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(54) INSULATING STRUCTURE AND METHOD FOR MANUFACTURING SUCH AN INSULATING STRUCTURE

(57) The present invention relates to a method for manufacturing an insulating structure, said insulated structure intended for insulating a rigid construction by fixing insulating elements, part of the mentioned insulating structure, and creating an insulation space that may thereafter be filled with insulating particles.

The invention is also related to such an insulating structure for the insulation of a rigid construction.

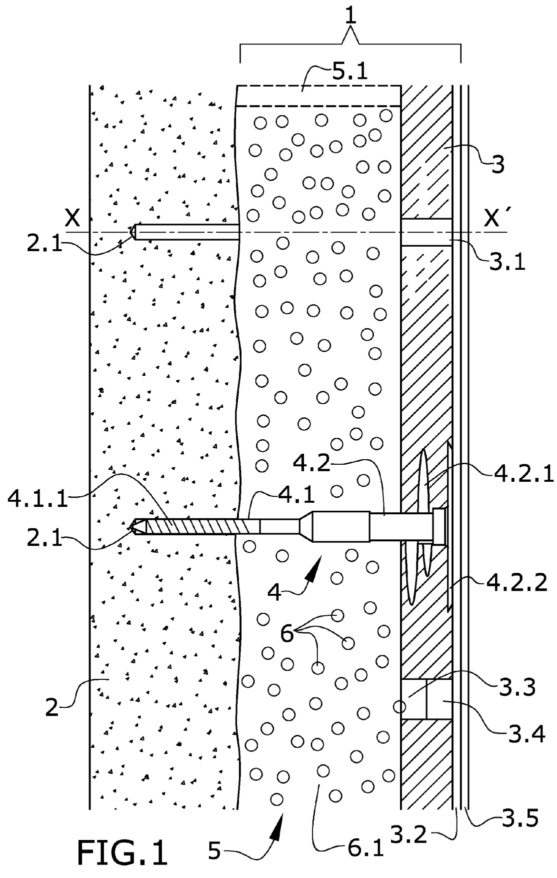

FIG.1

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a method for manufacturing an insulating structure, said insulated structure intended for insulating a rigid construction by fixing insulating elements, which form part of the mentioned insulating structure, and creating an insulation space that may be thereafter filled with insulating particles.

[0002] The invention is also related to such an insulating structure for the insulation of a rigid construction.

PRIOR ART

[0003] Building façades often need thermic and acoustic insulation improvement or renovation. Nowadays, it is known that using an insulation material directly on said façade can improve its insulating properties.

[0004] As known in the prior art, an improved building wall or roof system comprising fibrous insulation is disclosed in the patent document EP 3 150 772. The disclosed system in said patent publication is a panel or slab made of mineral wool on one side and rigid on the other side to create a visible façade ready for further construction work or renovation.

[0005] As described also in EP 3 150 772 the use of generically called "External Thermal Insulation Composite Systems" (abbreviated as ETICS) is nowadays well established. The mentioned system disclosed in the patent publication above-mentioned comprises a structural element, an insulation element and a spacer fastening device in order to solve problems and limitations known in the state of the art by offering better thermal insulation capacity, lighter and quicker installation, as well as economic and manufacturing advantages.

[0006] Specifically, ETICS comprises insulation elements with layers of different rigidity being 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 proximal layer. A harder, more rigid layer is located further away from the structural element, referred to as the distal layer. Fastening devices are also described, which extend through the proximal and distal layers in the insulation element and fix them firmly to the structural element.

[0007] Among other advantages, in these configurations, the more rigid 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.

[0008] 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.

[0009] 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 patents and patent applications EP 2215317 B1, EP 2216454 A2, WO 2014090707 A1 and EP 2666919 A2.

[0010] Specifically, the spacer fastening element is adapted for fixation of the insulation element to the structural element. The distance between the distal insulating element and the structural element is adjustable by acting on said spacer fastening element by choosing the length of the fastening device.

