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

(11) EP 3 150 773 A1

(12) # EUROPEAN PATENT APPLICATION

(43) Date of publication:
05.04.2017 Bulletin 2017/14

(51) Int Cl.:
E04B 1/76 *(2006.01)*

(21) Application number: **15188165.3**

(22) Date of filing: **02.10.2015**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA

(71) Applicant: **URSA Insulation, S.A.**
28004 Madrid (ES)

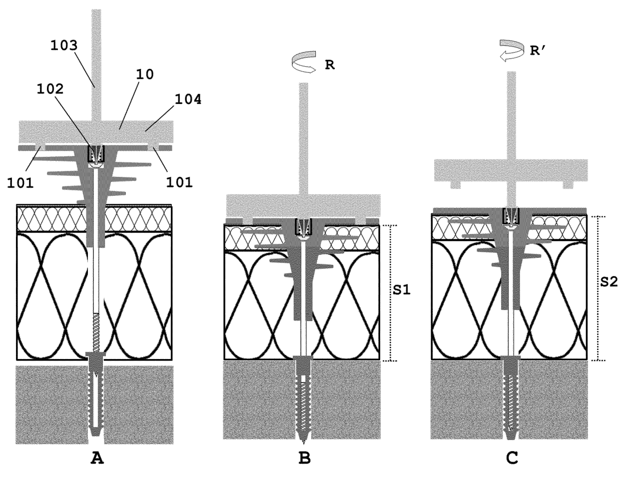
(72) Inventors:
- **Molinero Arenas, Alejandro**
  28050 Madrid (ES)
- **Casado Domínguez, Dr. Arturo Luís**
  28860 Paracuellos de Jarama (ES)

(74) Representative: **Zimmermann & Partner Patentanwälte mbB**
Postfach 330 920
80069 München (DE)

(54) **IMPROVED METHOD FOR FIXATION OF AN INSULATION ELEMENT TO A STRUCTURAL ELEMENT OF A BUILDING, AND SPACER FASTENING DEVICE SUITABLE FOR USE IN SUCH A METHOD**

(57) A method for fixation of an insulation element (3) to a structural element (2), the structural element having a first (21) and a second side (22), comprises: providing an insulation element (3) comprising an insulation material and comprising a first (31) and a second major surfaces (32); positioning the insulation element (3) with its first major surface (31) proximal to the second side (22) of the structural element (2); providing a spacer fastening device (6) comprising a hollow shank (65) and a fastening screw received in the cavity of the hollow shank, wherein the hollow shank and the fastening screw are adapted to be locked relative to each other in an axial longitudinal direction of the fastening screw, the fastening screw comprising a treaded tip for engagement with the structural element, and the hollow shank comprising a helical thread running on its outside; inserting the spacer fastening device with the threaded tip first from the second major surface into the insulation element; rotating simultaneously both the hollow shank and the fastening screw, so as to produce their advance towards the structural element, until the whole length of the helical thread is inserted into the insulation element; rotating the fastening screw, without rotating the hollow shank, to adjust the distance between the second major surface of the insulation element and the second side of the structural element.

FIGURE 4



EP 3 150 773 A1

Description

Filed of the Invention

[0001] The present invention relates to a method for fixation of an insulation element to a structural element of a building, and particularly for the fixation to a structural element of insulation elements comprising internal and external layers, particularly where the external layer is more rigid than the internal layer. The invention also concerns a spacer fastening device for use in such a method, and an insulation system comprising the spacer fastening device and an insulation element.

Background

[0002] The façades of buildings are recurrently thermally and acoustically insulated by applying insulating materials externally to its structural elements. For this purpose, the use of generically called "External Thermal Insulation Composite Systems" (abbreviated as ETICS) is nowadays well established. The ETICS commonly comprise a layer of insulation elements (e.g. panels) arranged externally on the surface of a structural element of a building, fastening devices erecting through the thickness of the insulation elements and fixing those to the structural element, a rendering coating (e.g. mesh reinforced mortar) applied to the external surface of the insulation elements, and optionally a finishing layer (e.g. dyed mortar), acting as an aesthetic and/or protective layer for the outer surface of the system. Frequently, a bonding agent is also applied to the insulation elements for adhering them to the structural element during installation.

[0003] ETICS comprising insulation elements with layers of different rigidity have been described as advantageous, particularly made of mineral wool or wood wool insulation. In these systems, a softer, more flexible layer is arranged closer to the structural element, referred to as the internal layer. A harder, more rigid layer is located further away from the structural element, referred to as the external layer. Fastening devices are also described, which extend through the internal and external layers in the insulation element and fix them firmly to the structural element. Among other advantages, in these configurations, the harder layer serves as resilient base for the rendering coating and it is able to withstand mechanical stresses applied to the insulation element. The softer layer reduces the weight of the insulation element, contributes to an improved thermal insulation capacity, and being more flexible, it is capable of adapting itself to contours and irregularities which might be present in the structural element. Often, in this type of systems, the surface of the structural element does not need to be prepared before the insulation elements are arranged on to it, such as by application of a rendering layer to smoothen and eliminate unevenness or irregularities. The application of binding agent, e.g. bonding mortar, for bonding the insulation elements to the structural element can be omitted by the use of this type of systems, and with it also the need of applying a primer for improving adhesion of the binding agent to the surface of the structural element. External insulation systems comprising multilayer insulation elements of this type, as well as spacer fastening devices to be used in these systems, are described in the patent applications EP 2215317 B1, EP 2216454 A2, WO 2014090707 A1 and EP 2666919 A2.

[0004] In the systems described in the art, the external layer is formed by high density mineral wool or wood wool insulation materials. The high density is associated with certain drawbacks, such as the increased weight, poorer thermal insulation, the need of higher amount of material for same level of insulation, or the less efficient and more complex wool manufacturing process.

[0005] It would be thus desirable to provide external insulation systems with a multilayer insulation element, wherein the external layer comprises a mineral wool material of lower density, particularly a glass wool mineral. Even more desirable would be if this mineral wool material could have a laminar arrangement of the fibers predominantly parallel to the major surfaces of the external layer, so that the thermal insulation capacity is enhanced.

[0006] However, the use of lower density laminar mineral or glass wool external layers presents certain challenges. Due to the less packed fiber structure of these materials, they have a much higher tendency to disaggregation of the fibrous matrix, resulting in a lower resistance against piercing or tearing in the direction of their thickness (perpendicular to the major surfaces).

[0007] There is also a desire for a quick and straightforward method for fixation of multilayer insulation panels, particularly in the cases where the external layer comprises lower density laminar mineral or glass wool materials.

[0008] The patent publications EP 2215317 B1 and EP 2216454 A2 are related in that the first one describes a spacer fastening device which is described in the latter as suitable for fixation of multilayer insulation panels, preferably of wood wool. The density of the external layer is between 180 kg/m^3 and 280 kg/m^3. The fixation comprises a hollow shank with a fastening screw received in its cavity, together with a non-backward-movement device for the fastening screw. The hollow shank has anchors on its outside, in the form of barbed hooks.

[0009] Patent publication EP 2666919 A2 describes a fastening device for fixation of double layer wood fiber insulation panels. The fastening device comprises a hollow shank and a fastening screw received in its cavity. The hollow shank has a spiral thread on its outside, for anchoring with the external layer. The distance of the outer surface of the insulation panel to the structural element is defined by providing a hollow cylinder of a preset length coupled with the shank and surrounding the screw.

[0010] Finally, WO 2014/090707 A1 describes double layer insulation materials, comprising a compressible internal layer and an incompressible external layer. The incompressible layer might comprise a large list of materials, among others also mineral wool, notably stone wool, with a density of at least 80 kg/m^3, but preferably of at least 120 kg/m^3. The majority of the mineral wool fibers in the incompressible layer are said to have an orientation substantially perpendicular to the major surfaces of the mineral wool. A shank is pre-installed, preferably factory assembled, along a pre-drilled hole in the panel, entirely within the body of the incompressible external layer. The shank has an external screw thread to advance it and secure it in its desired position. A fixation screw having a circular stop spaced from the screw head is received in a cavity of the shank, which is retained in a stop zone of the shank. A laser receiver is located in a screw driver to detect a laser beam used to adjust the desired distance of the external surface of the insulation panel to the structural element.

