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(54) A PANEL FOR A BUILDING STRUCTURE AND A METHOD OF MANUFACTURING SUCH PANEL

(57) The present invention concerns a panel for a building structure, said panel having a generally rectangular shape with a curvature, such that the panel has a convex outer surface (20) and a concave inner surface (10) with a set of side edge regions and a set of end edge regions, characterised in that the panel comprises a first, innermost mineral wool fibre layer (1) forming the concave inner surface and having a first outer surface (11); and a second, outermost mineral wool fibre layer (2) forming the convex outer surface and a second inner surface (21), and wherein said second layer is glued to the first layer by bonding said second inner surface to said first outer surface.

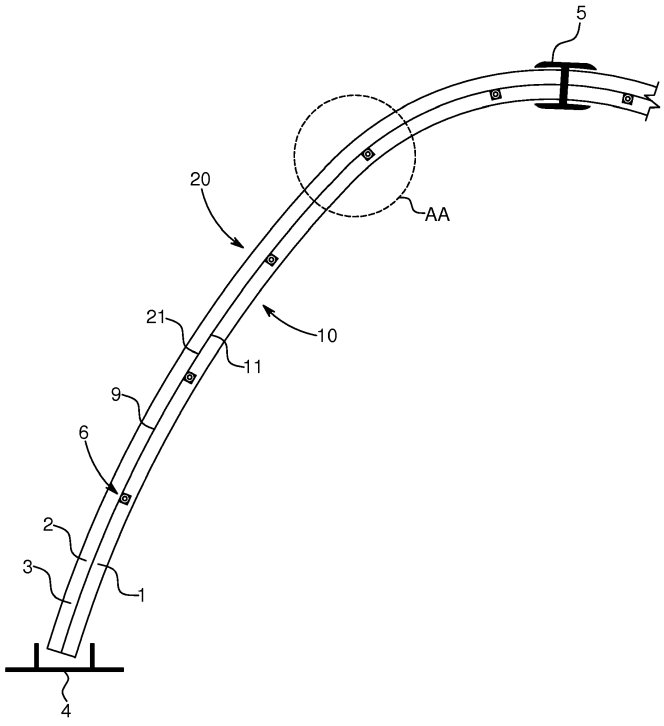

FIG. 1

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Description

[0001] The present invention relates to a panel for a building structure and a method of manufacturing such panel.

[0002] Building structures, such as temporary building structures, that are simple and fast to erect by using suitable panels are well known from e.g. WO 2013/064150.

[0003] In WO 2013/064150, a shelter construction is disclosed which comprises premade shells, i.e. preformed panels of e.g. polyurethane or polystyrene concrete for providing insulation. This is advantageous over the shelter constructions disclosed in GB 1,178,261 where the shells are made of glass fibre. In US 8,615,934 another example of a panelised portable shelter is known.

[0004] Such shelters are building structures of a portable kind are used in addition or instead of tents to provide immediate shelter for refugees, victims of a natural disaster or the like where people are made home-less and are therefore in need for accommodation. A requirement for such shelters is therefore that it is easy to transport to a sometimes remote geographical area in which it is needed and that it is easy to erect. Tents have been widely used as a tent fulfils these criteria, but a drawback for tents is that there is no thermal insulation. A further drawback is the relatively short life time of tents.

[0005] The building structure could also be a low cost or semi-permanent building, i.e. in regions with poverty or in situations where the building is needed for a limited number of years, e.g. for housing children or as a hunting lodge.

[0006] For a building structure, such as a shelter of the above-identified kind, it is desirable to obtain a building panel with good insulation properties besides the above-mentioned properties. The panels should also allow for construction that facilitates a quick, simple and easy construction of such a shelter. For meeting this requirement, a shelter panel is disclosed in PCT/EP2017/056918 (not yet published) with a sandwich of mineral wool materials with a low density core sandwiched between high density layers on each side and with the low density core extending beyond the side edges so that a tight assembly between panels can be provided.

[0007] However, in order to ensure low costs for manufacturing the shelter panels, and also to ensure a manufacturing process, which is simple and can be effectively carried out under rudimentary conditions, it is desirable to provide an improved panel design. Accordingly, it is an object of the present invention to achieve such improvements in relation to costs and local manufacturing feasibility.

[0008] Accordingly, this object is achieved by a panel for mounting in a building structure, which is simple and easy to manufacture.

[0009] This object is achieved by the provision of a panel for a building structure, said panel having a generally rectangular shape with a curvature, such that the panel has a convex outer surface and a concave inner surface with a set of side edge regions and a set of end edge regions, wherein the panel comprises a first, innermost mineral wool fibre layer forming the concave inner surface and having a first outer surface; and a second, outermost mineral wool fibre layer forming the convex outer surface and a second inner surface, and wherein said second layer is glued to the first layer by bonding said second inner surface to said first outer surface.

