation
16	first side edge	52	thermal insulation plate
17	first end edge	54	floor tile
18	second side edge	56	frost insulation
19	second end edge	100	exterior wall
20	edge beam	102	pillar
21	inner flat surface	104	roof
22	outer flat surface		
24	first border		
26	second border		
27, 27a	groove		
28	first batten		
29	second batten		
30	gap		
31	end beam		
32	lower guiding rail		
33	intermediate beam		
34	sealing tape		

Claims

1. An exterior wall element, which has a thermal insulation layer (10), which thermal insulation layer (10) has a first surface and a second surface, a first surface plate (12), the material of which is metal, on the first surface of the thermal insulation layer, and a second surface plate (14) on the second surface of the thermal insulation layer, **characterized in that** the water vapour permeability of the second surface plate (14) is substantially higher than the water vapour permeability of the first surface plate (12).
2. The exterior wall element according to claim 1, **characterized in that** the second surface plate (14) is of a different material than the first surface plate (12).

3. The exterior wall element according to claim 1 or 2, **characterized in that** the second surface plate (14) is a plaster board or wood fibre board suited as a windbreak plate of a building.
- 5 4. The exterior wall element according to any of the claims 1-3, **characterized in that** the wall element has a first side edge (16) and a second side edge (18), which side edges (16, 18) have an edge beam (20), and a first end edge (17) and second end edge (19), which end edges (17, 19) have an end beam (31).
- 10 5. The exterior wall element according to claim 4, **characterized in that** there is at least one intermediate beam (33) in the direction of the end beam (31) between the first end edge (17) and second end edge (19).
- 15 6. The exterior wall element according to claim 4 or 5, **characterized in that** the edge beams (20), the end beams (31) and/or the intermediate beams (33) are of wood material.
- 20 7. The exterior wall element according to any of the claims 4-6, **characterized in that** the edge beam (20) has an outer flat surface (22), a first border (24) settling against the surface of the first surface plate (12) and a second border (26) settling against the surface of the second surface plate (14).
- 25 8. The exterior wall element according to claim 7, **characterized in that** the edges of the first surface plate (12) which attach to the edge beam (20) have an edge strip (13), which is at a substantially perpendicular angle to the plane of the middle part of the first surface plate (12), which edge strip (13) settles against the outer flat surface (22) of the edge beam (20) and on the outer surface of which edge strip (13) there is a flexible and compressible sealing tape (34).
- 30 9. The exterior wall element according to claim 8, **characterized in that** the free edge of the edge strip (13) has an attaching edging (15), which is substantially at a perpendicular angle to the edge strip (13), and the outer flat surface (22) of the edge beam (20) has a groove (27), into which the attaching edging (15) is arranged.
- 35 10. The exterior wall element according to any of the claims 7-9, **characterized in that** the outer flat surface (22) of the edge beam (20) has a first batten (28) and a second batten (29), between which first and second batten there is a gap (30), into which gap (30) a positioning member of the exterior wall element, such as a lower guiding rail (32) of the foundation, can be fitted.
- 40 11. The exterior wall element according to any of the claims 1-10, **characterized in that** the surface of the second surface plate (14) has supporting rails (36) at a distance from each other, onto which supporting rails an outer cladding (38) is attached.
- 45 12. A building, which has an exterior wall (100), **characterized in that** said exterior wall (100) has exterior wall elements according to any of the claims 1-11.
- 50 13. The building according to claim 12, **characterized in that** exterior wall elements are arranged on the exterior wall (100), so that the side edges (16, 18) of the exterior wall elements are substantially horizontal.
- 55 14. The building according to claim 12 or 13, **characterized in that** the exterior wall has on top of each other at least two exterior wall elements, so that the first side edge (16) of the upper exterior wall element settles against the second side edge (18) of the lower exterior wall element, and edge beams (20) in the side edges settling against each other are attached together with mechanical attaching members, such as screws (40).
15. The building according to any of the claims 12-14, **characterized in that** the building has a frame, which comprises at least two vertical load-bearing construction parts, such as pillars (102), which load-bearing construction parts are at a distance from each other, and the edge beams (20) of said exterior wall elements are attached at their first end to the first construction part and at their second end to the second construction part.



