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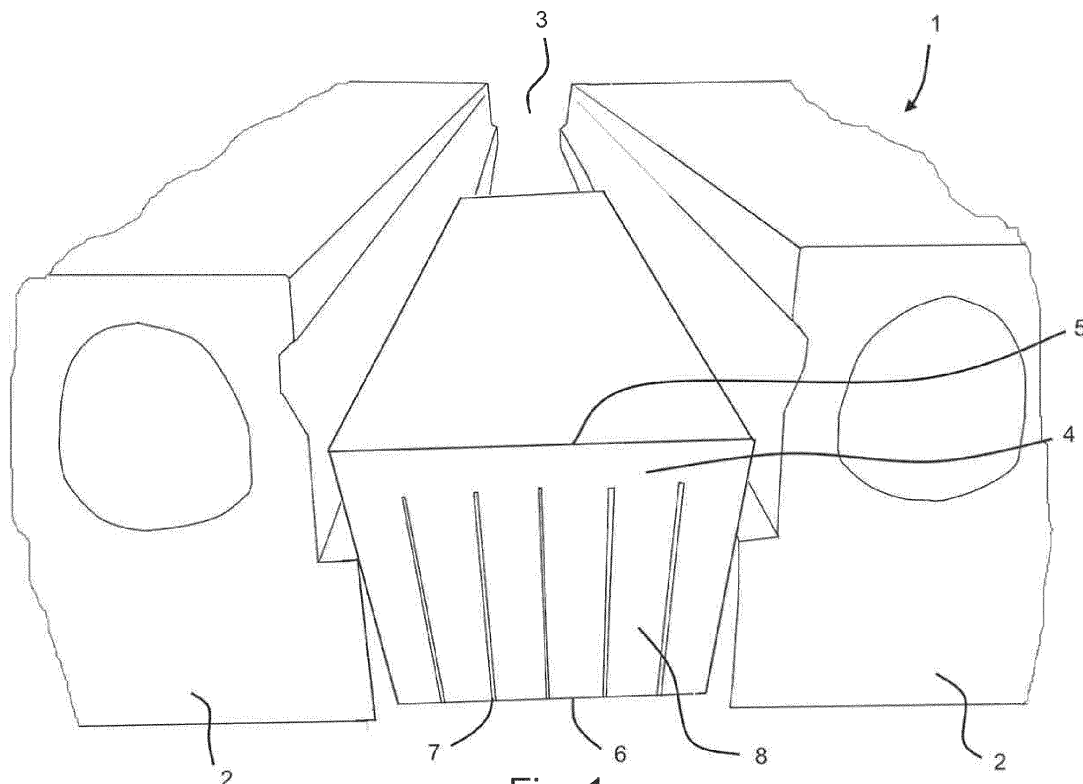
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(54) **A floor construction, a rigid thermal insulation element, and a method of installing a rigid thermal insulation element in a floor gap**

(57) A floor construction (1) comprises a floor including a gap (3) in which a rigid thermal insulation element (4) is mounted. The insulation element (4) comprises an upper side (5) and an opposite lower side (6). The insulation element (4) is provided with at least a groove (7)

extending from the lower side (6) toward the upper side (5) and ending at a groove bottom (9) so as to form tongues (8) at both sides of the groove (7). The tongues (8) are mutually pivotable about a pivoting axis extending between the groove bottom (9) and the upper side (5).



**Fig. 1**

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## Description

**[0001]** The present invention pertains to a floor construction comprising a floor including a gap in which a rigid thermal insulation element is mounted, wherein the insulation element comprises an upper side and an opposite lower side.

**[0002]** Such a floor construction is known in the prior art. Typically in case of floor constructions in which the floor is constituted of concrete slabs having standardized sizes a gap between two neighbouring slabs may arise. Below the floor a crawl space or cellar may be present such that the optical requirements of the floor as seen from below are less relevant. Such a gap is normally filled by means of a block of polystyrene. Depending on the width of the gap a block is fit to size by sawing a piece out of a large block at the construction site. It is however disadvantageous to perform time-consuming work at the construction site. Alternatively, polystyrene blocks of several different dimensions are supplied to the construction site such that the constructor can select a fitting block and insert it into the gap. However, this is undesired from a logistical point of view since a series of unused blocks will be transported to and from the construction site.

**[0003]** Furthermore, the rigid thermal insulation element must be easily insertable into the gap, on the one hand, but should not fall through the gap if a person stands on the installed insulation element at the construction site, on the other hand.

**[0004]** It is an object of the invention to provide a floor construction which eliminates the above-mentioned disadvantages and which can be installed in a simple manner.

**[0005]** This is achieved with the floor construction according to the invention, which is **characterized in that** the insulation element is provided with at least a groove extending from the lower side toward the upper side and ending at a groove bottom so as to form tongues at both sides of the groove, which are mutually pivotable about a pivoting axis extending between the groove bottom and the upper side.

**[0006]** The pivoting characteristics of the tongues due to the presence of the groove provides a certain degree of compressibility of the rigid insulation element although the element is made from a rigid material. In other words, a lower portion of the insulation element adjacent to the lower side can be compressed with respect to an upper portion adjacent to the upper side of the insulation element. This facilitates inserting the rigid insulation element into the gap. For example, in case of a block-shaped insulation element having a rectangular cross-section the insulation element obtains a wedge shape upon pivoting the tongues to each other.

**[0007]** The tongues may be pivoted towards each other such that the groove is closed when the insulation element is installed in the gap. In an installed condition the groove may be open or partly open, but in certain cases the tongues may be pressed to each other, depending

on the inner shape of the gap.

**[0008]** In a specific embodiment the width of the gap decreases in a direction from the upper side to the lower side of the insulation element. Due to this configuration a stronger compressing force may be exerted onto the insulation element upon displacing downwardly within the gap. Consequently, upon moving downwardly the tongues will be displaced to each other hence deforming the insulation element further until it arrives in a self-clamped condition.