[0010] Hereby, a two-layered panel is provided made of two mineral wool fibre slabs which are formed and then glued together in a form and thereby retains the form. The manufacture is simple and suitable for production locally or even on site. The two slabs constituting the layers may be transported to the manufacturing site in stacks of flat elements, which ensures a compact transport unit which is easy and cost-efficient to handle.

[0011] The panels are preferably formed with a predefined curvature, which is essentially formed as half-shells so that two panels may be provided forming an arc and a number of panels are similarly erected adjacent each other to form a building structure in the form of a shelter comprising a plurality of panels. By providing the panels in mineral wool fibre material, preferably stone wool, a thermally insulating panel is provided providing the shelter structure with thermal insulation just as the shelter hereby also attains fire-retarding properties.

[0012] The adhesive used may be any kind of glue, such as polyurethane glue or foam, for example SikaBond®-T2i, which is a 1-component polyurethane glue, Casco Nobel Superfix 3890, PU Construction- & Precision Foam 594 (Danalim), Construction Extra 292 (Danalim) or other suitable construction glues or foams.

[0013] In a panel according to the invention, the density of the first, innermost mineral wool fibre layer is provided with the same or a higher density than the second, outermost mineral wool fibre layer. As the panels will be subjected to compression at the inner side and potentially even tension of the outside, it is advantageous to ensure a sufficient density of the innermost layer to absorb the compression forces without risking deformation of the panels. By the invention, it is found advantageous that the density of either of the layers be kept within the range of 100-180 kg/m^3. Hereby, the sufficient strength of the panels is achieved whilst the weight of the panel is kept low. To ensure a relatively low weight, the thickness of each mineral wool fibre layer is preferably 25-50 mm or less and preferably the mineral wool fibre layers have the same thickness.

[0014] In order to ensure that the panel does not disintegrate due to tension forces along the outside, it is found advantageous that the panel is provided on the convex side with a facing layer for absorbing tension forces on the element when the shelter is erected. The facing layer may be a woven fabric or non-woven fleece.

[0015] The panels are preferably assembled by tension bars which are mounted through channels in the panels. In order to provide these channels, it is found

advantageous that wherein grooves may be pre-formed, such as cut out, on at least one the first outer surface of the innermost layer and/or the second inner surface of the outermost layer for providing the channels for a tension mounting system. The grooves are cut perpendicular to the side edge regions. If necessary, one or more mounting tubes are provided substantially perpendicular to the side edge regions.

[0016] According to a second aspect of the invention, there is also provided a method of manufacturing a panel for a building structure of the kind described above, comprising the steps of:

- providing a panel form with a predefined curvature, and placing the second layer therein, and then
- providing a layer of adhesive onto the inner surface of said second layer, and then
- positioning the first layer in the curvature shaped, adhesively coated second layer.

[0017] The method preferably further includes the step of providing a counter form with a curvature shape congruently shaped relative to the predefined curvature of the panel form, and positioning said counter form against the innermost surface of the panel, and potentially biasing the counter form against the panel form to clamp the first and second layers in the form while the adhesive is curing.

[0018] In a first embodiment, the panel form is a negative form with a predefined concave curvature. Alternatively, the panel form may be a positive form with a predefined convex curvature.

[0019] Moreover, by the method grooves are preferably pre-cut on at least one of the first outer surface of the innermost layer and/or the second inner surface of the outermost layer perpendicular to the side edge regions thereof before said first and/or second layer is/are provided in the panel form.

[0020] In the following the invention is described in more detail with reference to the accompanying drawings, in which:

Figure 1 is a schematic side view of a panel according to the invention positioned in a shelter building structure;

Fig. 2 is a schematic perspective view of a panel according to the invention;

Fig. 3 is a schematic side view of a production form with a panel according to the invention therein;

Fig. 4 is a perspective view of a negative form part with a mineral wool fibre layer positioned therein; and

Fig. 5 is a detailed side view of the marking AA in fig. 1.

[0021] With reference to the drawings, an embodiment of a panel for a temporary building structure, such as a shelter, is shown. The panel has a generally rectangular shape with a curvature, such that the panel has a convex outer surface 20 and a concave inner surface 10 with a set of side edge regions and a set of end edge regions. The panel comprises a first, innermost mineral wool fibre layer 1 forming the concave inner surface 10 and which has a first outer surface 11. The panel further comprises a second, outermost mineral wool fibre layer 2 forming the convex outer surface 20 and a second inner surface 21, at which surface 21 the second layer 2 is glued to the first layer 1 by an adhesive 9 bonding the second inner surface 11 to said first outer surface 21. A plurality of panels are assembled to a shelter. To fix the panels to the ground, a mounting rail 4 may be provided in which the lower end of the panels on one side of the shelter are retained. At the top the other end sides of the panels are retained by a T-shaped mounting rail 5 to ensure that the abutting panels at the top are kept in position.