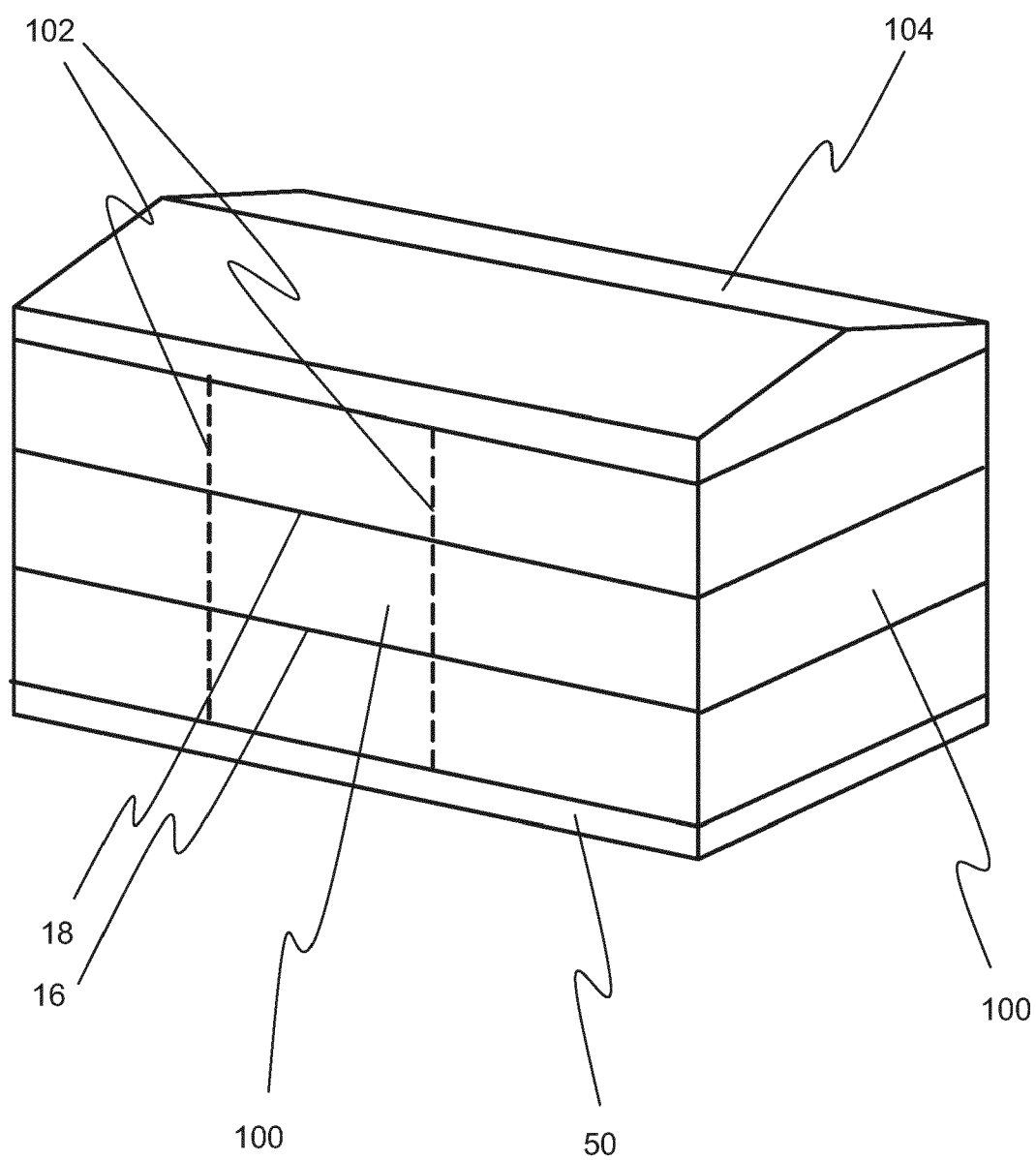
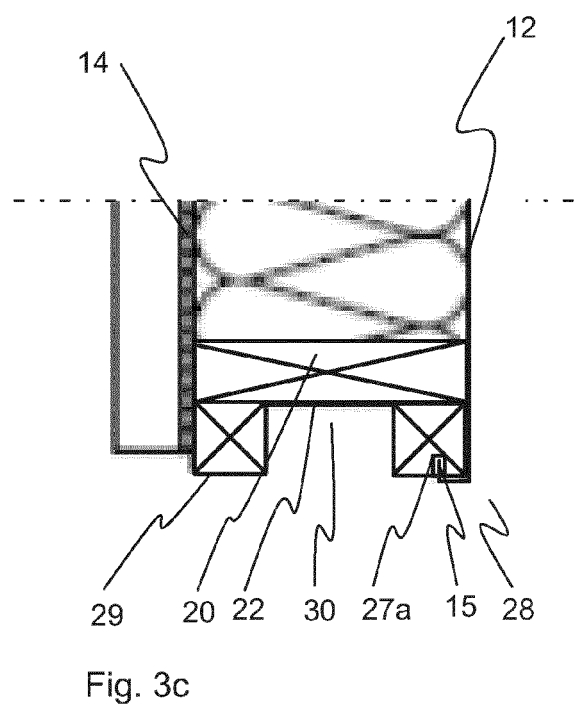