**[0009]** The insulation element may be block shaped, wherein the groove extends in longitudinal direction thereof. This allows to deform the insulating element into a wedge shape.

**[0010]** In a particular embodiment the insulation element has an arched cross-section, wherein preferably the lower side is formed by the concave surface of the insulation element. In this embodiment the rigid thermal insulation element has already a natural wedge shape even without pivoting neighbouring tongues to each other. This means that the groove may be very narrow, which simplifies the method of manufacturing and minimizes loss of material. The groove may be made by means of displacing a hot wire through the material of the insulation element.

**[0011]** Preferably, the upper side of the insulation element extends below an upper surface of the floor adjacent to the gap, since the remaining space above the insulation element can be filled with concrete so as to obtain a flat upper surface of the floor.

**[0012]** In a practical embodiment the floor is formed by concrete slabs, whereas the gap extends between two neighbouring slabs. The slabs may be provided with a thermal insulation layer, which is attached to the lower side of a concrete layer of the slabs.

**[0013]** The width of the groove may be smaller than the distance between the groove bottom and the upper side in order to obtain sufficient strength of the insulation element. The groove may be tapered as seen from the lower side to the groove bottom and/or the tongues may be tapered as seen from the groove bottom to the lower side. In case of a varying groove width the maximum groove width may be smaller than the distance between the groove bottom and the upper side. Alternatively, the maximum distance that the tongues can be displaced until they touch each other may be smaller than the distance between the groove bottom and the upper side.

**[0014]** The groove may be one of a plurality of similar grooves extending substantially parallel to each other. The advantage of this embodiment is that the element can be fit to size easily by cutting the element in longitudinal direction at one of the grooves. This allows a constructor to cut the insulation element to size at the construction site, depending on the gap width. It is noted that the grooves have different functions. On the one hand, due to the resulting pivoting effect, the rigid insulation element can be partly deformed, for example to deform a block shape into a wedge shape. On the other hand,

the plurality of grooves provide the opportunity to fit the insulation element to size at the construction site. Therefore, in case of an arched-shape insulation element which already has a wedge shape, the deformation or pivoting effect is less relevant such that the grooves may be relatively narrow.

**[0015]** In a preferred embodiment the insulation element is adapted such that it can be broken along one of the grooves at the corresponding groove bottom by hand force, since additional tools like a saw can be omitted. Breaking a large insulation element in one or more pieces along the grooves will become easier if the thickness between the groove bottoms and the upper side is reduced.

**[0016]** The insulation element may be made of a closed-cell foam, preferably expanded polystyrene (EPS), but alternative materials are conceivable, for example extruded polystyrene (XPS), polyisocyanurate (PIR), polyurethane (PUR) or the like. EPS is a rigid and tough, closed-cell foam. It is usually made of pre-expanded polystyrene beads. EPS is often applied in insulating buildings and has good properties to score so as to create a groove therein. Thermal conductivity varies between 0.03 and 0.04 W/(m.K) depending on bearing strength/density.

**[0017]** The invention is also related to a rigid thermal insulation element for filling a gap in a floor construction as described hereinbefore. More specifically, the invention is also related to a rigid thermal insulation element comprising an upper side and an opposite lower side, wherein the element is made of EPS or a similar rigid thermal insulation material, and wherein the element is provided with at least a groove extending from the lower side toward the upper side and ending at a groove bottom so as to form tongues at both sides of the groove, which are mutually pivotable about a pivoting axis extending between the groove bottom and the upper side. The element may further have one or more of the technical features as described hereinbefore.

**[0018]** The invention is also related to a method of installing a rigid thermal insulation element in a floor gap, comprising the steps of supplying a rigid thermal insulation element comprising an upper side and an opposite lower side, and a plurality of parallel grooves, each extending from the lower side toward the upper side and ending at a groove bottom, wherein the width of the insulation element in transverse direction of the grooves is larger than the width of the gap, measuring the width of the gap, and dividing the insulation element along one of the grooves such that the width of one of the resulting pieces is slightly larger than the width of the gap. Due to the presence of the grooves a lower portion of the piece of the insulation element adjacent to the lower side can be compressed so as to reduce its width for easily inserting it into the gap. Therefore, the insulation element is divided such that in a compressed condition the element at least partly fits into the gap. Preferably, the insulation element is divided by hand since that minimizes instal-

lation time.

**[0019]** The invention will hereafter be elucidated with reference to drawings showing embodiments of the invention very schematically.

Fig. 1 is a perspective view of a part of an embodiment of a floor construction according to the invention.

Fig. 2 is a side view of a rigid thermal insulation element in the embodiment of Fig. 1.

Fig. 3 is a similar view as Fig. 2, but showing an alternative embodiment.

Fig. 4 is a perspective view of a part of the embodiment of Fig. 3.

Fig. 5 is a perspective view of still another embodiment of the insulation element.

Figs. 6-9 are cross-sectional views of alternative embodiments of a floor construction according to the invention.

Figs. 10-12 are similar views as Figs. 6-9, but showing alternative embodiments.

**[0020]** Fig. 1 shows a part of an embodiment of a floor construction 1 according to the invention. The floor construction 1 comprises a floor which is formed by hollow core concrete slabs 2. In a major part of the floor the slabs 2 are placed adjacent to each other or very close to each other. In practice, the surface area of the intended floor deviates from the sum of the surface areas of the individual slabs 2. Often the dimensions of the slabs 2 are standardized, for example a width of 600, 900 or 1200 mm. As a consequence, a gap 3 between two neighbouring slabs 2 may arise. This is illustrated in Fig. 1. It is noted that such a gap 3 is generally undesired in cases in which the floor is located at a storey of a building where a lower side of the floor forms a ceiling. However, if the floor is a ground floor and the space below the floor is used as a crawl space or cellar the gap 3 may be present. In that case esthetical requirements are limited. The width of the gap 3 may be 300 mm, but a wider or narrower gap 3 is conceivable.