[0011] Additionally, said spacer fastening element comprises a hollow shank, preferably made of plastic, which shows an inner cavity. The hollow shank is provided with a helical thread running as a helical band. The above-mentioned inner cavity of the hollow shank is made for receiving a metal fastening screw provided with means for fixation to the structural element, specifically a threaded tip.

[0012] The hollow shank and the fastening screw 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. The helical thread is configured to penetrate into the insulating layer with help of a specifically designed screwing tool that allows to rotate the hollow shank while keeping the fastening screw already fixed into the structural element. An embodiment of the described spacer fastening element will be used in embodiments of the present invention.

[0013] The structural element part of the disclosed device is characterized as a wall such as a façade, floor or buildings' ceiling. In addition, said insulation element is shaped as rectangular panels or slabs. Both proximal and distal layers of the insulation element of the prior art previously disclosed have distinct compositions and/or properties and more precisely external layer presents higher rigidity than internal layer.

[0014] In some cases, the type of panel or slab previously described requires a lot of manipulations. For example, in case of cutting fitting pieces to size, it should be ensured that they are cut at right angles. In this particular case, panels that need cutting can end up being damaged, presenting broken or compressed corners or edges, and result being unusable.

[0015] The spacer fastening of disclosed device above-mentioned is used for fixation of the insulation element, panel or slab to the structural element, wall, roof or ceiling, the device is adapted to hold the distal layer at a defined and adjustable distance from the second side of the structural element resulting in an external flat surface. In that case, the fastening device' length provides spacing adjustability between the panel and the wall ensuring that the proximal layer is always in contact with the surface of the structural element.

[0016] The patent publication EP 3 150 772 also discloses that each of the panels or slabs are fastened to the wall or roof by a plurality of spacer fastening devices specifically ensuring certain pressure from the proximal layer to the structural layer.

[0017] Additionally, it is known in the present field of the technique that mineral wool and more precisely glass wool are commonly used. On one hand, mineral wool is well-known for this moisture resistance characteristics, sound blocking and low inflammability. On the other hand, glass wool is well-known in that field of technique for low inflammability properties, high compressibility, economic advantages and finally for being a recyclable material.

DESCRIPTION OF THE INVENTION

[0018] The present invention solves the above identified drawbacks in an alternative manner generating an inner space between an insulating layer and the substrate and, optionally, subsequently filling the gap with insulating particles. It has been shown that, contrary to the expected result the resulting structure is very stable in windy conditions and allows a very fast installation even for very thick insulations.

[0019] *In a first inventive aspect, the present invention provides a method for manufacturing an insulating structure, configured for the insulation of a rigid construction, the method comprising:*

a) providing an insulating layer made of mineral wool comprising mineral fibers,
wherein

- *the thickness of the insulating layer is between 20 and 40mm;*
- *the density of the mineral wool is between 60 and 150 kg/m3, and*

b) perforating at least one construction hole in the rigid construction;
c) providing a mounting hole in the insulating layer;
d) aligning each construction hole with the mounting hole of the insulating layer;
e) fixing at least one spacer fastening means, said fastening mean comprising:

- *a hollow shank comprising a helical thread running along its outside with a maximum major diameter of at least 50 mm and adapted to penetrate into the insulating layer,*
- *a fastening screw comprising a threaded tip adapted to be fixed to the rigid construction*
- *wherein the hollow shank and the fastening screw 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;*

wherein the spacer fastening means are fixed through the aligned holes to the rigid construction by means of the threaded tip at one end and to the insulating layer by means of the helical thread at the opposite end leaving a predetermined insulation space in-between.

[0020] In this first inventive aspect, the present invention provides a method intended to manufacture an insulating structure in order to insulate a rigid construction such as a wall, façade or roof. The manufactured insulating structure comprises an insulating layer, at least one construction hole, at least one mounting hole, at least one spacer fastening means and it is provided an insulation space that, according to an embodiment, is adapted to be filled with insulating particles.

[0021] The insulating layer has a thickness between 20 and 40mm and a density between 60 and 150 kg/m3 which have been evaluated, in those ranges, for being highly performant insulation structure parameters.