[0022] The resulting two-layered panel is manufactured of two layers 1, 2 of mineral wool fibre slabs, which are positioned and formed in a negative form part 7 (see fig. 3) and during curing of the adhesive 9 a positive second form part 8 may be provided to ensure that the panel retains the curved form. The adhesive 9 used may be any kind of glue suitable for bonding mineral wool fibre materials, such as polyurethane glue or foam, for example SikaBond®-T2i, which is a 1-component polyurethane glue, Casco Nobel Superfix 3890, PU Construction- & Precision Foam 594 (Danalim), Construction Extra 292 (Danalim) or other suitable construction glues or foams.

[0023] The form part 7, 8 is provided with a predefined curvature, which is essentially formed as half-shells so that two panels may be provided forming an arc and a number of panels are similarly erected adjacent each other to form a building structure in the form of a shelter comprising a plurality of panels (such as indicated in fig. 1).

[0024] One of the form parts 7, 8 may include an opposite form part on the other side to enable a stack of panels to be made. This can save floor space at the manufacturing site, which may be important especially when working with glues requiring substantial drying or curing time.

[0025] The two layers 1, 2 are made of mineral wool fibre material, preferably stone wool. This ensures a thermally insulating panel for the shelter structure as well as good fire-retarding properties. The density of the layers is preferably within the range of 100-180 kg/m^3. Hereby, the sufficient strength and rigidity of the panel is achieved whilst the weight of the panel is kept low. To ensure a relatively low weight, the thickness of each mineral wool fibre layer is preferably 25-50 mm or less and preferably the mineral wool fibre layers 1, 2 have the same thickness.

[0026] As the panels are assembled in an arc-like structure in the shelter, the panels will be subjected to compression forces at their inner sides and potentially

even tension forces on the outside surface. To ensure the form stability of the panels when subjected to such forces, it is advantageous to ensure a sufficient density of the innermost layer to absorb the compression forces without risking deformation of the panels. Therefore, the density of the innermost layer 1 may be higher than the outside layer 2. However, the density may also be the same, which may be advantageous for a cost perspective as the same slabs may be used for both the inner and outer layers 1, 2.

[0027] As shown in detail in fig. 5, the panel is provided with a facing layer 3 on the convex side. This facing layer 3 protects the outer surface of the panel and absorbs tension forces on the outer surface of the panel when the shelter is erected. The facing layer 3 may be a woven fabric or non-woven fleece.

[0028] The panels may be provided with a facing, such as a fleece or fabric, on the concave inner side 10. The effect of such a facing on the concave inner side 10 is mainly to add impact strength to surface, but also to provide improved aesthetics for inhabitants of the building structure. Such facing could be coloured or painted.

[0029] The panels are preferably assembled by tension bars, which are mounted through channels 6 in the panels. In order to produce these channels 6 in the panels, it is by the invention realised that grooves 61 may be pre-formed, such as cut out, on at least the first outer surface 11 of the innermost layer 1. It is also realised that in addition to or as an alternative the grooves 61 may be pre-formed in the second inner surface 21 of the outermost layer 2, such as shown in fig. 4. When the two layers 1, 2 are then glued together, the grooves 61 will become channels 6 for a tension mounting system. The grooves 61 are cut perpendicular to the side edge regions of the panel. If necessary, mounting tubes 62 may be provided substantially perpendicular to the side edge regions in the grooves 61 (see fig. 5).

[0030] With reference to figs. 3 and 4, the method of manufacturing the panel comprises the steps of placing a slab making up the first layer 1 in the negative form 7 with a predefined concave curvature 71, and then providing an adhesive 9 onto the inner surface 21 of said second layer 2, and then positioning the first layer 1 in the concavely shaped, adhesively coated second layer 2.

[0031] A positive counter form part 8 with a convex shape congruently shaped relative to the predefined concave inner curvature 71 of the negative form part 7 may then be positioned abutting the concave innermost surface 10 of the panel, and potentially biasing the counter form part 8 against the negative form part 7 to clamp the first and second layers 1, 2 in the form while the adhesive is curing.

[0032] The tension bar channels 6 may be drilled afterwards, or pre-made as grooves 61 pre-cut on at least one the first outer surface 11 of the innermost layer 1 and/or the second inner surface 21 of the outermost layer 2 perpendicular to the side edge regions thereof before said first and/or second layer 1, 2 is/are provided in the panel form.

[0033] Above, the present invention is described with reference to some currently preferred embodiments. However, it is by the invention realised that variants to the embodiments may be made without departing from the scope of the invention as defined in the accompanying claims.