**[0021]** In general the floor requires thermal insulating properties. For this reason the slabs 2 are often provided with an insulation layer at a lower side thereof. In order to insulate the entire floor the gap 3 should be filled by an insulation material, as well. Furthermore, the insulation material should be strong enough to withstand the weight of a person who walks on the floor during the period of building.

**[0022]** In the embodiment as shown in Fig. 1 a rigid thermal insulation element 4 is mounted in the gap 3. The rigid thermal insulation element 4 comprises an upper side 5 and an opposite lower side 6. The upper side 5 of the insulation element 4 extends below the upper surfaces of the slabs 2 adjacent to the gap 3. The remaining space between the slabs 2 and above the insulation element 4 can be filled with concrete. Therefore, the insulation element 4 should be able to withstand the

weight of a concrete layer.

**[0023]** The rigid insulation element 4 may be made of a closed-cell foam, for example expanded polystyrene (EPS). Alternative materials are conceivable as long as the material is substantially rigid. Therefore, it must be more rigid than soft insulation material like glass fibre mats.

**[0024]** In the embodiment as shown in Fig. 1 the insulation element 4 is block shaped. The insulation element 4 is provided with five parallel scores or grooves 7, which result in six tongues 8. The grooves 7 and tongues 8 extend in longitudinal direction of the insulation element 4. Furthermore, the grooves 8 extend from the lower side 6 toward the upper side 5. Each of the grooves 7 ends at a groove bottom 9, which is shown in Fig. 2. Of course, the number of grooves 7 and tongues 8 may be different and depends on the width of the gap 3 and the dimensions of the insulation element 4. The length of the insulation element 4 may be shorter than the length of the slabs 2 such that a plurality of insulation elements 4 can be placed behind each other to fill the gap 3 along its entire length.

**[0025]** Due to the presence of the grooves 7 the tongues 8 are displaceable with respect to each other in a direction perpendicular to the grooves 7. In fact, pivots are formed between the groove bottoms 9 and the upper side 5. Consequently, although the insulation element 4 is made from a rigid material a lower portion thereof obtains a certain degree of compressibility. This provides the opportunity to compress a lower portion of the insulation element 4 so as to insert it into the gap 3 easily. Comparing the conditions of the insulation element 4 in Fig. 2 and Fig. 1, it can be seen that the insulation element 4 is changed to a wedge shape in the installed condition of the floor construction 1 as illustrated in Fig. 1.

**[0026]** In the embodiment as shown in Fig. 1 the width of the gap 3 decreases in downward direction, i.e. in a direction from the upper side 5 to the lower side 6 of the insulation element 4. On the other hand, the insulation element 4 obtains a wedge shape such that the insulation element 4 will be self-clamping upon moving downwardly within the gap 3.

**[0027]** Fig. 3 shows a side view of an alternative embodiment of the insulation element 4, whereas Fig. 4 shows a part thereof in perspective view. The shapes of the grooves 7 and tongues 8 of this embodiment are different with respect to those of the embodiment as shown in Fig. 2. The tongues 8 are tapered toward their free ends and the grooves 8 terminate pointed at their groove bottoms 9. The widths of the grooves 8 vary in their depth direction. In general, the maximum width of the groove 8 is preferably smaller than the thickness of the element 4 between the groove bottom 9 and the upper side 5.

**[0028]** Fig. 5 shows still another embodiment of the insulation element 4. In this case the insulation element 4 has an arched cross-section. The lower side 6 is formed by the concave surface of the insulation element 4. The curvature of the arched insulation element 4 may vary

per product or from product-to-product. The curvature of the lower side 6 and/or of the upper side 5 may have centre lines that extend parallel to each other or coincide. In general, the centre lines are straight lines extending in longitudinal direction of the insulation element 4.

**[0029]** The insulation element 4 can be adapted such that a desired width can be broken at one of the grooves 7 by hand force. In case of installing a piece of an insulation element 4 in a gap 3, the width of the gap 3 can be measured. Subsequently, an insulation element 4 larger than the gap width can be divided along one of the grooves 8 such that the width of one of the resulting pieces is slightly larger than the gap width. Alternatively, a skilled constructor may count the number of tongues 8 that corresponds to the desired width. Upon inserting the insulation element 4 into the gap 3 a compressing force can be exerted onto the tongues 8 in transverse direction of the insulation element 4 until the tongues 8 touch each other.

**[0030]** Figs. 6-9 show different embodiments of the floor construction 1. The embodiments are comparable to the embodiment as shown in Fig. 1, but in these cases the widths of the respective gaps 3 are different and the insulation elements 4 are of the arched type as shown in Fig. 5. Of course, the insulation element 4 according to Fig. 3 can be used instead. Figs. 6-9 illustrate that the insulation elements 4 are cut to size corresponding to the actual gap width. The slabs 2 of the embodiments comprise insulation layers 10 which are attached to the concrete portions of the slabs 2. It is noted that lower portions of side edges of the concrete portion of the slabs 2 of the embodiment according to Fig. 6 are inclined such that the gap 3 between the slabs 2 is tapered in downward direction.

**[0031]** Figs. 10-12 show further alternative embodiments of the floor construction 1, in which the insulation elements 4 are also of the arched type, but the slabs 2 are of the type ribbed floor slabs.