[0022] Preferably, the density of the insulating layer is at least 70 Kg/m3, more preferably at least 80 kg/m3, even more preferably between 100 and 150 Kg/m3. Preferably the thickness of the insulating layer is between 20 and 40 mm, more preferably about 30 mm.

[0023] The density of the insulating layer refers to the material as such, in the uncompressed and unpacked state. The person skilled in the art knows how to determine the density of the fibrous insulating layer. 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.

[0024] In preferred embodiments, the mineral fibers of the insulating layer, are bonded by a cured organic binder, suitably comprising a thermoset resin. The content of the organic binder in the insulating 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.%. These levels of binder content contribute to further enhance the mechanical properties, particularly the rigidity and compression resistance, of the insulating layer. The LOI values provided in the present application were measured according to the norm ISO 29771:2008.

[0025] The mean fiber diameter of the mineral fibers in the insulating layer may be suitably at least 4 micrometers and lower than 15 micrometers, preferably from 5 to 10 micrometers, as calculated from microscopy analysis. Fibrous insulating material with this fiber diameter range provides an enhanced rigidity to the external layer.

[0026] The compressive stress at 10% deformation of the insulating layer, measured according to UNE EN 826:2013, is preferably lower than 15 kPa, preferably lower than 10 kPa and more preferably in the range 5 - 1 kPa. The compressive stress, although it represents only the resistance to compression forces, is a parameter for estimating the robustness, hardness and rigidity in the thickness direction of the material since it is directly proportional to any of these properties.

[0027] According an embodiment of step b) of the first aspect of the invention, at least one construction hole is perforated in the rigid construction passing through the insulating layer. After being perforated, the insulating layer presents a mounting hole. The at least one construction hole in the rigid construction is preferably performed passing through the insulating layer, thus preserving alignment and ensuring a further leveled insulating structure. Both construction holes and mounting holes may be repetitively perforated through both the rigid construct and the insulating layer in one step, until the needed number of fixations for said insulating structure is performed.

[0028] In an alternative embodiment, the mounting hole is already present in the insulating layer and shows an optimal pattern that helps the user on selecting the position of the spacer fastening means.

[0029] The at least one spacer fastening means is introduced inside both holes, the construction hole and the mounting hole respectively performed in the rigid construction and the insulating layer. The spacer fastening means comprises a fastening screw located inside an inner cavity designed in the hollow shank.

[0030] Said fastening screw is made for receiving a screwing tool and said hollow shank is previously shaped with a cavity through its entire thickness to allow access from the exterior to the fastening screw. Preferably, the hollow shank is made of plastic and, also preferably, the fastening screw is made of metal.

[0031] The hollow shank may further comprise a retainer disk for the insulation layer, preferably at its end most distal to the first end portion, and with a diameter at least the size of the diameter of the helically shaped hollow shank. The retainer disk may further comprise small indentations on its surface more proximal to the insulation element, so that during installation the retainer disk might cut into the insulation element and slightly penetrate it.

[0032] On one hand, the fastening screw engages in the rigid construction and houses inside the construction hole. On the other hand, the hollow shank engages in the insulating layer by going through the mounting hole.

[0033] In addition, the hollow shank is helically shaped in order to ease the introduction of said hollow shank inside the insulation assembly. According to claim 1, the hollow shank is provided with a helical thread. The term "helical thread" refers to a thread running as a helical band, arranged on the outside of the hollow shank along its length. The pitch of the helical thread, this is, the distance between two consecutive thread crests, is preferably constant and at least 3 mm, more preferably at least 4 mm. The thread pitch preferably does not exceed 30 mm, and more preferably it does not exceed 20 mm, and even more preferred it does not exceed 10 mm.

[0034] Preferably, the helical thread has a conical shape, with increasing diameter going away from the structural element. The conical shape facilitates the penetration of the thread in the fibrous insulating material. The helical thread might be formed as a continuous band or it might be formed by different separated thread sections. The parameters of the helical thread such as the pitch and the thread angle are adapted to facilitate the penetration by screwing movement into the external layer, and to allow sufficient fibrous insulating material getting inserted between thread crests to enhance the anchoring effect.