[0034] Presently suitable dimensions of the panels are considered to be arc length of 1.0 to 6.0 m and width of 0.4 to 2.0 m. Increasing the width reduces the number panels needed to provide a building structure, so assembly may be faster, but with increasing width manageability of the panels get worse. An advantage with increasing width is that the number of joints are reduced, and hence the risk of leakage.

Claims

1. A panel for a building structure, said panel having a generally rectangular shape with a curvature, such that the panel has a convex outer surface and a concave inner surface with a set of side edge regions and a set of end edge regions, **characterised in that** the panel comprises

   a first, innermost mineral wool fibre layer forming the concave inner surface and having a first outer surface; and

   a second, outermost mineral wool fibre layer forming the convex outer surface and a second inner surface, and wherein said second layer is glued to the first layer by bonding said second inner surface to said first outer surface.

2. A panel according to claim 1, wherein the density of the first, innermost mineral wool fibre layer is provided with the same or a higher density than the second, outermost mineral wool fibre layer.

3. A panel according to claim 2, wherein the density of the mineral wool fibre layers is within the range of 100-180 kg/m^3.

4. A panel according to any one of the preceding claims, wherein the thickness of each mineral wool fibre layer is 25-50 mm or less and preferably the mineral wool fibre layers have the same thickness.

5. A panel according to any one of the preceding claims, wherein the panel is provided on the convex side with a facing layer for absorbing tension forces on the element when the shelter is erected.

6. A panel according to claim 5, wherein the facing layer is a woven fabric or non-woven fleece.

7. A panel according to any one of the preceding claims,

wherein grooves may be pre-formed, such as cut out, on at least one the first outer surface of the innermost layer and/or the second inner surface of the outermost layer for providing channels for a tension mounting system, said grooves being perpendicular to the side edge regions.

8. A panel according to any one of the preceding claims, wherein one or more mounting tubes are provided substantially perpendicular to the side edge regions.

9. A panel according to any one of the preceding claims, wherein the panel is provided with a predefined curvature, which is essentially a half-span of the building structure.

10. A building structure comprising a plurality of panels according to any one of the preceding claims.

11. A method of manufacturing a panel for a building structure according to any one of the preceding claims, comprising the steps of:

- providing a panel form with a predefined curvature, and placing the second layer therein, and then
- providing a layer of adhesive onto the inner surface of said second layer, and then
- positioning the first layer in the curvature shaped, adhesively coated second layer.

12. A method according to claim 11, further providing a counter form with a curvature shape congruently shaped relative to the predefined curvature of the panel form, and positioning said counter form against the innermost surface of the panel, and potentially biasing the counter form against the panel form to clamp the first and second layers in the form while the adhesive is curing.

13. A method according to claim 11 or 12, wherein the panel form is a negative form with a predefined concave curvature.

14. A method according to claim 11 or 12, wherein the panel form is a positive form with a predefined convex curvature.

15. A method according to any one of claims 11 to 14, wherein grooves are pre-cut on at least one the first outer surface of the innermost layer and/or the second inner surface of the outermost layer perpendicular to the side edge regions thereof before said first and/or second layer is/are provided in the panel form.