[0011] It is thus an aim of the present invention to provide a method for fixation of an insulation element to a structural element comprising a layer of low density laminar mineral wool, particularly glass wool, which is fast and straightforward, and which overcomes the problems of the methods known in the art. The method is applicable particularly for the fixation to a structural element of insulation elements comprising internal and external layers, the external layer being preferably more rigid than the internal layer, and the external layer comprising preferably low density laminar mineral wool, particularly glass wool.

[0012] Another aim of the present invention is to provide a spacer fastening device for use in the inventive methods mentioned above, and which is suitable for reliably fixing insulation elements having a layer of low density laminar mineral wool, particularly glass wool, and which permits uncomplicated adjustment of the distance between the outer surface of the insulation element and the surface of the structural element on which the insulation element is arranged.

Description of the invention

[0013] In a first aspect of the invention, a method for fixation of an insulation element to a structural element of a building is provided, wherein the structural element has a first side and a second side. The method includes:

a) providing an insulation element comprising an insulation material and a first and a second major surfaces;

b) positioning the insulation element with its first major surface proximal to the second side of the structural element;

c) providing a spacer fastening device comprising a hollow shank and a fastening screw received in the cavity of the hollow shank; wherein hollow shank and fastening screw are adapted to be locked relative to each other in the axial longitudinal direction of the fastening screw; the fastening screw comprising a threaded tip for engagement with the structural element; and wherein the hollow shank comprises a helical thread running on its outside;

d) inserting the spacer fastening device, with the threaded tip first, from the second major surface into the insulation element;

e) rotating simultaneously both the hollow shank and the fastening screw, so as to produce their advance towards the structural element, until the whole length of the helical thread is inserted into the insulation element;

f) rotating the fastening screw, without rotating the hollow shank, to adjust the distance between the second major surface of the insulation element and the second side of the structural element.

[0014] The method optionally comprises a step of forming a hole from the second major surface through the thickness of the insulation element, and optionally also into the structural element, before step c) above.

[0015] Preferably, in the step a), the insulation element is provided comprising mineral wool, more preferably laminar mineral wool, and even more preferred laminar glass wool. Also preferred, the density of the mineral wool is lower than 140 kg/m^3, preferably equal or lower than 120 kg/m^3, and more preferably equal or lower than 100 kg/m^3.

[0016] Also preferably, in step a), the insulation element is provided comprising internal and external layers, the external layer being more rigid than the internal layer, and the external layer comprising mineral wool, more preferably laminar mineral wool, and even more preferably laminar glass wool, with a density lower than 140 kg/m^3, preferably equal or lower than 120 kg/m^3, and more preferably in the range 100 - 60 kg/m^3. The internal layer is the one intended to rest proximal to the structural element after fixation, while the external layer is intended to rest distal from it. The higher rigidity of the external layer turns into a better ability of this layer to resist deformation without fracture in response to applied forces in its thickness direction.

[0017] In preferred embodiments, the insulation element does not comprise fibrous insulating material with a density equal or higher than 140 kg/m^3.

[0018] The structural element comprises a first side and a second side, usually essentially parallel with each other. The structural element might comprise a wooden, masonry or concrete structure of the type used in the construction of walls, façades, ceilings, roofs and the like of buildings.

[0019] The insulation element comprises two major surfaces, referred here as a first major surface and a second major surface. The first major surface is preferably substantially parallel to the second major surface of the insulation element, and distanced from it by the thickness of the insulation element. The insulation element is preferably in the shape of a panel or slab, with two larger parallel surfaces forming the first and second major surfaces mentioned above, and four smaller lateral surfaces parallel two-by-two and perpendicular to the two larger surfaces, forming the edges of such panel or slab.

[0020] In the embodiments where the insulation element comprises internal and external layers, these layers extend, preferably homogeneously, planar and in parallel, through the whole length and width of the insulation element, i.e. in the length and width direction of the insulation element, being the thickness of the insulation element the sum of the thicknesses of both layers. In other words, preferably the two layers are arranged in a two-ply configuration.

[0021] In embodiments, the thickness of the insulation element is the sum of the thicknesses of the internal layer and the external layer. In other words, in embodiments, the insulation element does not comprise other layers apart from the internal layer and the external layer.

[0022] In preferred embodiments, the insulating element comprises an internal layer and an external layer and both internal and external layers comprise glass wool material. Also preferably, the density of the external layer is higher than the density of the internal layer. The glass wool comprised in both internal and external layers might have a laminar configuration of the glass fibers. More preferably, the external layer comprises glass wool material with a density in the range 100 - 70 kg/m^3 and a laminar orientation of the glass fibers. The external layer preferably further comprises a reinforcing web applied on or at its major surface intended to be located more distal from the structural element. In this embodiment, the internal layer comprises glass wool material with a density in the range 20 - 45 kg/m^3 and a laminar orientation of the glass fibers.

[0023] The method according to embodiments comprises a step of positioning the insulation element with its first major surface proximal to the second side of the structural element. In preferable embodiments, this is done without intermediation of any binding agent. In other words, the insulation element is preferably arranged directly against the second side of the structural element, wherein the first major surface directly contacts, at least partially, the second side of the structural element.

[0024] In the particular embodiments where the insulation element comprises internal and external layers, the external layer being more rigid than the internal layer, the internal layer is positioned proximal to the second side of the structural element, while the external layer is positioned distal from it.

[0025] Following the positioning step, a hole is preferably created from the second major surface of the insulation element and through its thickness. Preferably also, the hole is created by drilling. In this case, the drilling may be continued until a second hole is drilled into the structural element to the desired depth. By creating both holes in one step, it is achieved that the holes match each other in size and position, and that they are communicating. The drilling is preferably done in a direction essentially perpendicular to the second major surface of the second side of the structural element.

[0026] In a subsequent step, a spacer fastening device is provided comprising a hollow shank and a fastening screw received in the cavity of the hollow shank, both adapted to be locked relative to each other in the axial longitudinal direction of the screw. In preferred embodiments, the hollow shank and the fastening screw in the locked position are freely rotatable relative to each other.

[0027] The hollow shank comprises a helical thread running on its outside. The maximum major diameter of the helical thread is preferably at least 50 mm, and it preferably ranges from 50 - 100 mm, more preferably from 60 - 80 mm. The maximum external diameter of the body of the hollow shank is at most 35 mm, preferably at most 25 mm.

[0028] In preferred embodiments, the hollow shank further comprises a retainer disk, usually with a diameter larger than the maximum major diameter of the helical thread, located on the one end of the shank intended to rest more distal from the second side of the structural element after fixation.

[0029] The fastening screw is preferably elongated and may comprise a head on a first end, and a threaded tip on a second end furthest away from the head. The screw head is received in the cavity of the hollow shank, and the fastening screw extends away from the cavity through an aperture in the hollow shank. The threaded tip is adapted to engage with the dowel inserted in the structural element, or with the structural element directly, in order to achieve fixation.

[0030] The lock between the hollow shank and the fastening screw is exemplarily achieved by retaining the head of the fastening screw between a circular neck formed in the cavity of the hollow shank and a stopper fastened over the screw head. In this case, it is preferred that the stopper has an aperture which permits the access from the outside of the hollow shank to the head of the fastening screw, for example with the tip of a screw driver. In the locked position, when the head of the fastening screw is retained between the circular neck and the stopper, the hollow shank and the fastening screw are freely rotatable relative to each other.

[0031] The spacer fastening device is inserted with the threaded tip first from the second major surface into the insulation element, or into the hole formed in the insulation element, preferably until the initial portion of the helical thread rests onto the second major surface of the insulation element and preferably until the threaded tip has entered at least partially into the structural element, or the hole drilled in it. An expansion dowel is preferably pre-mounted in unexpanded form in the threaded tip of the fastening screw, before the latter is inserted into the insulation element. In this way, the expansion dowel might be introduced into the hole of the structural element together with the threaded tip. In alternative embodiments, the expansion dowel may be introduced into the hole of the structural element separated from the spacer fastening device. Also, for some embodiments where the structural element allows it, for example for wood substrates, the threaded tip of the fastening screw can be fixed to the structural element without any expansion dowel. The insertion and advancement of the spacer fastening device into the insulation element and optionally the hole in the structural element is preferably produced by translational displacement, e.g. by pushing manually by gently striking it with an adequate hammer.