[0035] According to this embodiment, the preferred major diameter of the hollow shank is at least 50 mm which has been proven to provide maximum stability to the axial fixation of the insulating structure. Preferably, the diameter is from 50 to 100 mm, more preferably from 60 to 80 mm.

[0036] According to this embodiment, the fastening screw has an axial retention with the hollow shank by locking the fastening screw head on the inside of the inner cavity of said hollow shank but also freely rotate with each other.

[0037] Advantageously, the introduction of the spacer fastening means ensures the alignment previously provided by the perforating step but also brings stability and fixation of the insulating layer respectively to the rigid construction.

[0038] The insulation space is a resultant of the fixation of the insulating layer to the rigid construction. Said insulation space is therefore predetermined and the void space depends on the previously studied structural parameters of the insulating structure. Void space does not impose any permanent force in a direction perpendicular to the insulation layers due to the contact of the layer on the external surface of the rigid construction resulting in an insulating construction that may be correctly leveled.

[0039] In a particular embodiment, the mineral fibers of the insulating layer are predominantly oriented in a plane perpendicular to the thickness of said insulating layer.

[0040] Specifically, the insulating layer, made of mineral wool an especially made of glass wool, predominantly presents fibers oriented perpendicularly to the thickness of the insulating layer or, from another perspective, parallel to the major surfaces of the insulating layer. The expression "laminar configuration" in the context of the present invention, refers to the predominant orientation of the fibers of the insulating layer, perpendicular to the thickness of said insulating layer.

[0041] The expression "predominantly oriented" may be interpreted as being opposite to the feature of having an orientation equally distributed in all directions. Specifically, the expression "predominantly oriented" also refers to preferred embodiments wherein at least 50% of fibers of the rigid insulating layer are perpendicularly oriented to the thickness of the rigid insulating layer, preferably more than 60% of the fibers, more preferably at least 70% of the fibers, even more preferably more than 80% of the fibers or more than 90% of the fibers.

[0042] The preferred orientation of the fibers can be measured by visual evaluation of the fibers in the panel. Alternatively, the orientation of the fibers can be measured by optical microscopy, such as stereo microscopy, or by scanning electron microscopy (SEM). Moreover, artificial intelligence-based methods also provide measurements of the percentage of "predominantly oriented" fibers in said panel.

[0043] The predominant orientation of the fibers in the insulating layer may be produced in the manufacturing line. The laminar configuration of the fibers naturally 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 (also referred to as forming conveyor), under air suction from beyond the conveyor. Additionally, stretching of the fibers in the manufacturing line leads to the laminar configuration of the fibers, wherein the fibers are predominantly oriented perpendicularly to the thickness of the insulating layer. Stretching of the fibers can be produced by increasing the velocity by which the mat passes between the foraminous receiving conveyor and the curing oven conveyor.

[0044] In the context of the present invention, a stretching ratio is defined as the ratio between the speed of the curing conveyor (Vcc) and the speed of the forming conveyor (Vfc); i.e. Vcc / Vfc. Particularly, the stretching ratio that leads to the laminar configuration of the fibers is comprised between 0.9-1.2, preferably 0.95-1.15 and more preferably between 1.0-1.1.

[0045] The inventors have seen that when the stretching ratio is slightly below 1, that is between 0.90 and 0.99, fibers become slightly wavy, producing an improvement in the final product properties, such as flexibility, compressive strength, delamination strength and less bending strength. If the stretching ratio is 1 or slightly above 1, that is from 1 to 1.2, the fibers become stretched and, as a result, the stiffness increases, and lambda (thermal conductivity) improves. When the stretching ratio is higher than 1.2, the risk of mineral fibers breakage is very high, hindering the product manufacturing.

[0046] In a further embodiment, the degree of stretching of the mat can be increased by running the conveyors at sequentially increased speeds downstream the manufacturing line. The following example might demonstrate this type of arrangement, a manufacturing line comprises 3 conveyors: A first conveyor (= forming conveyer; v1 = Vfc) is followed by a second conveyor; the second conveyor is operated with a higher speed than the speed of the first conveyor (v2/v1 = e.g. 1.05 to 1.2); the second conveyor is followed by a third conveyor, whereas the third conveyor is operated with a higher speed than the speed of the second conveyor (v3/v2 = e.g. 1.05 to 1.20); the third conveyor might be designed as curing conveyor (v3 = Vcc).