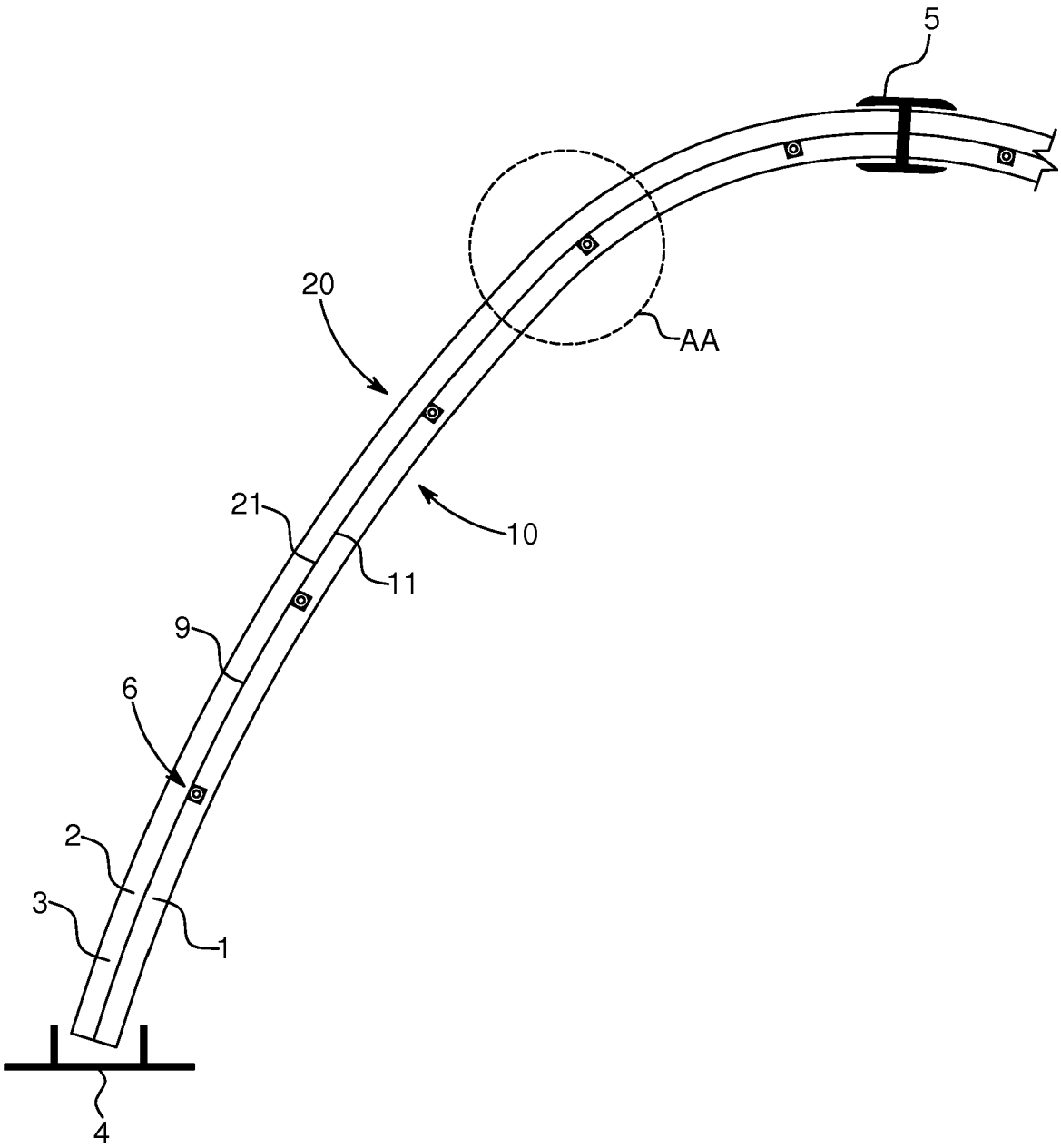

FIG. 1

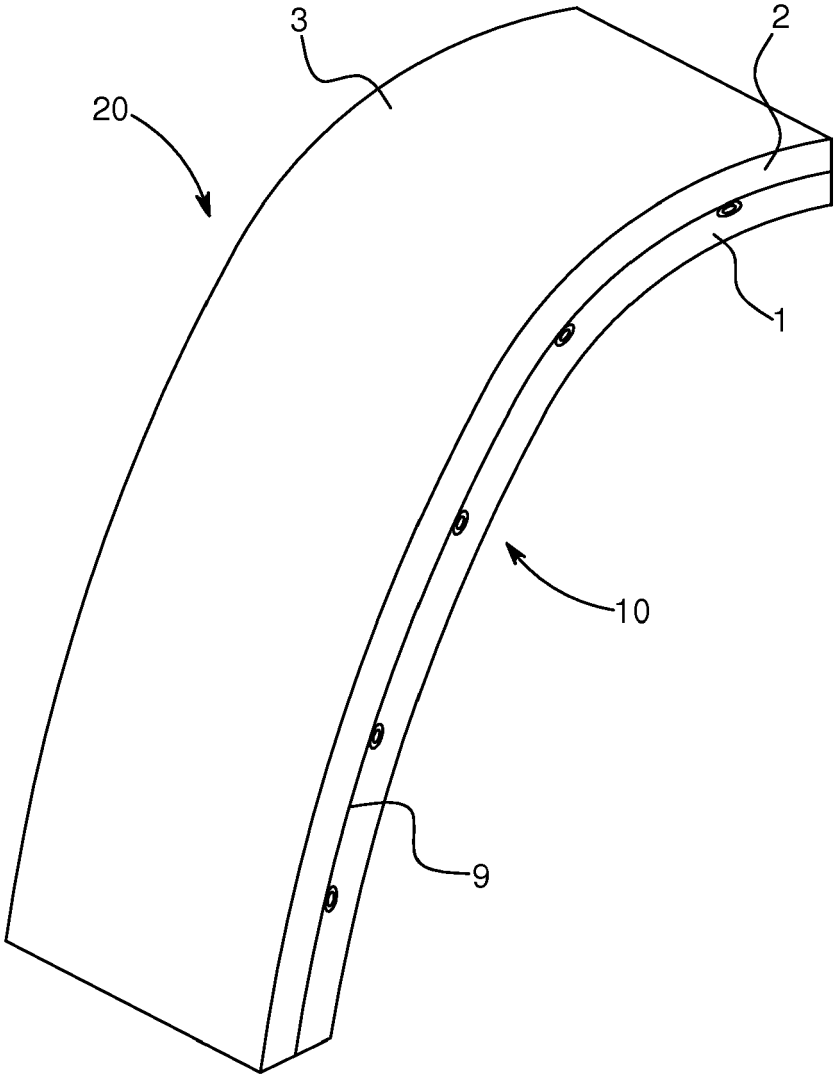

FIG. 2

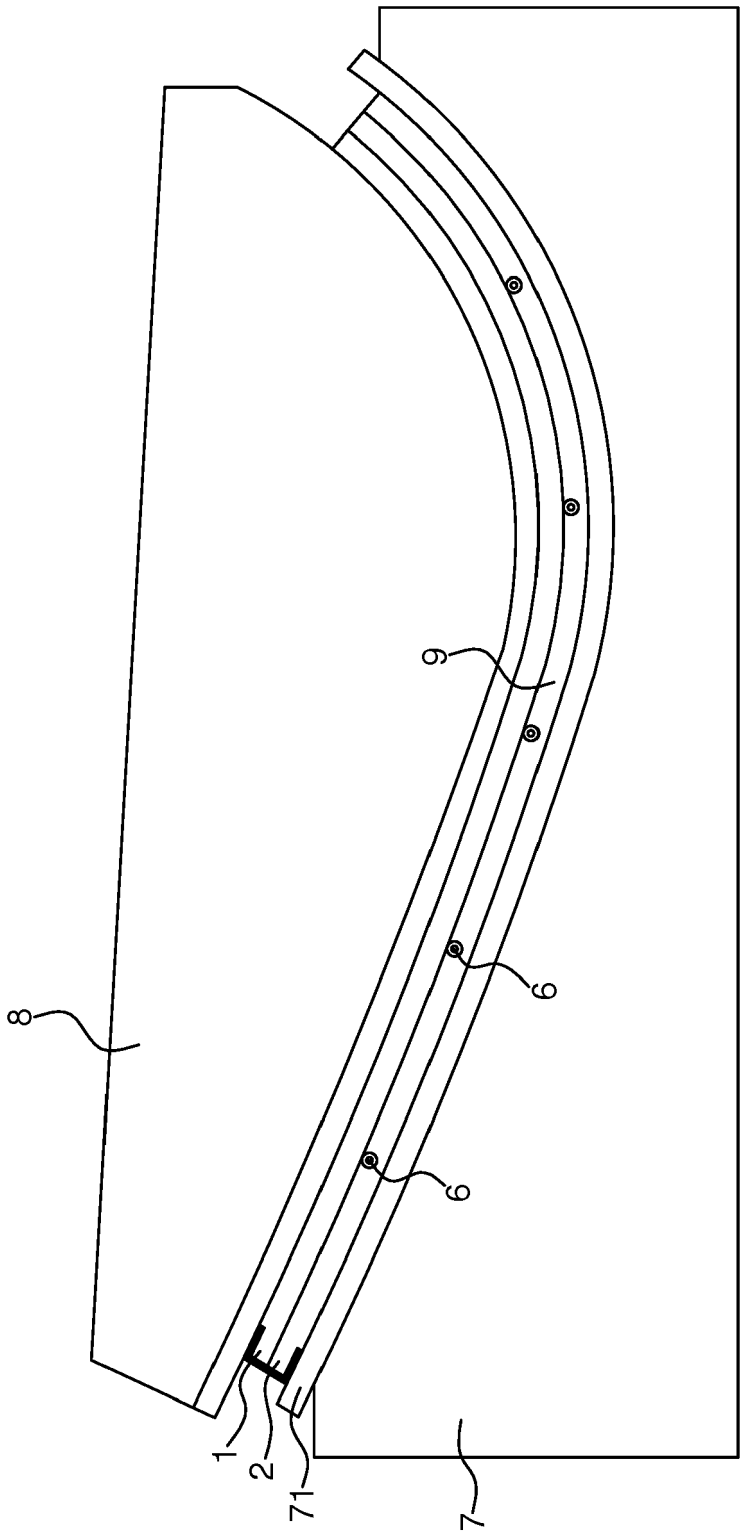

FIG. 3

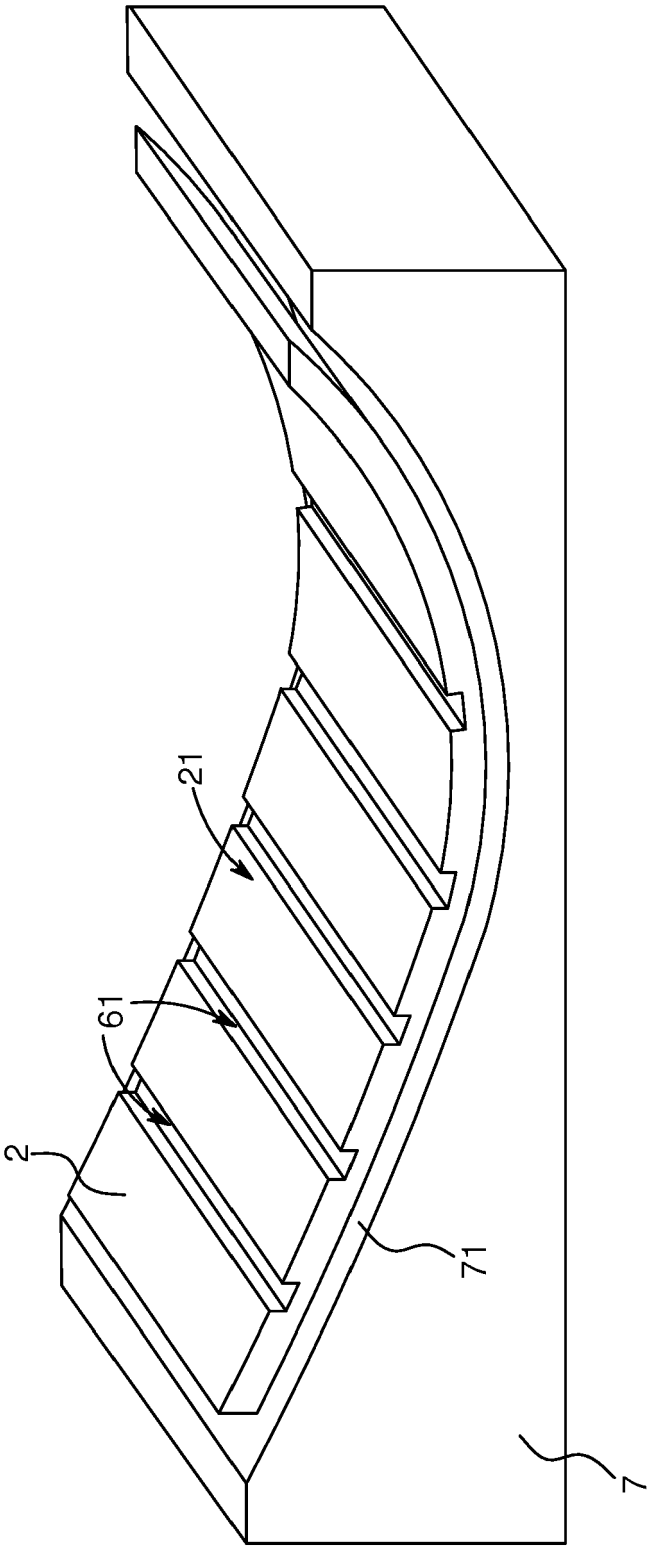

FIG. 4

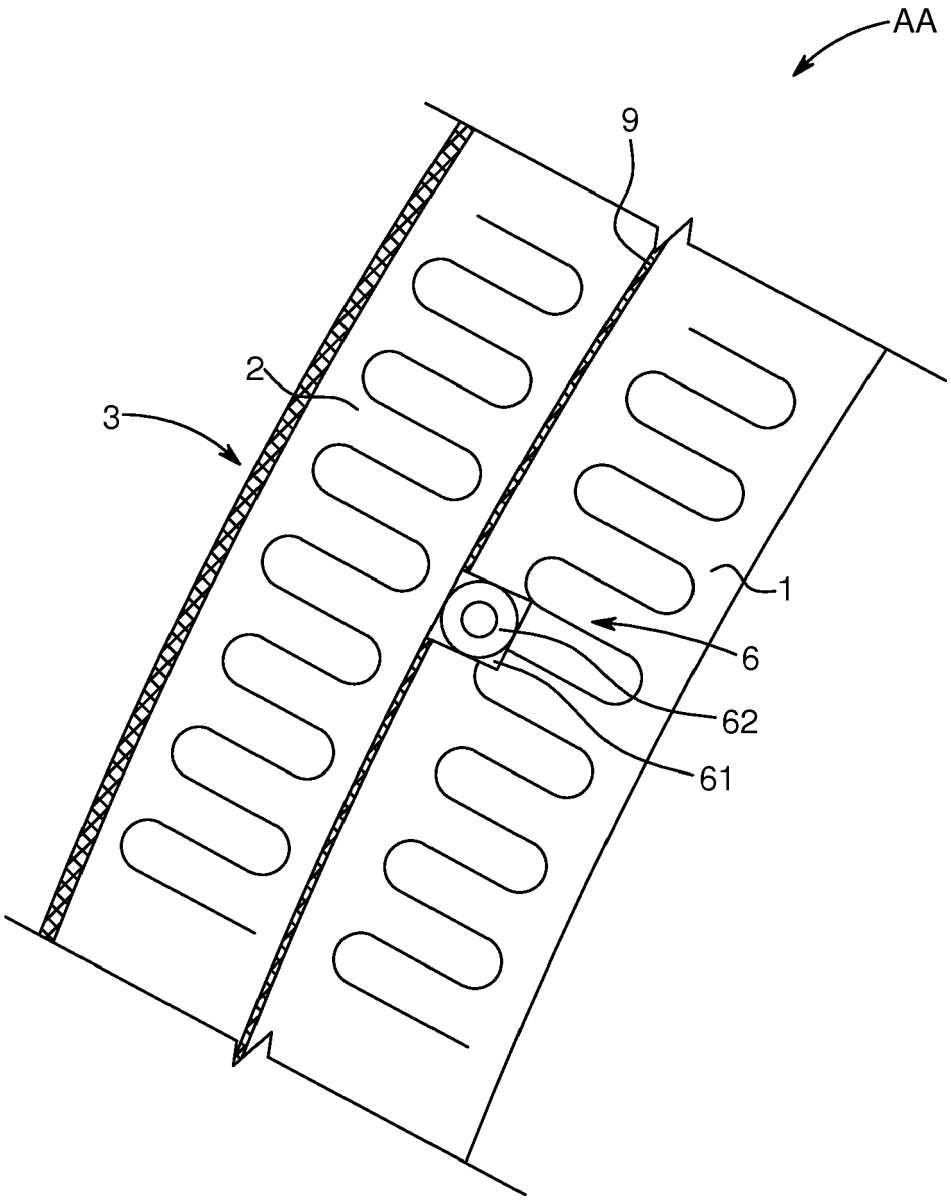

FIG. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 17 18 4648

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 90/01090 A1 (ROCKWOOL INT [DK]) 8 February 1990 (1990-02-08) * page 4, lines 33-36; claims 1,2,7; figures 1-4 *	1-7,9-14	INV. E04B1/80 E04B7/22 E04C2/16
Y	FR 2 989 704 A1 (UNILIN BVBA [BE]) 25 October 2013 (2013-10-25) * claim 8; figures 1,5 *	1-5,7, 9-15	