[0032] A screw driver might then be positioned over the spacer fastening device and engaged simultaneously with the hollow shank and the fastening screw. Preferably, the screw driver is adapted to engage with the tip of the fastening screw and with the retainer disk of the hollow shank.

[0033] Afterwards, the screw driver is operated to provide a rotation in the screwing direction to produce the simultaneous rotation of the hollow shank and the fastening screw. This rotation produces the advance of the threaded tip of the fastening screw into the structural element, and given the case into the expansion dowel, and the advance towards the structural element of the hollow shank by screwing inside the insulation element. By the rotation, the helical thread of the hollow shank gets progressively inserted by screwing into the insulation element. The simultaneous rotation of the hollow shank and the fastening screw is done, in preferred embodiments, with the same rotational speed.

[0034] The rotation is preferably continued until the whole length of the helical thread of the hollow shank is inserted into the insulation element, and the optional retainer disk rests in abutment with the second major surface of the insulation element.

[0035] After the threaded tip and the hollow shank have advanced to the desired position, the simultaneous rotation is ended.

[0036] A screw driver may be then positioned over the spacer fastening device and engaged with the fastening screw, this time without engaging with the hollow shank. It can be the same screw driver as in the previous step, or it might be a different one. In the case of using the same screw driver, this one may be modified to disengage the screw driver from the hollow shank, for instance by moving the corresponding engagement means away from the engagement position. The disengagement can be done manually, or it can be achieved automatically once the screw driver detects a certain level of resistance to rotation which indicates the accomplishment of the desired position.

[0037] Subsequently, the distance between the second major surface of the insulation element and the second side of the structural element is adjusted by rotating the fastening screw, without rotating the hollow shank. In other words, the hollow shank remains rotationally stalled inside the insulation element while the fastening screw is rotated for distance adjustment. This might be achieved by operating the screw driver with a rotation in the screwing direction for reducing the distance between the second major surface of the insulation element and the second side of the structural element, or by rotation in the unscrewing direction for increasing such distance.

[0038] This adjustment of the distance of the second major surface of the insulation element from the second side of the structural element permits optimization of the level of compression applied to the insulation element, a better adaptation of the insulation element to the contours and irregularities of the second side of the surface, the elimination of the need for application of a binding agent between the insulation element and the structural element, and the adjustment of the planarity of the second major surfaces of a plurality of insulation elements, e.g. in cases where several insulation elements are used to cover the same structural element.

[0039] In embodiments where the hollow shank comprises a retainer disk, this disk might be provided with protrusions extending slightly towards the threaded tip of the fastening screw. The protrusions are intended to cut into the second major surface of the insulation element as the retainer disk approaches the structural element during the simultaneous rotation of the fastening screw and the hollow shank. The cut facilitates the partial embedment of the retainer disk in the insulation material.

[0040] The method of the invention is particularly useful for the construction of externally insulated walls or roofs of buildings, such as façades, flat or pitched roofs. The invention is however not limited to these type of constructions, and, although less preferred, the inventive method might be also useful in other cases, such as e.g. for the construction of insulated internal walls or ceilings of buildings.

[0041] In another aspect of the invention, it is provided a spacer fastening device for use in the method according to the first aspect of the invention, the spacer fastening device comprising;

a) a hollow shank comprising a helical thread running on its outside and

b) a fastening screw comprising a threaded tip,

wherein the hollow shank and the fastening screwing are adapted to be locked relative to each other in the axial longitudinal direction of the fastening screw, while being freely rotatable relative to each other, and
wherein the maximum major diameter of the helical thread of the hollow shank is preferably at least 50 mm.

[0042] In embodiments, the maximum external diameter of the body of the hollow shank is preferably at most 35 mm.

[0043] Embodiments of this second aspect of the invention relate to a spacer fastening device for application of the method for fixation of the embodiments of the first aspect of the invention. The spacer fastening device is particularly suitable for the fixation of insulation elements comprising a layer of laminar mineral wool, particularly glass wool, with a density lower than 140 kg/m^3, preferably equal or lower than 120 kg/m^3, and more preferably equal or lower than 100 kg/m^3. According to an embodiment, the density is at least 60 Kg/m^3. The spacer fastening device is even more suitable for the fixation of an insulation element comprising internal and external layers, the external layer being more rigid than the internal layer, and the external layer comprising laminar mineral wool, particularly glass wool, with a density lower than 140 kg/m^3, preferably equal or lower than 120 kg/m^3, and more preferably in the range 120 - 60 kg/m^3.

[0044] The spacer fastening device comprises a hollow shank and a fastening screw received in the cavity of the hollow shank. Both hollow shank and fastening screw are adapted to be locked relative to each other in the axial longitudinal direction of the fastening screw. The hollow shank comprises a helical thread running on its outside, this is, a thread in the form of a helical band. The helical thread is adapted to penetrate and to engage into the insulation element by rotational screwing movement. The helical thread has preferably a maximum major diameter which decreases progressively going towards the structural element during use, thus forming a conical helical thread shape. The conical shape facilitates the penetration of the thread in the insulation element.

[0045] The object of the helical thread in the hollow shank is to anchor sufficiently the insulation element to the spacer fastening device against pulling, tearing and pressing forces, overcoming the problems caused by the reduced resistance to these stresses in the thickness direction of the low density laminar mineral wool material, particularly for glass wool. The major diameter of the thread band has to be large enough to provide sufficient anchoring strength of the fibrous insulating material to the shank, without destroying the material when compression or suction forces are applied to the insulation material. For this object, the maximum major diameter of the helical thread is preferably at least 50 mm, and it preferably ranges from 50 - 100 mm, more preferably from 60 - 80 mm. The maximum external diameter of the body of the hollow shank is at most 35 mm, preferably at most 25 mm.

[0046] The other parameters of the helical thread such as the pitch and the thread angle should be selected to facilitate the penetration by screwing movement into the insulation element, and to allow sufficient insulating material getting inserted between thread turns to enhance the anchoring effect without destroying the low density laminar mineral wool material. The pitch of the helical thread is preferably constant. The thread pitch is preferably at least 3 mm, more preferably at least 4 mm. The thread pitch preferably does not exceed 30 mm, more preferably it does not exceed 20 mm, and even more preferably it does not exceed 10 mm. In preferred embodiments, the length of helical thread ranges from 30 mm - 60 mm, preferably from 40 - 50 mm, and the number of threads may range from 3 to 9, preferably from 5 - 7. The helical thread might run along the whole length of the hollow shank, or only along a part of it. The helix angle of the helical thread might vary along the length of the helical thread, and its average value preferably ranges from 1° to 7°, and more preferably from 2° to 6°.

[0047] The fastening screw is preferably elongated and comprises a screw head on its first end, the end most distal from the structural element when the fastening device is used, and a threaded tip on its second end, the one end intended to engage with the structural element during use. The screw head preferably incorporates means for engagement with the tip of a screw driver, such as slots, sockets or the like.

[0048] The lock between the hollow shank and the fastening screw is preferably achieved by retaining the head of the fastening screw between a circular neck formed in the cavity of the hollow shank and a stopper fastened over the screw head. The circular neck is formed between portions of the cavity with different diameter in the hollow shank. It is preferred that the stopper has an aperture through its thickness which permits the access from the outside of the hollow shank to the head of the fastening screw, for example with the tip of a screw driver.

[0049] In alternative embodiments, the lock between the hollow shank and the fastening screw might be achieved by providing the fastening screw with a ring shaped stop along its length adapted to be received in a stop area available in the cavity of the hollow shank, with a shape corresponding with the ring shaped stop.