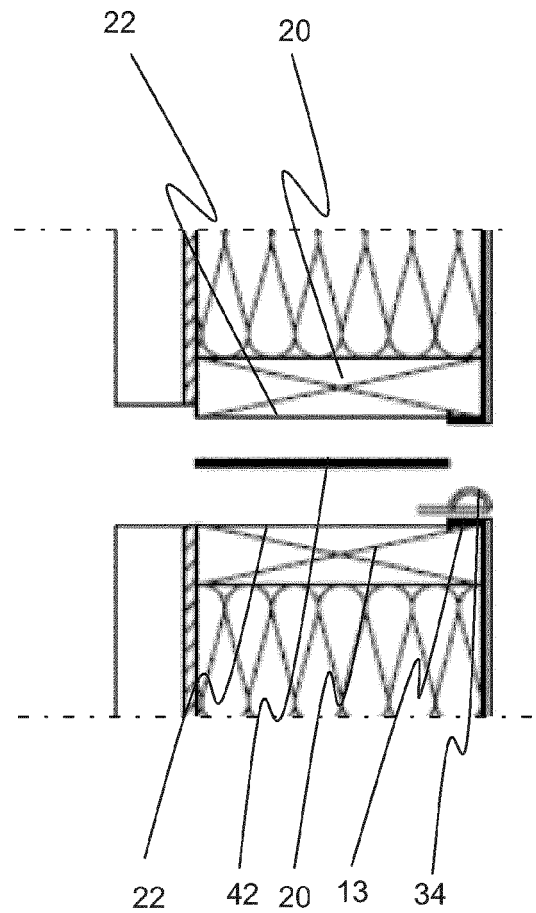
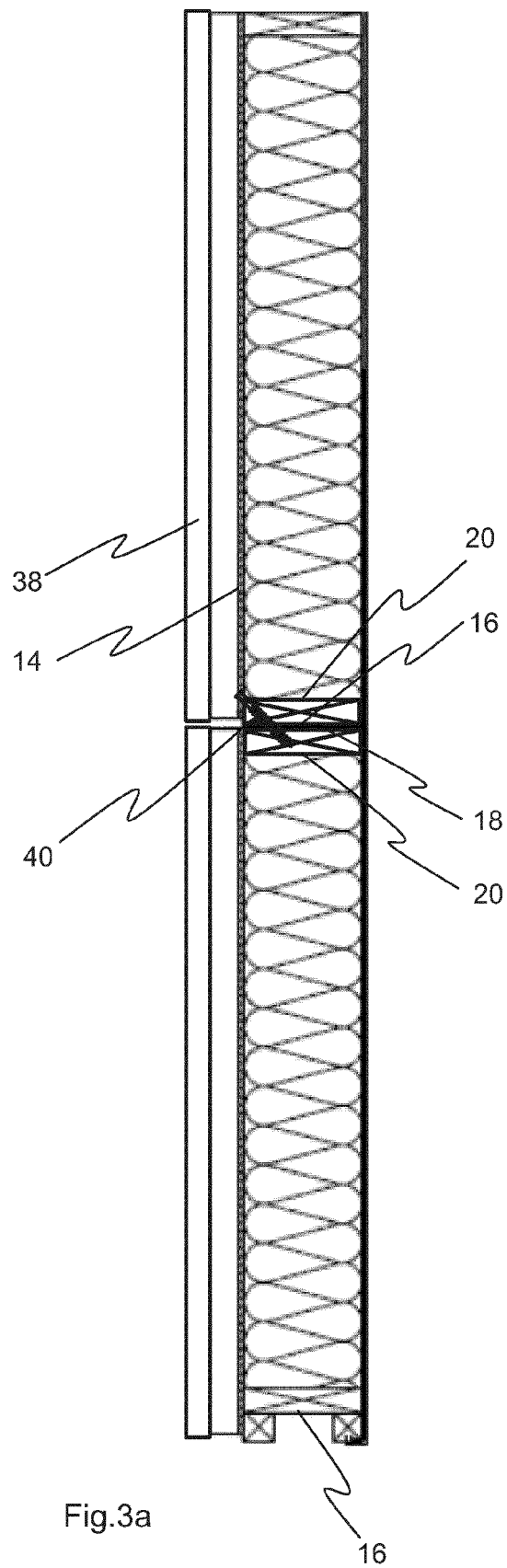