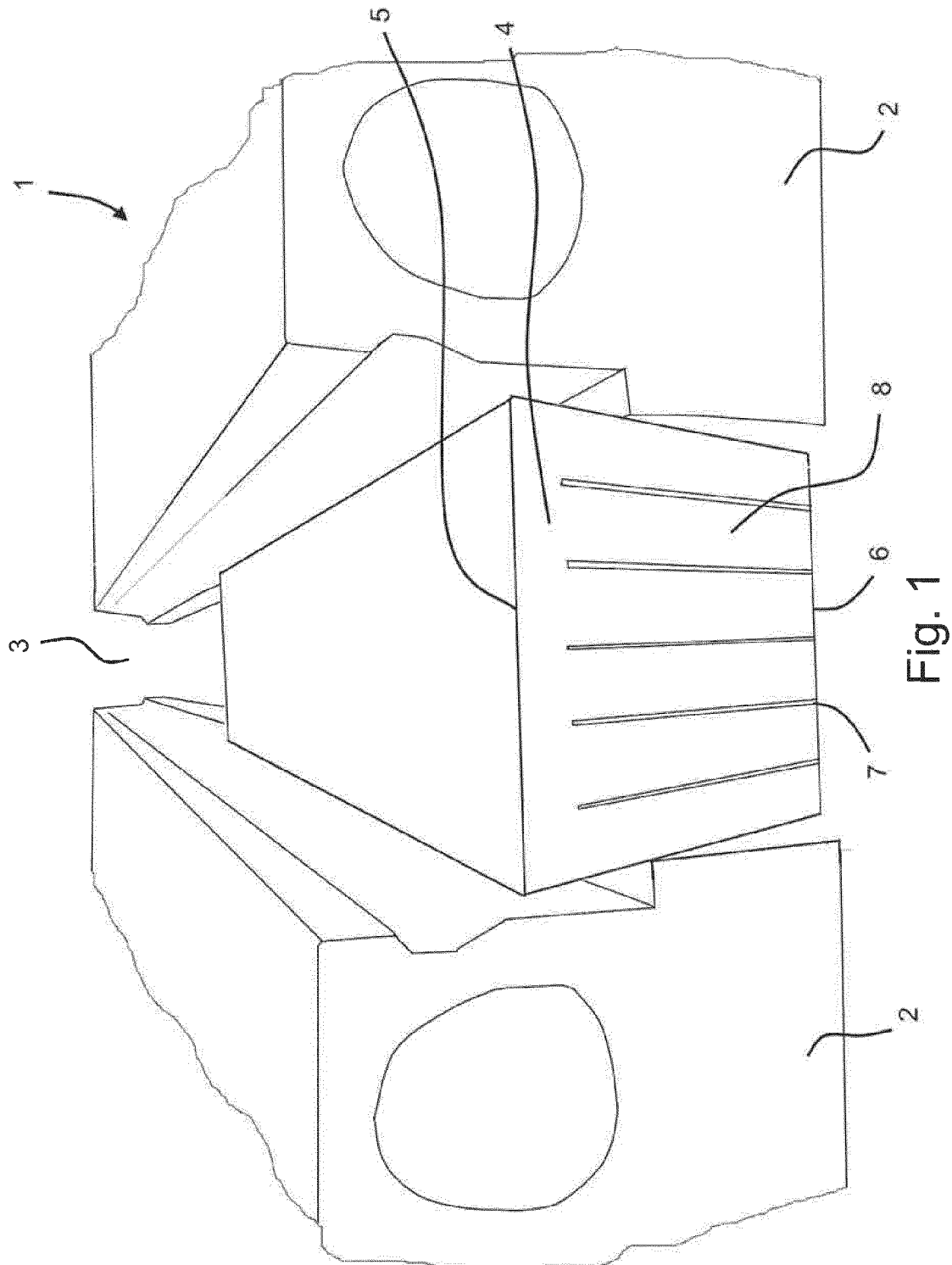
**[0032]** From the foregoing it will be apparent that the invention provides an improved floor construction having a floor including a gap which can be filled by a rigid thermal insulation element in a simple manner.

**[0033]** The invention is not restricted to the above-described embodiments as shown in the drawings, which can be varied in several ways without departing from the scope of the invention. The floor may be built-up in a different manner than by means of concrete slabs.

## Claims

1. A floor construction (1) comprising a floor including a gap (3) in which a rigid thermal insulation element (4) is mounted, wherein the insulation element (4) comprises an upper side (5) and an opposite lower side (6), **characterized in that** the insulation element (4) is provided with at least a groove (7) extending from the lower side (6) toward the upper side

- (5) and ending at a groove bottom (9) so as to form tongues (8) at both sides of the groove (7), which are mutually pivotable about a pivoting axis extending between the groove bottom (9) and the upper side (5).
2. A floor construction (1) according to claim 1, wherein the width of the gap (3) decreases in a direction from the upper side (5) to the lower side (6) of the insulation element (4).
  3. A floor construction (1) according to claim 1 or 2, wherein the insulation element (4) is block shaped and the groove (7) extends in longitudinal direction thereof.
  4. A floor construction (1) according to claim 1 or 2, wherein the insulation element (4) has an arched cross-section, whereas preferably the lower side (6) is formed by the concave surface of the insulation element (4).
  5. A floor construction (1) according to one of the preceding claims, wherein the upper side (5) of the insulation element (14) extends below an upper surface of the floor adjacent to the gap (3).
  6. A floor construction (1) according to one of the preceding claims, wherein the floor is formed by concrete slabs (2), whereas the gap (3) extends between two neighbouring slabs (2).
  7. A floor construction (1) according to one of the preceding claims, wherein the width of the groove (7) is smaller than the distance between the groove bottom (9) and the upper side (5).
  8. A floor construction (1) according to one of the preceding claims, wherein the groove (7) extends substantially perpendicularly to the lower side (6).
  9. A floor construction (1) according to one of the preceding claims, wherein the groove (7) is tapered as seen from the lower side (6) to the groove bottom (9) and/or wherein the tongues (8) are tapered as seen from the groove bottom (9) to the lower side (6).
  10. A floor construction (1) according to one of the preceding claims, wherein the groove (7) is one of a plurality of similar grooves (7) extending substantially parallel to each other.
  11. A floor construction (1) according to claim 10, wherein the insulation element (4) is adapted such that it can be broken along one of the grooves (7) at the corresponding bottom groove (8) by hand force.
  12. A floor construction (1) according to one of the preceding claims, wherein the insulation element (4) is made of a closed-cell foam, preferably expanded polystyrene (EPS).
  13. A rigid thermal insulation element (4) for filling a gap (3) in a floor construction (1) according to one of the preceding claims.
  14. A method of installing a rigid thermal insulation element (4) in a floor gap (3), comprising the steps of supplying a rigid thermal insulation element (4) comprising an upper side (5) and an opposite lower side (6), and a plurality of parallel grooves (7), each extending from the lower side (6) toward the upper side (5) and ending at a groove bottom (9), wherein the width of the insulation element (4) in transverse direction is larger than the width of the gap (3), measuring the width of the gap (3), dividing the insulation element (4) along one of the grooves (7) such that the width of one of the resulting pieces is slightly larger than the width of the gap (3).