[0050] According to embodiments, the lock between the hollow shank and the fastening screw does not impede the free rotation of either the hollow shank or the fastening screw relative to each other. This is achieved e.g. by the embodiments described above, comprising either a circular neck or a ring shaped stopper. By free rotation or freely rotatable it has to be understood that the two parts can be rotated relative to each other without any of the parts being destroyed or essentially modified. A certain resistance against rotation, e.g. as such arising from friction between the two parts, does not account as a hindrance of free rotation.

[0051] In preferred embodiments, the hollow shank of the spacer fastening device comprises a retainer disk usually with a diameter larger than the major diameter of the helical thread, located on the one end of the shank intended to rest most distal from the structural element during use. The retainer disk provides further holding of the insulation element against pulling forces in the direction of its thickness. The retainer disk might be provided with protrusions extending slightly towards the structural element, i.e. towards the threaded tip, intended to cut slightly into the insulation element when the spacer fastening device is used.

[0052] The retainer disk of the hollow shank might comprise apertures through its thickness in preferred embodiments. The apertures can be used for engagement with a screw driver, for example, in order to produce the simultaneous rotation of the hollow shank and the fastening screw as described in the method of the embodiments. The holes further reduce the amount of material, without decreasing significantly the holding strength of the retainer disk.

[0053] In still another aspect of the invention, it is provided an insulation system comprising a spacer fastening device according to the embodiments described above, and an insulation element comprising an internal layer and an external layer, the external layer comprising laminar mineral wool, and even more preferably laminar glass wool, with a density lower than 140 kg/m^3, preferably equal or lower than 120 kg/m^3, and more preferably in the range 100 - 60 kg/m^3.

[0054] In the system according to this aspect of the invention, the helical thread of the hollow shank of the spacer fastening device engages into the external layer, i.e. into the laminar mineral wool comprised in the external layer, of the insulation element.

[0055] In preferred embodiments, the external layer of the insulation element comprises at least 90 wt.-%, more preferably at least 95 wt.-% in relation to the total weight of the external layer, of mineral wool material with a density lower than 140 kg/m^3. The mineral wool material in the external layer has preferably a homogeneous composition and/or uniform properties.

[0056] In preferred embodiments, the external layer is distinct from the internal layer. In embodiments, the external layer is more rigid than the internal layer.

[0057] By laminar mineral wool it should be understood that the fibers in the mineral wool are predominantly oriented perpendicular to the thickness of the external layer. In other words, with the laminar configuration of the fibers of the mineral wool material in the external layer it is meant that the fibers have not been subjected to any process to enhance their orientation in the direction of the thickness of the external layer.

[0058] The insulation system is useful for insulation of structural elements of buildings, where the insulation elements are arranged proximal to the structural element and fixed to it by the spacer fastening devices.

[0059] The external layer is intended to be located distal from and the internal layer proximal to the structural element of the building during use.

[0060] In preferred embodiments, the insulation element does not comprise fibrous insulating material, such as mineral wool or wood wool, with a density equal or higher than 140 kg/m^3.

[0061] The internal and external layers extend preferably homogeneously, planar and in parallel, through the whole length and width of the insulation element, i.e. in the length and width direction of the insulation element, being the thickness of the insulation element the sum of the thicknesses of both layers. In other words, preferably the two layers are arranged in a two-ply configuration. In embodiments, the thickness of the insulation element is the sum of the thicknesses of the internal layer and the external layer. In other words, in embodiments, the insulation element does not comprise other layers apart from the internal layer and the external layer.

[0062] In preferred embodiments, the mineral wool material of the external layer is bonded by a cured organic binder, suitably comprising a thermoset resin. The content of the organic binder in the mineral wool of the external layer, measured as "Loss On Ignition" (LOI) is preferably higher than 5 wt.-% related to the total weight of the fibers, preferably between 6 - 15 wt.-% and more preferably between 8 - 13 wt.%. This levels of binder content contribute to further enhance the mechanical properties, particularly the rigidity and compression resistance, of the external layer.

[0063] Preferably, the external layer has a compressive stress at 10% deformation, measured according UNE EN 826:2013, of at least 3 times, preferably at least 4 times, higher than the compressive stress at 10% deformation of the internal layer. Also preferably, the external layer has a compressive stress at 10% deformation lower than 15 kPa or lower than 10 kPa, more preferably of 5 - 1 kPa.

[0064] The external layer of the insulation element preferably comprises a reinforcing web either on or at its larger surface (inner side of the external layer) more proximal to the structural element, or on or at its larger surface (outer side of the external layer) more distal to the structural element. More preferably, the reinforcing web is present in or on or at both larger surfaces.

[0065] The reinforcing web can be any web of sufficient mechanical resistance to dimensional change. It is preferred that it has a porous open structure, more preferably a fabric or nonwoven structure of fibers. The reinforcing web is preferably a glass fiber textile or non-woven. Glass fiber veils made out of glass fibers laid down randomly and bonded with a binder have shown to be suitable. Reinforcing filaments might be incorporated into the web structure to increase dimensional stability. The thickness of the reinforcing web ranges preferably from 100 to 1000 micrometers, more preferably from 200 - 700 micrometers, and the weight per surface area from 20 - 150 g/m^2, more preferably from 30 - 100 g/m^2.

[0066] In embodiments, the internal layer comprises fibrous insulating material. According to these embodiments of the insulation system, the fibrous insulating material of the internal layer has a density lower than 60 kg/m^3, preferably lower than 45 kg/m^3 and more preferably lower than 35 kg/m^3. Also preferably, the fibrous insulating material of the internal layer is mineral wool, particularly glass wool. The orientation of the fibers in the fibrous insulating material of the internal layer might be laminar, not having been subjected to any process to enhance their orientation in the direction of the thickness of the internal layer.

[0067] In preferred embodiments, the insulating element comprises an internal layer and an external layer and both internal and external layers comprise glass wool material. Also preferably, the density of the external layer is higher than the density of the internal layer. The glass wool comprised in both internal and external layer might have a laminar configuration of the glass fibers. More preferably, the external layer comprises glass wool material with a density in the range 100 - 70 kg/m^3 and a laminar orientation of the glass fibers. The external layer preferably further comprises a reinforcing web applied on or at its major surface intended to be located more distal from the structural element. The internal layer comprises glass wool material with a density in the range 20 - 45 kg/m^3 and a laminar orientation of the glass fibers.

[0068] In embodiments, the external layer thickness is lower than 50% of the thickness of the insulation element, and preferably lower than 40%. It is preferred that the thickness of the external layer is enough to avoid excessive bending when pulling or compression loads are applied to the insulation element during installation or use of the system. The thickness of the external layer is at least 15 mm, more preferably at least 20 mm and even more preferred at least 25 mm. The thickness of the external layer might range from 10 to 60 mm, preferably from 20 - 40 mm and more preferably it ranges from 25 - 35 mm.

[0069] The thickness of the internal layer might be in the range 10 to 200 mm, preferably from 30 - 150 mm and more preferably from 40 - 100 mm, depending on the application.

[0070] The insulation elements, comprising the external and internal layers, have preferably a total thickness of 60 - 220 mm, more preferably of 80 - 160 mm. The length of the insulation elements preferably ranges from 60 - 150 cm and the width from 30 - 120 cm.

[0071] Preferably, the internal and external layers are laminated by being bonded to each other by an adhesive applied to their facing surfaces. The adhesives used might be reactive (one or two component) polyurethane, polyolefin hotmelt or other adhesives, applied by any suitable method known in the art. Alternatively, the internal and external layers might be joined by application of a layer of thermoplastic film or non-woven (e.g. non-woven polyamide) between them, which is molten before the layers are contacted and cooled down after the joining to achieve their bonding.

Description of the drawings

[0072]

Figure 1 represents a schematic lateral cut-through view of a spacer fastening device according to an embodiment of the invention, employed to fix an insulation element to a structural element.

Figure 2 represents a perspective view of the hollow shank of a spacer fastening device according to embodiments.

Figure 3 represents another perspective view of the hollow shank of Figure 2.

Figure 4 represents a schematic lateral view showing three different steps of a method for fixation of an insulation element to a structural element according to an embodiment.