[0047] In a further embodiment, additional conveyors are placed between the first conveyor (= forming conveyer) and the last conveyor (= curing conveyor) downstream the manufacturing line. Thus, in total 4 or more conveyors can be arranged downstream the manufacturing line, whereas with respect two consecutive conveyors, each subsequent conveyor is operated at least with the same speed, but preferentially with a higher speed than the immediately preceding conveyor.

[0048] 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 (= vertical compression) and/or by stretching the uncured mat, and then curing the binder.

[0049] Unlike crimping processes or lamella formation, in the laminar configuration of the fibrous insulating material according the present invention, the fibers shall not have been subjected to any process to increase their orientation in the direction perpendicular to the major surfaces of the mat. Thus, the laminar configuration of the fibers requires less manufacturing efforts. Further, for the crimped configuration of the fibrous insulating material the "stretching" ratio-which should be actually understood as "bulging ratio" or "factor of horizontal compression" - is typically comprised between 0.3 and 0.5, being the velocity of the curing conveyor (Vcc) significantly lower than the velocity of the forming conveyor (Vfc).

[0050] According to the present invention the laminar configuration of the fibers increases the rigidity of the whole insulating structure and provides stability to the spacer fastening means fixed through both the insulating layer and the rigid construction. More specifically, the predominantly orientation of fibers, parallel to the larger surfaces of the insulating layer, increases the stability of the joint between the helical thread of the hollows shank and the insulating layer.

[0051] Additionally, the laminar configuration of the fibers contributes to an enhanced thermal insulation capacity in comparison with insulating layers wherein the fibers are oriented in the direction of the heat transfer. In this sense, the thermal conductivity of the insulating layer, measured as lambda at 10°C according to UNE EN 12667:2002 is preferably lower than 0.045 W (K m)-1, more preferably lower than 0.036 W (K m)-1, and even more preferably in the range 0.036 - 0.030 W(K m)-1.]

[0052] In a particular embodiment, the insulation space is filled with insulating particles.

[0053] According to this embodiment, the void space is filled with insulating particles generating an insulation space volume.

[0054] The insulating particles, preferably individual flocs without binding element or with low binder quantities between them, barely present compressive strength. Suitable insulating particles to fill the insulation space include particles of glass wool, stone wool, slag wool, cellulose and EPS balls (Expanded Polystyrene balls). Preferably, the blowing insulating particles are blowing glass wool flakes. Also, the density of said applied insulating particles are previously selected following the required characteristics of said insulating structure. Preferably, the density of insulating particles inside the insulation space is between 25 and 45 Kg/m3, even more preferably about 35 kg/m3.

[0055] Advantageously, by blowing insulating particles directly inside the insulation space resultant of the insulating layer installation, the induced weight of the installation of said insulating structure is reduced by manufacturing the installation directly on the rigid construction instead of installing pre-manufactured panels or slab as performed in the prior art.

[0056] Additionally, the claimed method also provides a way of molding the irregularities of the rigid construction by blowing the insulating particles as desired, inside the insulation space and adapt quantity of said insulating particles.

[0057] In a particular embodiment, at least 50% of fibers of the insulating layer are perpendicularly oriented to the thickness of the insulating layer.

[0058] Specifically, the expression "predominantly oriented" also refers to preferred embodiments wherein at least 50% of fibers of the insulating layer are perpendicularly oriented to the thickness of the insulating layer, preferably more than 60% of the fibers, more preferably at least 70% of the fibers, even more preferably more than 80% of the fibers or more than 90% of the fibers.

[0059] In a particular embodiment, the mounting holes are performed in the insulating layer in step b) when perforating the rigid construction passing through the insulating layer.