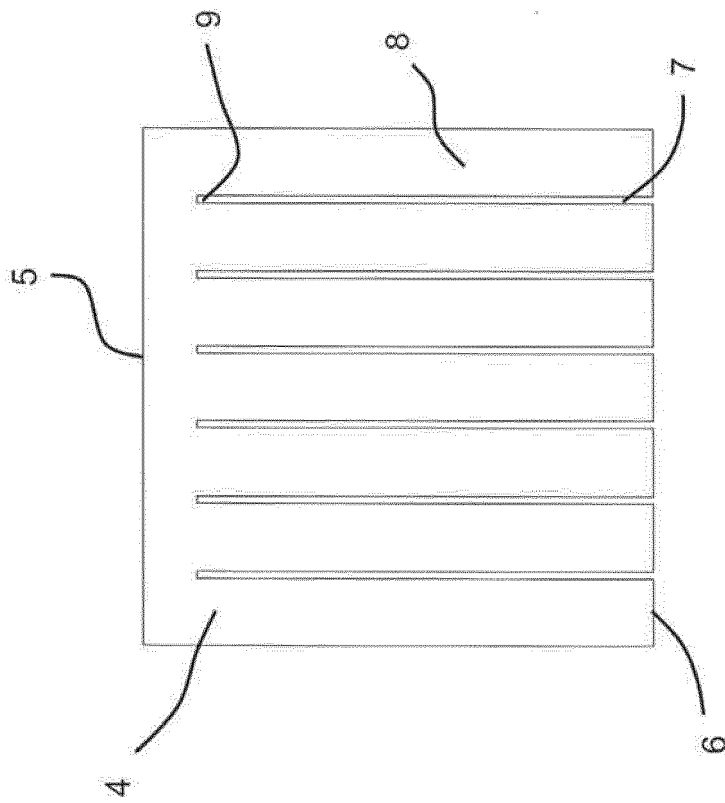


Fig. 2

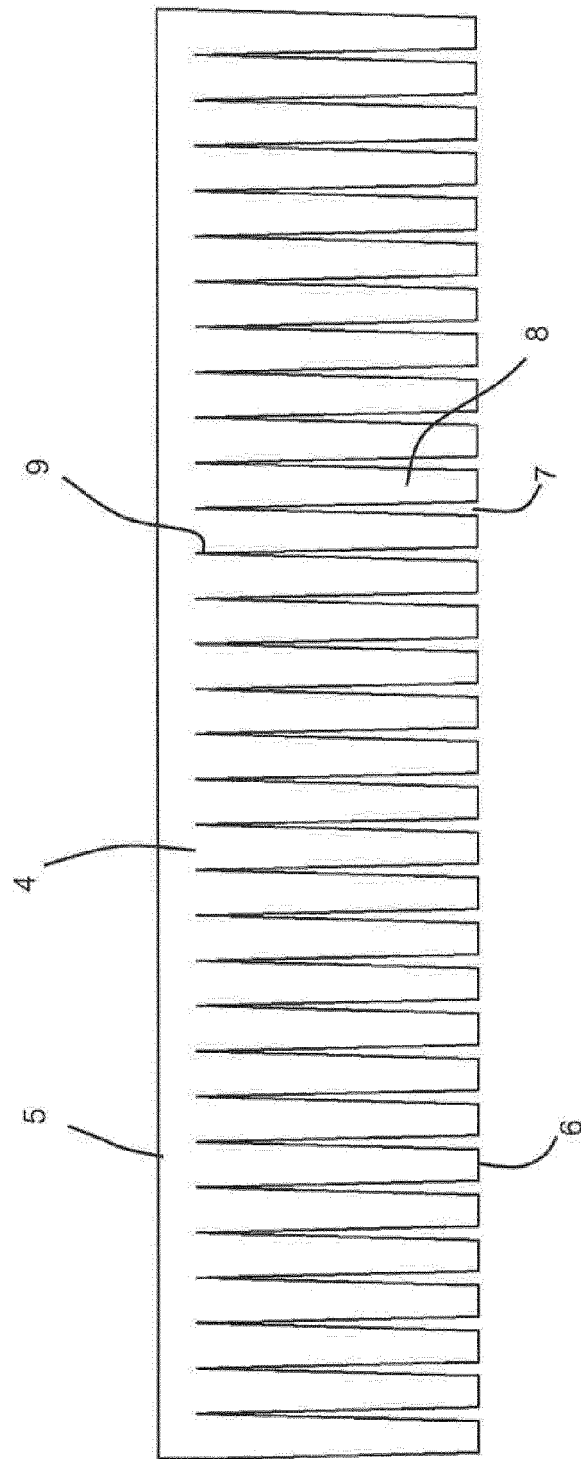


Fig. 3

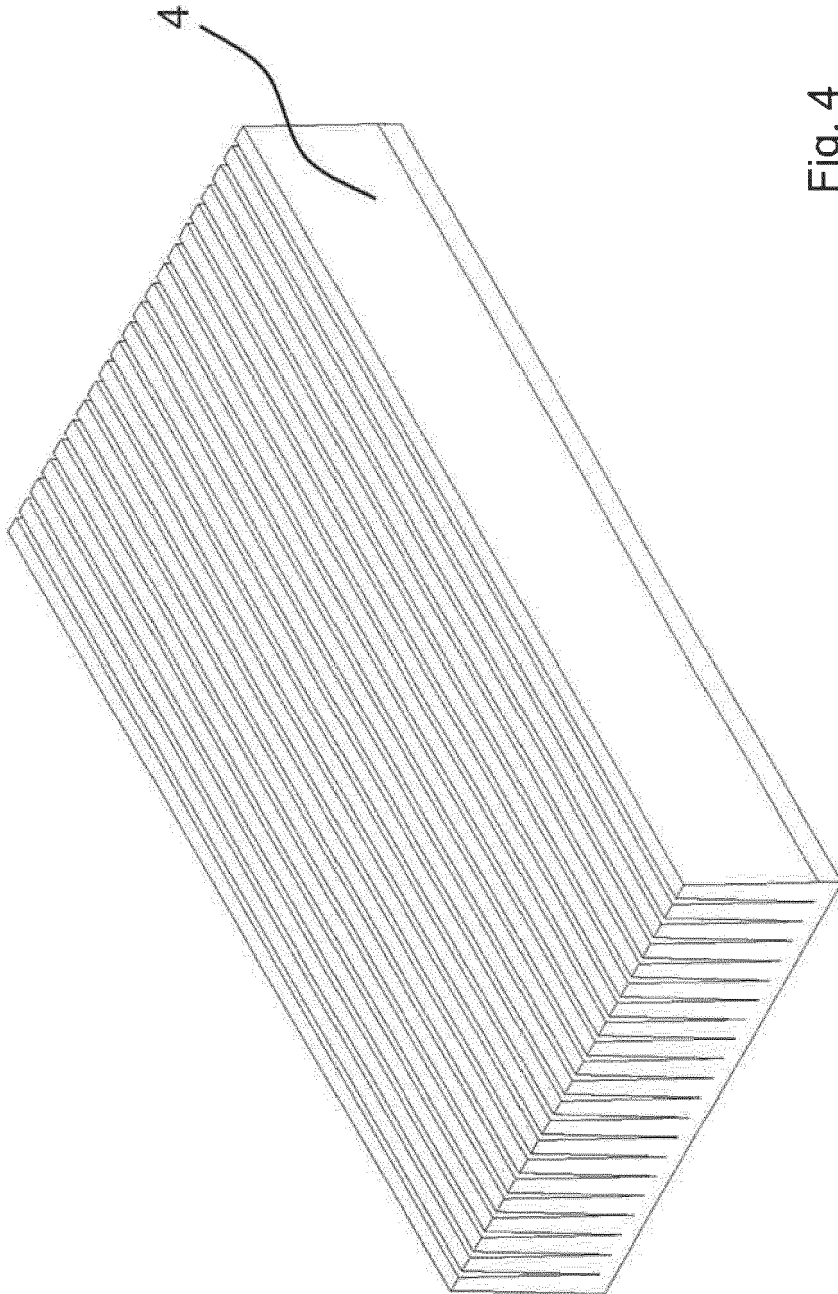


Fig. 4

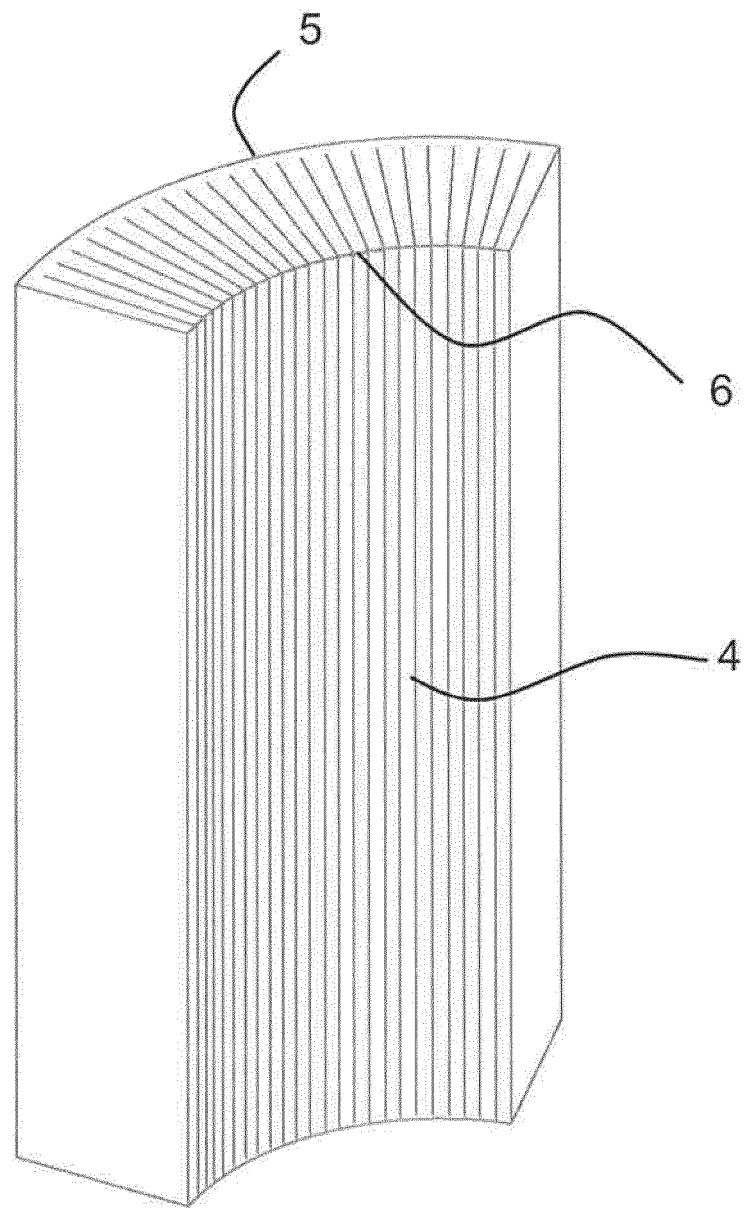


Fig. 5

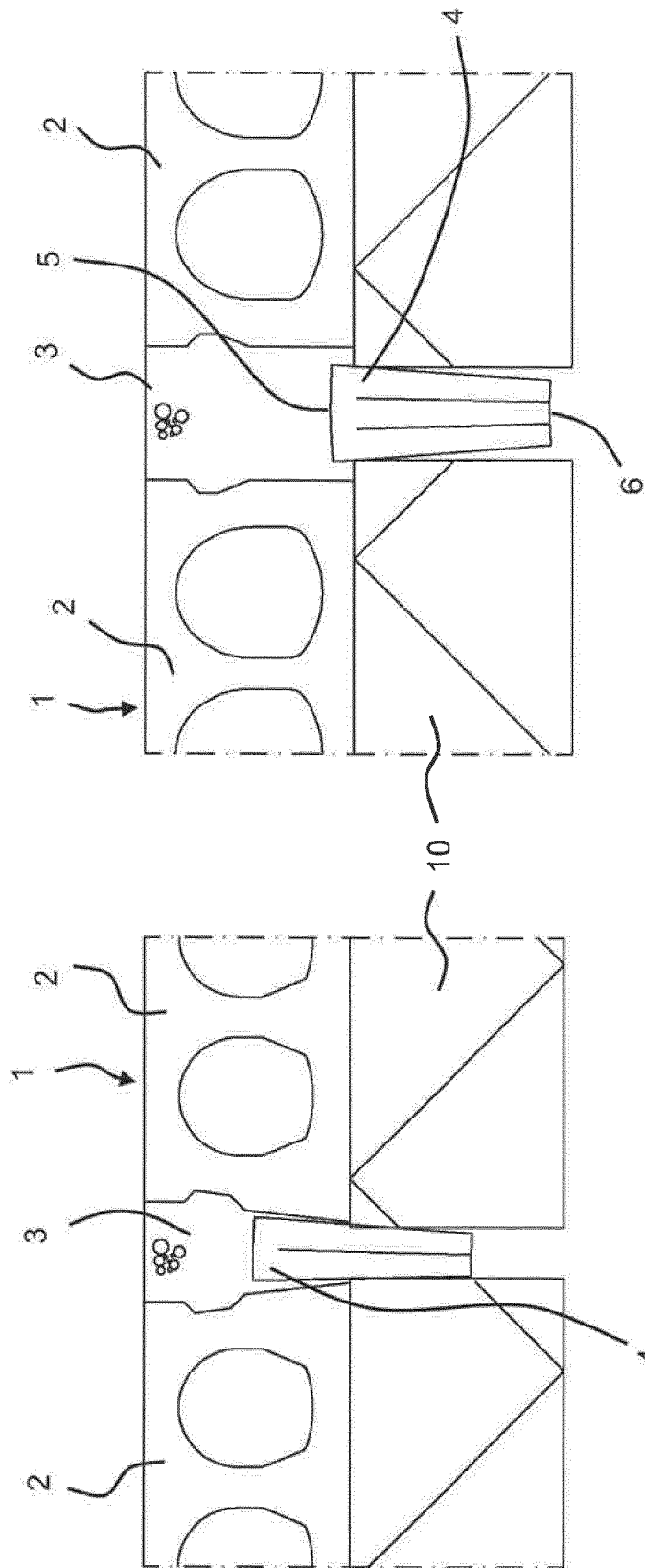