[0073] **Figure 1** depicts a wall system 1 comprising a structural element 2 having first 21 and second 22 sides. In this scheme, the first side 21 is the side facing the interior of the building, while the second side 22 faces the exterior.

[0074] The wall system further comprises an insulation element 3 having a first major surface 31 and a second major surface 32. The insulation element 3 is arranged with its first major surface 31 proximal to the structural element 2. The insulation element 3 in this embodiment comprises two layers 4, 5 of smaller thickness than the insulation element 3. The external layer 5 is located further away from the structural element 2, while the internal layer 4 is arranged closer to it. The external layer 5 comprises a reinforcing web 8 of glass fiber veil laminated to the external surface of the external layer 5.

[0075] The insulation element 3 is fixed to the structural element 2 by a spacer fastening device 6 according to the embodiments, having a first end portion 62 and a second end portion 64. The spacer fastening device 6 extends through the thickness of both internal and external layers 4, 5. The spacer fastening device 6 comprises a hollow shank 65 located in the second end portion 64 and a fastening screw 66 received in the inner cavity of the hollow shank 65. The hollow shank 65 has a stepped inner cavity, this is, the cavity has portions with different diameter, and the head of the fastening screw 66 rests on the neck 651. The fastening screw 66 and the hollow shank 65 are restrained from movement along the direction of the longitudinal axis of the fastening screw 66 relative to each other, by locking the fastening screw 66 head between the cavity neck 651 and a stopper 68. This stopper 68 is firmly fixed to the hollow shank 65 by gluing, clamping or by being molded together with the rest of the shank, and is exemplarily shaped with an aperture extending through its thickness to permit access from the exterior of the shank to the fastening screw head, e.g. with a screw driver (not drawn in Figure 1).

[0076] In the first end portion 62 of the spacer fastening device 6, means for fixation 61 to the structural element 2 are arranged. The means for fixation 61 comprise in the embodiment of Figure 1 a threaded tip 611 provided in the fastening screw 66. Fixation is achieved by engagement of the threaded tip 611 into the expanded plastic dowel 612 inserted in a hole drilled in the structural element 2.

[0077] As means for engagement into the external layer 5, the hollow shank 65 comprises a helical thread 63, i.e. a thread running as a helical band on the outside of the hollow shank 65.

[0078] A hollow shank 65 according to embodiments is shown with some more level of detail and in 3D-perspective in **Figures 2 and 3.**

[0079] The helical thread 63 of the hollow shank 65 engages into the external layer 5 and partially also into the internal layer 4 of the insulation element 3. The helical thread 63 has a major diameter which progressively decreases going towards the structural element 2, i.e. toward the threaded tip 611, during use, forming a conical thread shape.

[0080] In the embodiments shown in Figures 1-3, the hollow shank 65 further comprises a retaining disk 69, intended to be located flush with the second surface 32 of the insulation element 3 after fixation. The retainer disk 69 has preferably a diameter larger than the maximum major diameter D of the helical thread 63, and it may be provided with a pattern of openings 691 along the disk, as shown in Figure 3. Figure 3 also shows a possible realization of the stopper 68 according to embodiments, configured with a hexagonal shape that fits into a corresponding hexagonal receptacle 681 in the hollow shank 65. The size of the stopper 68 may be slightly larger than then receptacle 681, so as to produce its firm locking by clamping once it has been introduced.

[0081] The maximum major diameter D of the helical thread 63 in embodiments of Figures 2 and 3 coincides with the major diameter of the helical thread closer to the retainer disk 69. According to embodiments, this maximum major diameter D is at least 50 mm. The maximum external diameter d of the body of the hollow shank, according to the embodiments in Figures 2 and 3, increases towards the retaining disk. The maximum external diameter d of the body of the hollow shank, according to embodiments, is at most 35 mm.

[0082] The pitch P of the helical thread 63 is adequate to produce sufficient axial anchoring of the insulation element 3 to the hollow shank 65. In the embodiments shown in Figures 2 and 3, the thread pitch P is constant along the helical thread 63. In embodiments, the thread pitch is at least 3 mm.

[0083] The length L of the helical thread 63 according to embodiments ranges from 30 mm - 60 mm.

[0084] The helical thread 63 according to the embodiments is configured with an helix angle (α in Figure 2), which favors the insertion of the helical thread 65 into the insulation element 3, and which cooperates to the axial anchoring effect of the insulation element 3 to the hollow shank 65. This helix angle α preferably varies slightly along the helical thread 63. The average helix angle α according to embodiments may range from 1° to 7°.

[0085] **Figure 4** depicts schematically three stages of a method according to an aspect of the invention. The stages occur sequentially from left to right, this is, from A to C. For clarity purposes, the reference numbers for elements which are the same as in the previous figures are omitted in this drawing, and only the new elements are referenced.

[0086] In an initial stage, marked in Figure 4 as (A), the provided insulation element 3 is positioned with its first major surface 31 proximal to the second side 22 of the structural element 2, in this embodiment without intermediation of any binding agent. Then, a hole is drilled from the second major surface 32 of the insulation element 3, through its full thickness and essentially perpendicular to the structural element 2. The drilling is continued until a hole of the desired depth is also created in the structural element 2. As a consequence, both holes in the insulation element 3 and the structural element 2 match each other and are in direct communication.

[0087] The spacer fastening device 6 comprising the hollow shank 65 and the fastening screw 66, having a dowel 612 pre-mounted in unexpanded form in the threaded tip 611, is then inserted with the threaded tip 611 first into the hole of the insulation element 3, and advanced until the dowel 612 has entered substantially into the hole in the structural element 2.

[0088] A screw driver 10, manual or automatically operated, having a cross head 102 and protrusions 101 is placed over the spacer fastening device 6, engaging simultaneously with the fastening screw 66 and the hollow shank 65. The cross head 102 of the screw driver is adapted for engaging through the aperture in the stopper 68 with the head of the fastening screw 66. The screw driver is further provided with protrusions 101 adapted for engaging with the openings 691 in the retainer disk 69 (not shown in Figure 4). The engagement between the protrusions 101 and the retainer disk 69 is achieved for instance by designing the protrusions 101 so that they enter into the openings 691 present in the retainer disk 69.

[0089] The screw driver 10 is operated to provide a rotation in the screwing direction, shown as R in the Figure 4 (B), to produce the simultaneous rotation of the fastening screw 66 and the hollow shank 65. The rotation of the fastening screw 66 results in the advance of the threaded tip 611 into the dowel 612. The rotation of the hollow shank 65 produces the advance and the insertion of the helical thread 63 into the insulation element 3. This screwing step is preferably continued until the retainer disk 69 of the hollow shank 65 rests in abutment with the second major surface 32 of the insulation element 3. Preferably, at this stage the threaded tip 611 has also entered the dowel 612, expanding it, and achieving firm fixation to the structural element 2. The spacer fastening device 6 holds the external layer (5) and therefore also the second major surface 32 of the insulation element 3 at a defined distance S1 from the second side 22 of the structural element 2.

[0090] In a next step shown in Figure 4 (C) the screw driver 10 might be modified so that the protrusions 101 do not engage anymore with the retainer disk 69, for instance, by shifting the plate 104 to a further position up along the shaft 103. Alternatively, a different screw driver can be used, which only engages with the head of the fastening screw 66. The fastening screw 66 is then rotated, this time without simultaneous rotation of the hollow shank 65, to adjust the distance between the second major surface 32 of the insulation element 3 and the second side 22 of the structural element 2 to a desired defined distance S2.

[0091] This screwing step can be used to reduce the distance between the second major surface 32 of the insulation element 3 and the second side 22 of the structural element 2, and thus, to increase in the compression of the internal layer 4, so that it better adapts to the contours of second side 22 of the structural element 2. Alternatively, as shown in Figure 4 (C), an unscrewing rotation (shown as R' in Figure 4 (C)) results in the partial withdrawal of the threaded tip 611 from the dowel 612, and the separation of the second major surface 32 of the insulation element 3 from the second side 22 of the structural element 2, achieving the desired separation distance S2. This unscrewing can be useful for instance to adjust the planarity of the second major surfaces 32 of a plurality of insulation elements 3 positioned over the same structural element 2, and to compensate its irregularities.