[0060] Advantageously, by performing the mounting holes inside the insulating layer and the construction hole inside the rigid construction in one step ensures the alignment of both holes along the whole installation of the insulating structure.

[0061] *In a particular embodiment, the mounting hole are performed in the insulating layer during the manufacturing process of said insulating layer.*

[0062] Advantageously, by performing the mounting hole during the manufacturing process of said insulating layer saves time and reduces the risk of errors during installation. Additionally, the spatial distribution of the mounting holes may be located at optimized positions.

[0063] *In a particular embodiment, the insulation space left during step d) is predefined by spacing means.*

[0064] According to this specific embodiment, the insulation space is a resultant of the distance between the rigid construction and the insulating layer, previously set by the size of the selected spacing means, located between the rigid construction and the insulating layer. Said distance, predetermined by the required length of the spacer fastening means, also predetermines the volume of the insulation space to be filled. A preferred distance between the rigid construction and the internal side of the insulating layer is between 50 and 170 mm, more preferably between 60 and 150 mm, more preferably between 70 mm and 130 mm, even more preferably about 100 mm.

[0065] Advantageously, the set spacing means maintains the insulating layer at the required distance but also provides regularity, stability and ensures the levels of the insulating structure.

[0066] *In a particular embodiment, the spacing means are a support tool being temporally interposed between the rigid construction and the insulating layer when fixing the spacer fastening means to the insulating layer.*

[0067] The spacing means, located between the rigid construction and the insulating layer, brings support to the installation. Advantageously, the spacing means is removable and stay set until one of the insulating layer is installed allowing to reuse the tool for the next insulating layer.

[0068] *In a particular embodiment, the insulating particles filling the insulation space form a continuous layer.*

[0069] According to this embodiment, the layer of insulating particles is continuous in order to provide homogeneity of insulation over the whole rigid construction.

[0070] *In a particular embodiment, the filling of insulation space with insulating particles is performed by injecting the insulating particles through the insulating layer.*

[0071] Advantageously, by injecting the insulating particles through the insulating layer, the insulating particles are homogenously inserted inside the insulation space by targeting specific points of injection. An advantageous order for injecting the insulating particles is selecting points located in the lower part of the construction and, progress from bottom to top.

[0072] *In a particular embodiment, the method comprises the step of performing at least one filling hole on the insulating layer for the filling of the insulation space with insulating particles.*

[0073] The one filling hole is performed on the insulating layer in order to inject the insulation particles inside the insulation space with the minimum but also most effective number of manipulations.

[0074] Advantageously, a plurality of filling holes is performed in order to target specific points, preferably center and corners or the insulating layer, and inject a homogeneous insulation layer inside the insulation space. The diameter of the hole depends on the flocs of insulating particles, the insulating particle size, and their physical properties since said diameter of the hole must allow an easy injection but, once the flocs have been injected, they must be kept in the inner space until the hole is closed.

[0075] *In a particular embodiment, the method comprises the step of covering the insulating layer with a base coat before filling the insulation space with insulating particles.*

[0076] Advantageously, by covering the insulating layer with a first base coat before filling the insulation space with insulating particles, the insulating layer is completely sealed by the base coat so that it lowers the risk of leaving gaps between individual panels that lead to openings that would allow the insulating particles to escape when filling the insulation space.

[0077] *In a particular embodiment, the method comprises the step of covering the filling hole with covering means after filling the insulation space with insulating particles.*

[0078] Once the insulation space is fully filled with insulation particles, the filling hole is covered by covering means in order to seal the insulating layer.

[0079] *In a particular embodiment, the covering means are a portion of the insulating layer extracted from said insulating layer for performing the at least one filling hole.*

[0080] According to this embodiment, the covering means is a portion of the same material used as insulating layer so as to maintain the same insulation thermic and acoustic properties of said insulating layer. Advantageously, the covering means is the same portion previously cut when performing the filling hole to minimize waste and manipulations.

[0081] *In a particular embodiment, the method further comprises the step of covering the insulating layer and the covering means with a base coat before applying the finishing layer.*

[0082] According to this specific embodiment, a base coat is applied over the insulating layer and the covering means in order to provide a flat surface before applying the finishing layer.