Fig. 7

Fig. 6

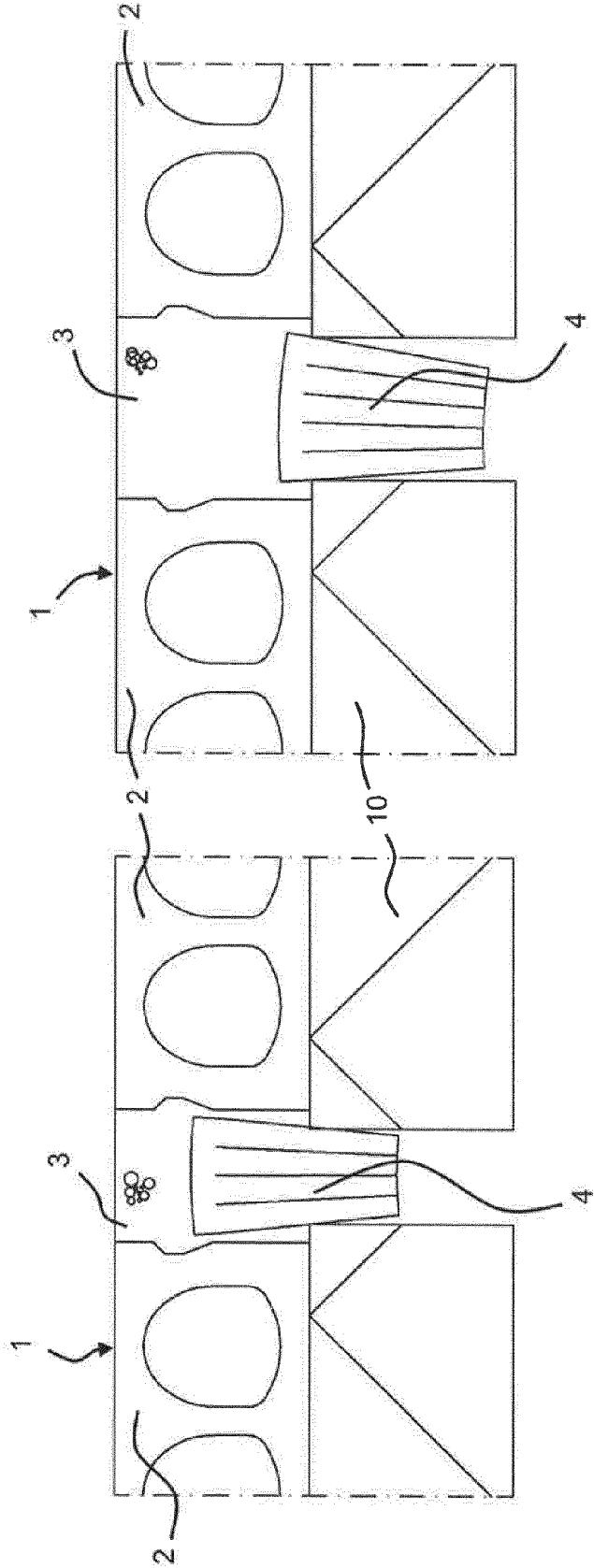


Fig. 8

Fig. 9

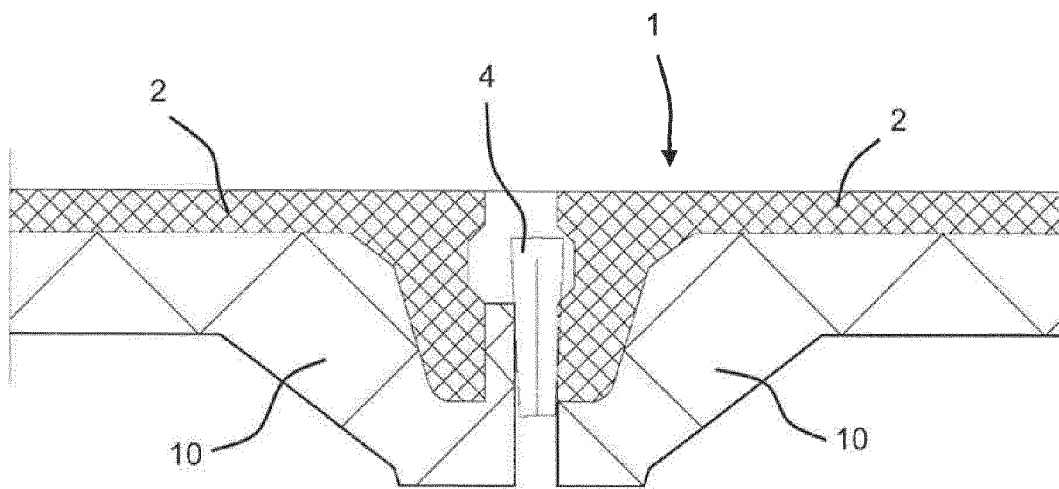


Fig.10

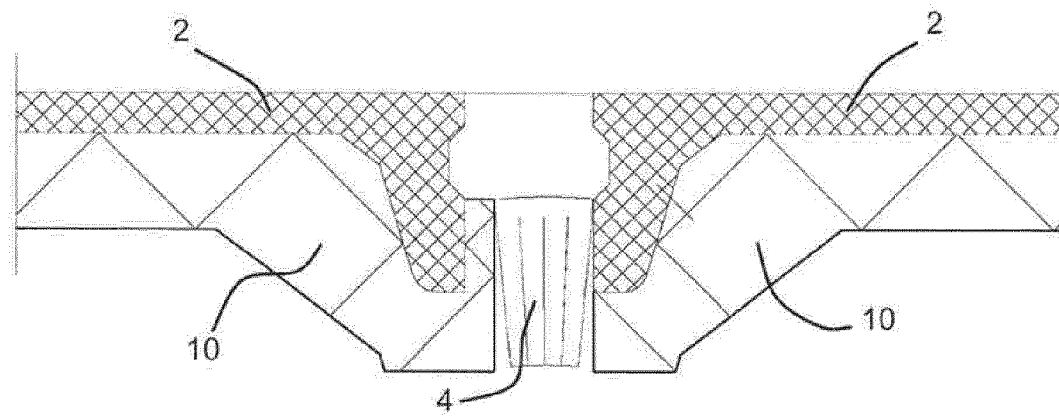


Fig.11

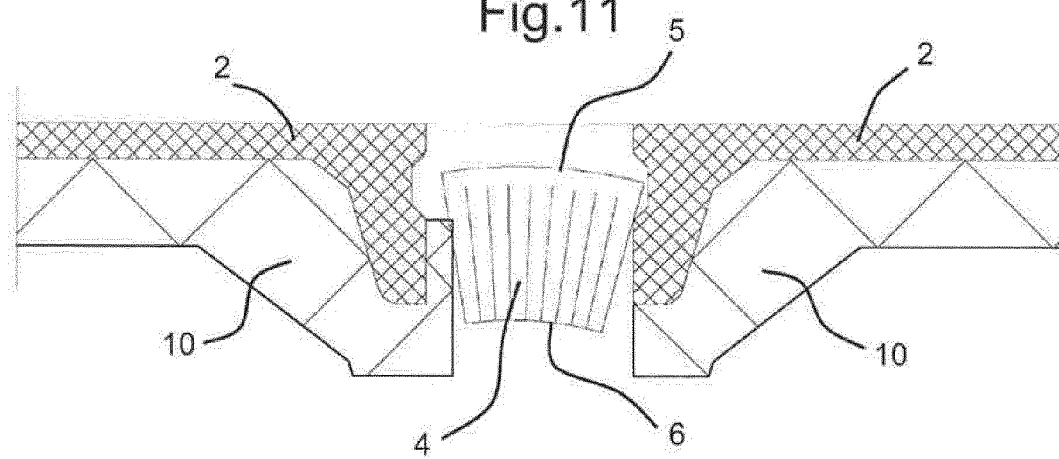


Fig.12



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| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                    |                                                      |                                         |
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**ANNEX TO THE EUROPEAN SEARCH REPORT  
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EP 12 17 4806

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