Definitions

[0092] Mineral wool is a material formed by an intricate network of fibers which might be bonded in their cross-over points by different means, e.g. by using a cured binder. Three types of mineral materials are most commonly employed, glass, stone or slag. Processes for the production of mineral wool products are well known in the art, and usually comprise the steps of melting the mineral material to an adequate temperature, fiberizing the molten mixture into fine fibers, application (e.g. spraying) of a binder composition to the individual fibers, collection of the fibers and formation of a primary fleece on a foraminous conveyor, densifying the fleece, and curing the binder at elevated temperatures. The cured mat is then cut to the desired size with transverse and edge trimmers and optionally rolled up, before it is packaged for transport. It should be understood that the main component of the mineral wool are the fibers, being the binder in a much lower amount, usually in a content of less than 30 wt.-% relative to weight of the fibers.

[0093] The artisan readily identifies the characteristics making a mineral fiber composition a glass fiber composition, and differentiates a glass from other minerals. As a simple distinguishing feature, the term glass fibers means that the mineral composition of the fibers is characterized by having a weight ratio of compounds having alkali metals (i.e. K_2O, Na_2O) relative to compounds having alkaline earth metals (i.e. MgO, CaO) higher than 1. In comparison, stone wool or slag wool fibers have a weight ratio of compounds having alkali metals to compounds having alkaline earth metals of less than 1. Glass wool is a mineral wool material where the fibers have a glass composition.

[0094] By laminar mineral wool it is meant that the fibers forming the mineral wool material are predominantly oriented parallel to the major surfaces of the mat as produced in the manufacturing line. These major surfaces normally correspond to the major surfaces of the elements, such as panels, cut from the mat. From a different perspective, the fibers are predominantly oriented perpendicular to the thickness of the mat or the panels formed therefrom. The laminar configuration of the fibers results from the deposition of the fibers freshly formed by a series of fiberizers and attenuated by air streams from burners vertically onto a receiving foraminous conveyor, under air suction from beyond the conveyor. Optionally, the laminar configuration of the fibers, this is, the predominant orientation parallel to the major surfaces, can be further improved by compressing the mat in the thickness direction and/or by stretching the uncured mat, and then curing the binder. The stretching of the mat can be achieved for example by running the conveyors at sequentially increased speeds downstream the manufacturing line, before the mat is cured. In the laminar mineral wool material, the fibers shall have not been subjected to any process to increase their orientation in the direction perpendicular to the major surfaces of the mat, such as lamella formation or crimping processes.

[0095] The density of the fibrous insulating material refers to the material as such, including the fiber network and any binder, additive, etc. it might have. The density is meant in the uncompressed and unpacked state. The artisan knows how to determine the density of fibrous insulating materials such as wood wool or mineral wool. Reference is made to the standard method UNE EN 823:2013 for measuring the thickness of thermal insulating products, from which density can be calculated from the length and width dimensions, and the weight of a fibrous material sample.

[0096] The major diameter of the helical thread should be understood as the cylinder distance between two diametrically opposed thread crests, this is the distance between two opposed crests measured in projection onto a plane perpendicular to the central axis of the thread. For a helical thread in the shape of a cone, the maximum major diameter corresponds to the larger of such distances.

[0097] The external diameter of the body of the hollow shank should be understood as the distance between two diametrically opposing points on the outside surface of the body of the hollow shank, along which the helical thread runs, and measured in a plane perpendicular to the central longitudinal axis of the hollow shank. When the body of the hollow shank is configured with a conical shape, the maximum external diameter of the body of the shank is the largest of such distances.

[0098] Helix angle of the helical thread is defined as the angle formed by a tangent to the thread at a pitch diameter with a plane perpendicular to the central axis of the thread.

[0099] By the pitch of the helical thread it is meant the distance between two consecutive thread crests measured along the direction of the central axis of the thread.

[0100] The length of the helical thread refers to the distance from the first to the last thread of the helix in the direction of the central axis of the thread.

Claims

1. A method for fixation of an insulation element (3) to a structural element (2), the structural element (2) having a first (21) and a second side (22), the method comprising:

    a) providing an insulation element (3) comprising an insulation material and comprising a first (31) and a second major surfaces (32);
    b) positioning the insulation element (3) with its first major surface (31) proximal to the second side (22) of the structural element (2);
    c) providing a spacer fastening device (6) comprising a hollow shank (65) and a fastening screw (66) received in the cavity of the hollow shank (65), wherein the hollow shank (65) and the fastening screw (66) are adapted to be locked relative to each other in an axial longitudinal direction of the fastening screw (66), the fastening screw (66) comprising a treaded tip (611) for engagement with the structural element (2), and the hollow shank (65) comprising a helical thread (63) running on its outside;
    d) inserting the spacer fastening device (6), with the threaded tip (611) first, from the second major surface (32) into the insulation element (3);
    e) rotating simultaneously both the hollow shank (65) and the fastening screw (66), so as to produce their advance towards the structural element (2), until the whole length of the helical thread (63) is inserted into the insulation element (3) ;
    f) rotating the fastening screw (66), without rotating the hollow shank (65), to adjust the distance between the second major surface (32) of the insulation element (3) and the second side (22) of the structural element (2).

2. A method according to any of the previous claims, wherein in step a) the insulation element (3) is provided comprising a layer of laminar mineral wool with a density lower than 140 kg/m^3, preferably laminar glass wool.

3. A method according to any of the previous claims, wherein in step a) the provided insulation element comprises internal (4) and external (5) layers, the internal layer (4) intended to rest proximal to the structural element (2) after fixation, and the external layer (5) most distal from it, the external layer (5) being more rigid than the internal layer (4), and the external layer (5) comprising laminar mineral wool, preferably laminar glass wool, with a density lower than 140 kg/m^3.

4. A method according to any of the previous claims, wherein in step b) the first major surface (31) of the insulation element (3) is directly positioned proximal to the second side (22) of the structural element (2), without intermediation of any binding agent.

5. A method according to any of the previous claims, wherein the lock between the hollow shank (65) and the fastening screw (66) in the spacer fastening device (6) provided in c), is achieved by retaining the head of the fastening screw (66) between a neck (651) formed in the cavity of the hollow shank (65) and a stopper (68) fastened over the fastening screw head.

6. A method according to any of the previous claims, wherein the maximum major diameter (D) of the helical thread (63) of the hollow shank (65) in the spacer fastening device (6) provided in c), is at least 50 mm.

7. A method according to any of the previous claims, wherein in step e), a screw driver (10) is positioned over the spacer fastening device (6) engaged simultaneously with the hollow shank (65) and the fastening screw (66).

8. A spacer fastening device (6) for use in the method according to claims 1 - 7, the spacer fastening device (6) comprising;

    a) a hollow shank (65) comprising a helical thread (63) running along its outside and
    b) a fastening screw (66) comprising a threaded tip (611),

    wherein the hollow shank (65) and the fastening screw (66) are adapted to be locked relative to each other in the axial longitudinal direction of the fastening screw (66), while being freely rotatable relative to each other; and
    wherein the maximum major diameter (D) of the helical thread (63) of the hollow shank (65) is at least 50 mm.

9. A spacer fastening device (6) of claim 8, wherein the maximum external diameter (d) of the body of the hollow shank (65) is at most 35 mm.

10. A spacer fastening device (6) of claims 8 - 9, wherein the pitch (P) of the helical thread (63) is at least 3 mm.

11. A spacer fastening device (6) of claims 8 - 10, wherein the lock between the hollow shank (65) and the fastening screw (66) is achieved by retaining the head of the fastening screw (66) between a neck (651) formed in the cavity of the hollow shank (65)

and a stopper (68) fastened over the fastening screw (66) head.

12. A spacer fastening device (6) of claims 8 - 11, wherein the hollow shank (65) comprises a retainer disk (69) located on the one end of the hollow shank (65) intended to rest most distal from the structural element (2) during use.

13. An insulation system comprising a spacer fastening device (6) of claims 8 - 12 and an insulation element, the insulation element comprising an internal layer and an external layer, the external layer comprising laminar mineral wool with a density lower than 140 kg/m^3, wherein the helical thread (63) of the hollow shank (65) engages into the external layer (5) of the insulation element (3).