Y	EP 2 273 024 A2 (UNILIN BVBA [BE]) 12 January 2011 (2011-01-12) * paragraph [0066] *	1-5,7, 9-15	
X	EP 1 111 147 A2 (FLII RE S R L [IT]) 27 June 2001 (2001-06-27) * paragraphs [0005], [0013], [0019]; claim 1; figures 1,5 *	1-5,7,10	
A	EP 1 826 335 A1 (ROCKWOOL INT [DK]) 29 August 2007 (2007-08-29) * paragraph [0008]; figures 1,2 *	6	
A	WO 2013/064150 A1 (EVERSHELTER APS [DK]) 10 May 2013 (2013-05-10) * page 16, lines 12-15; figure 41 *	8	TECHNICAL FIELDS SEARCHED (IPC) E04B E04C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	16 February 2018	Rosborough, John

CATEGORY OF CITED DOCUMENTS

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16-02-2018

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9001090 A1	08-02-1990	DK 415888 A	26-01-1990
		WO 9001090 A1	08-02-1990
FR 2989704 A1	25-10-2013	BE 1020648 A3	04-02-2014
		FR 2989704 A1	25-10-2013
EP 2273024 A2	12-01-2011	BE 1018822 A5	06-09-2011
		EP 2273024 A2	12-01-2011
EP 1111147 A2	27-06-2001	AT 296930 T	15-06-2005
		DE 60020506 D1	07-07-2005
		EP 1111147 A2	27-06-2001
		IT MI992574 A1	13-06-2001
EP 1826335 A1	29-08-2007	CA 2642959 A1	07-09-2007
		DK 1989368 T3	08-07-2013
		EA 200870297 A1	27-02-2009
		EP 1826335 A1	29-08-2007
		EP 1989368 A1	12-11-2008
		ES 2415777 T3	26-07-2013
		UA 94447 C2	10-05-2011
		WO 2007098761 A1	07-09-2007
WO 2013064150 A1	10-05-2013	BR 112014010712 A2	18-04-2017
		CN 103917721 A	09-07-2014
		EP 2773819 A1	10-09-2014
		US 2014290153 A1	02-10-2014
		WO 2013064150 A1	10-05-2013
		ZA 201403214 B	25-11-2015

EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 2013064150 A **[0002] [0003]**
- GB 1178261 A **[0003]**
- US 8615934 B **[0003]**
- EP 2017056918 W **[0006]**