Fig. 2



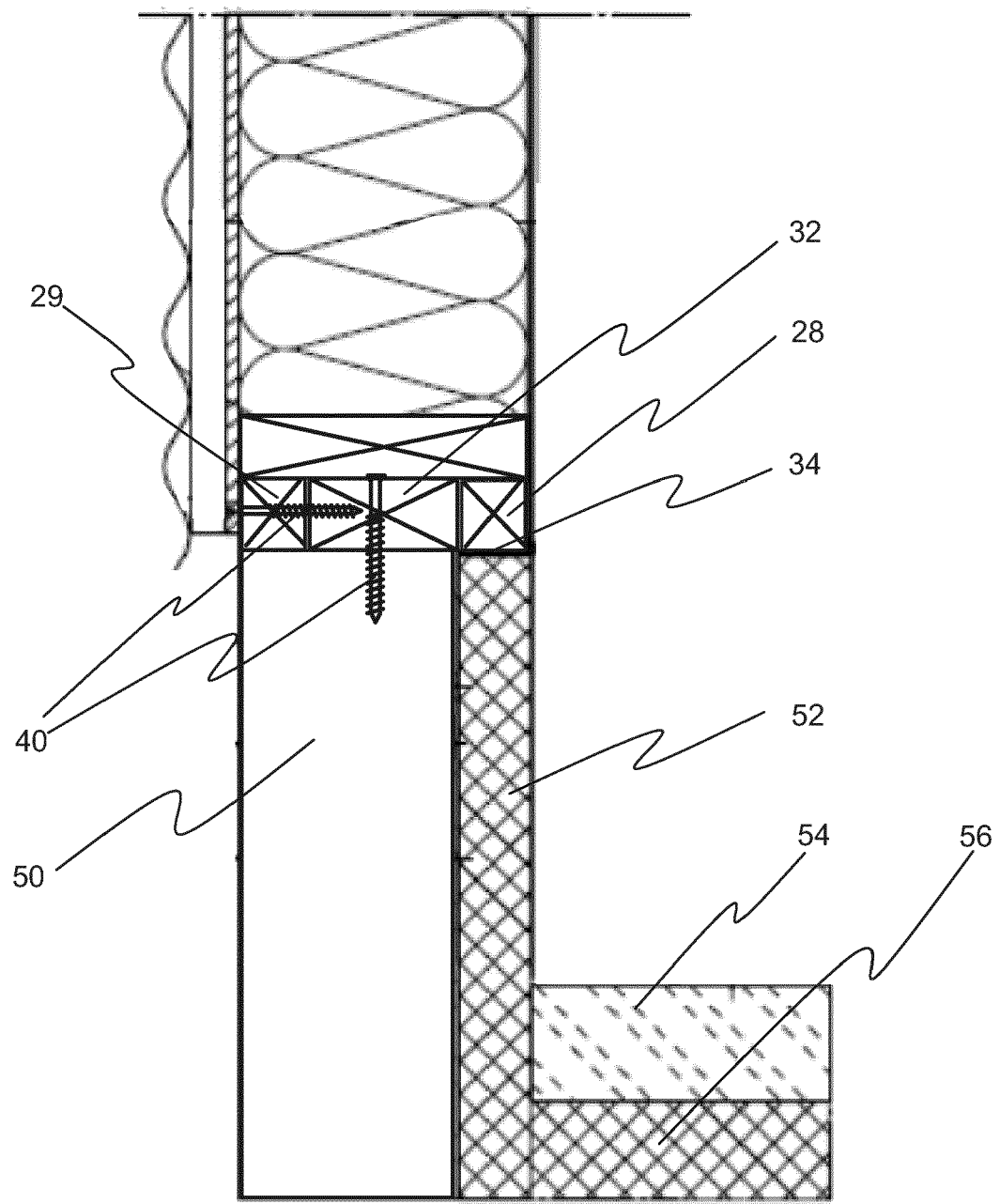


Fig. 3d



EUROPEAN SEARCH REPORT

Application Number

EP 23 21 5055

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EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 8 May 2024	Examiner Lorandi, Lorenzo
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