FIGURE 1

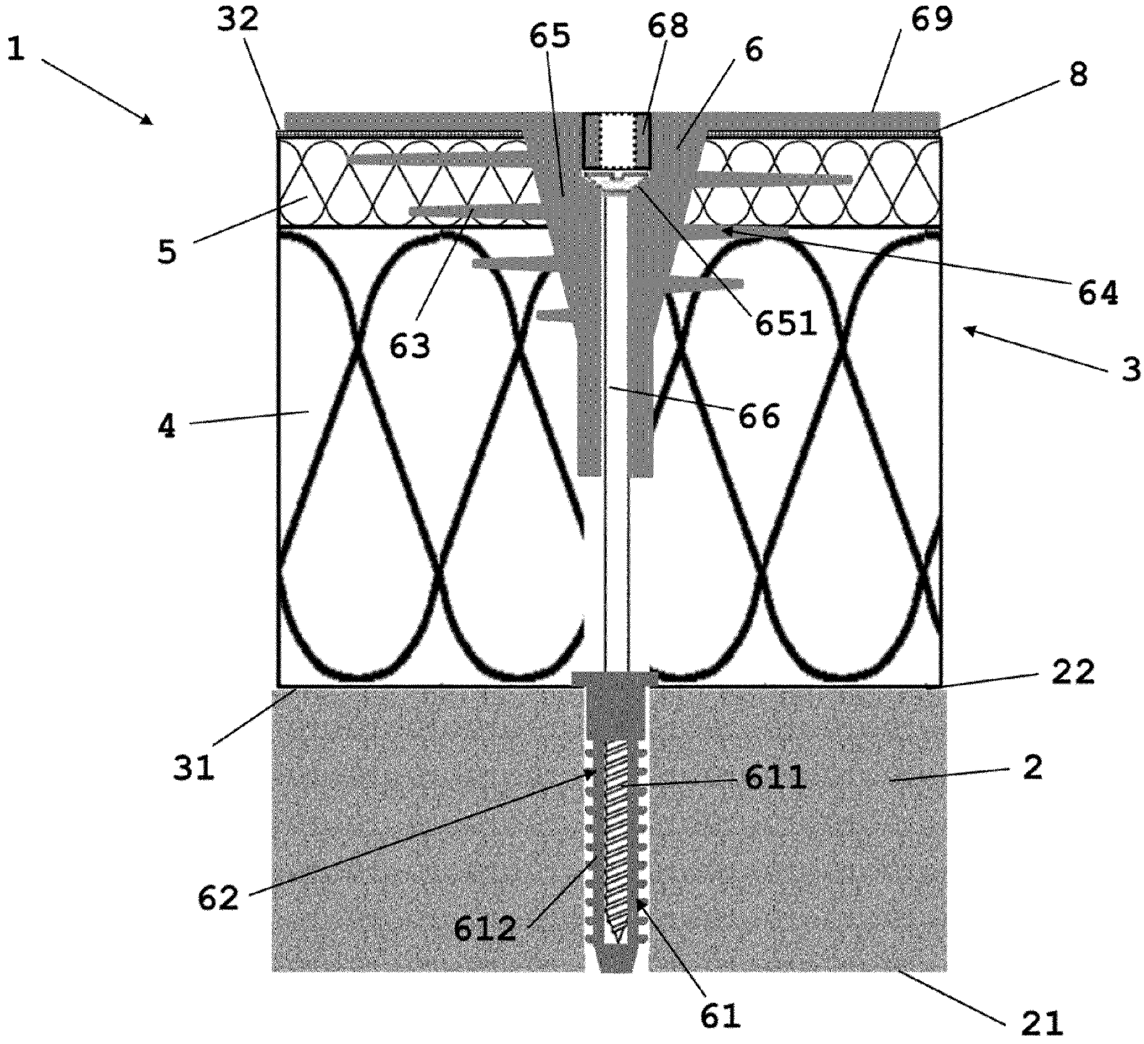


FIGURE 2

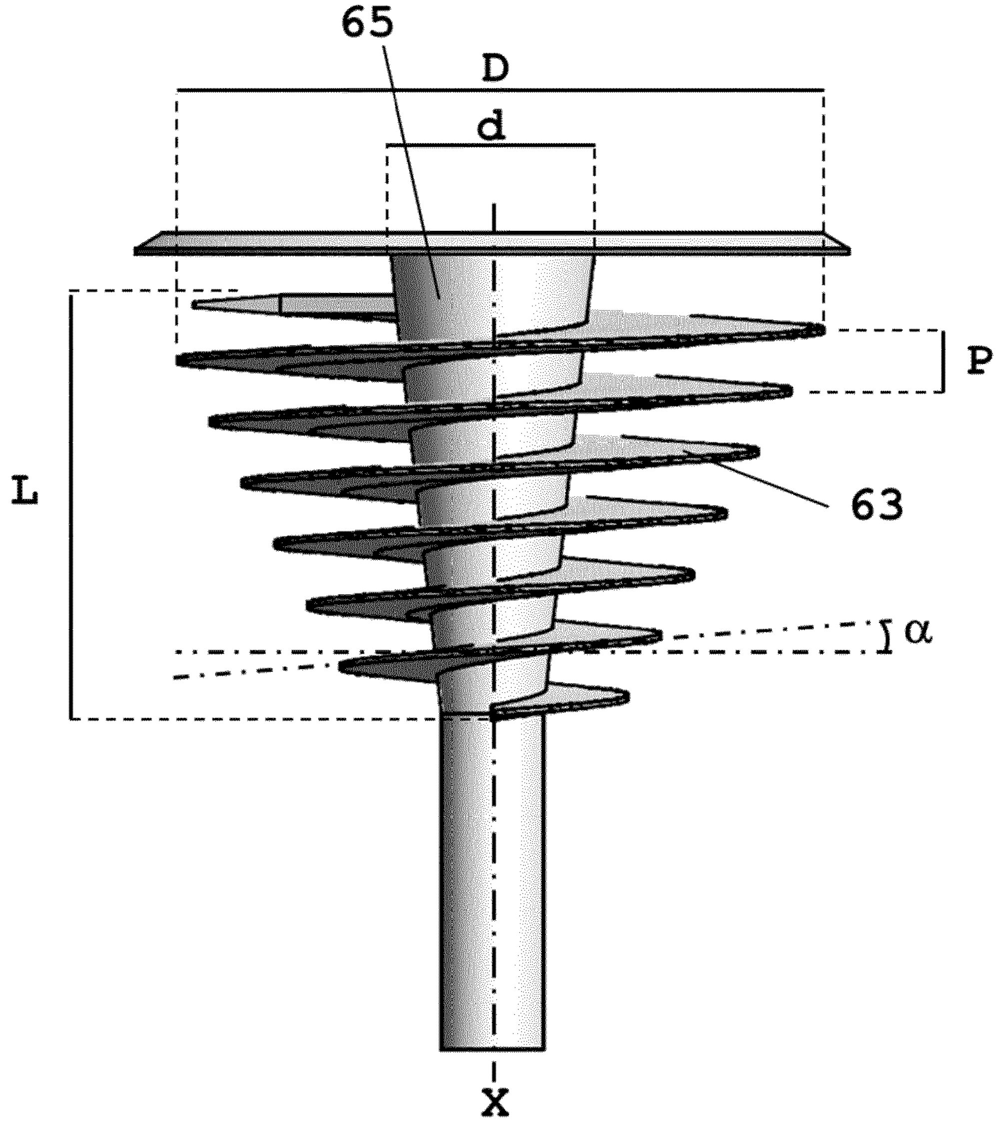


FIGURE 3

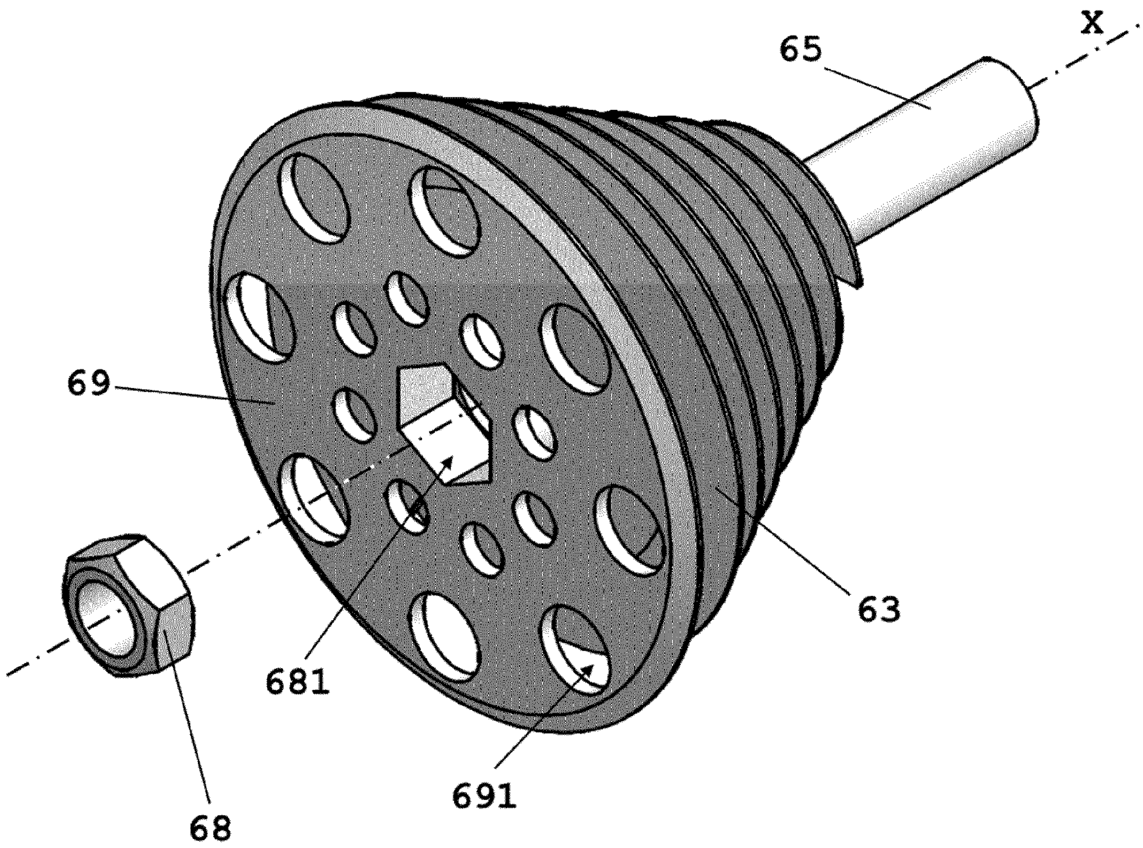
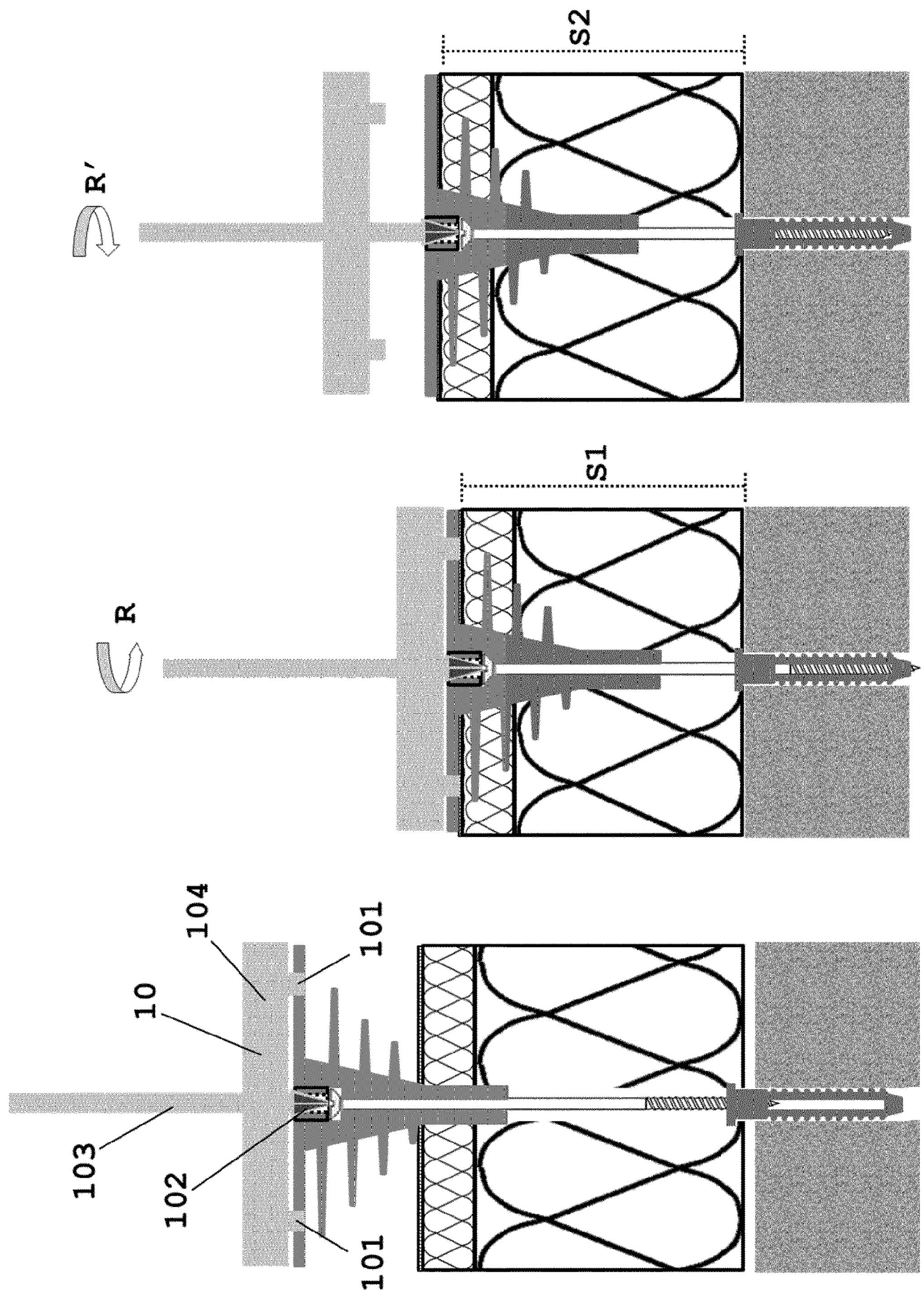


FIGURE 4



Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 15 18 8165

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,D	WO 2014/090707 A1 (KNAUF INSULATION [BE]) 19 June 2014 (2014-06-19) * page 1, line 1 - page 11, line 29; figures 1-5B * -----	1-13	INV. E04B1/76
A	EP 2 784 243 A1 (RANIT BEFESTIGUNGSSYSTEME GMBH [DE]) 1 October 2014 (2014-10-01) * paragraph [0021] - paragraph [0036]; figures 1-9 * -----	1-13	
A,D	EP 2 666 919 A2 (RANIT BEFESTIGUNGSSYSTEME GMBH [DE]) 27 November 2013 (2013-11-27) * paragraph [0001] - paragraph [0042]; figures 1-7 * -----	1-13	
			TECHNICAL FIELDS SEARCHED (IPC)
			E04B

The present search report has been drawn up for all claims

2

Place of search	Date of completion of the search	Examiner
The Hague	11 March 2016	Dieterle, Sibille

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 15 18 8165

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

11-03-2016

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2014090707 A1	19-06-2014	EP 2928683 A1 WO 2014090707 A1	14-10-2015 19-06-2014
EP 2784243 A1	01-10-2014	NONE	
EP 2666919 A2	27-11-2013	NONE	

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

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 2215317 B1 **[0003] [0008]**
- EP 2216454 A2 **[0003] [0008]**
- WO 2014090707 A1 **[0003] [0010]**
- EP 2666919 A2 **[0003] [0009]**