[0083] Also in this specific embodiment, the insulating layer and covering means are covered by two layers of base coat, one before filling the insulation space and one after filling the insulation space with insulation particles and covering it with covering means. Advantageously, no space is left uncovered, particularly around the insulation space, and it increases the quality of the surface covered with said base coat before spreading a finishing layer.

[0084] Additionally, a finishing layer is spread over the insulating layer and the covering means covering the rigid construction wall or roof in order to improve the resistance of the exterior surface of the insulating layer to weather conditions, protect and/or adapt the appearance of the finished wall or roof with the preferred colored mortar, paint or similar. The addition of mortar prevents the exterior surface, being visually accessible, from showing irregularities generated for example by the hollow shank.

[0085] *In a second inventive aspect, the present invention provides an insulating structure assembly for insulating a rigid construction, the assembly comprising: an insulating layer made of mineral wool and provided with a mounting hole wherein*

- *the thickness of the insulating layer is between 20 and 40mm; and,*
- *the density of the mineral wool is between 60 and 150 kg/m3;*

at least one spacer fastening means, said fastening means comprising:

- *a hollow shank comprising a helical thread running along its outside with a maximum major diameter of at least 50 mm and penetrating into the insulating layer,*
- *a fastening screw comprising a threaded tip fixed to the rigid construction,*
- *the hollow shank and the fastening screw 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;*

said spacer fastening means passing through the mounting hole and fixing the insulating layer to the rigid construction such that the rigid construction and the insulating layer are separated by an insulation space.

[0086] It is a second aspect of the invention resulting of manufacturing an insulating structure intended for insulating a rigid construction by injecting insulating particles inside an insulation space resultant of the installation of a insulating layer fixed to said rigid construction thanks to a spacer fastening means introduced inside a mounting hole and a construction hole, both holes preferably perforated at the same time to ensure alignment.

[0087] *In an embodiment of the second aspect of the invention, the insulation space is filled with insulating particles preferably an intermediate mild insulating layer comprising insulating particles such as flocs.*

[0088] The resulting insulating structure assembly comprises an intermediate insulating layer comprising insulating particles such as flocs being by injecting the insulating particles through the insulating layer, preferably through filling holes of the insulating layer. These filling holes are preferably done on the insulating layer by extracting a portion of the insulating layer, said portion of insulating layer being covering means for covering the filling holes after filing the insulation space.

[0089] *In an embodiment of the second aspect of the invention, the spacer fastening means are configured with an adjusting portion when axially locking the fastening screw and the hollow shank.*

[0090] The adjusting portion allows locking the fastening screw and the hollow shank determining the distance between the rigid construction and the insulating layer; that is, the thickness of the resulting insulating layer formed by injecting the insulating particles.

[0091] *In an embodiment of the second aspect of the invention, the insulating layer comprises at least a filling hole for filling the insulating particles and covering means adapted to close the filling hole.*

[0092] *More preferably, the covering means is a portion of the insulating layer adapted to close the filling hole.*

[0093] The filling hole allows injecting the insulating particles into the insulation space. After injecting the insulating particles, the filling hole must be closed in order to prevent insulating particles escaping from the insulation space and, preferably providing a continuous external surface that may be covered with a finishing layer.

[0094] According to the preferred embodiment, the covering means must fit the filling hole ensuring to close the filling hole and preferably also ensuring a continuous external surface. When the covering means are extracted from the insulating layer, this feature may be easily met since the extracted portion shows a complementary shape of the filling hole.

[0095] *In an embodiment of the second aspect of the invention the insulating particles are made of mineral wool or EPS balls.*

[0096] In a preferred embodiment the insulating particles of mineral wool are glass wool particles. The features of the elements disclosed above in the method for manufacturing an insulating structure are those characterizing the disclosed embodiments of this second aspect of the invention.

[0097] According to another embodiment, the insulating particles are in form of individual non-bonded flocs presenting a previously selected density which provide a homogeneous layer and the ability to mold the irregularities of the rigid construction. Preferably, the insulating particles in form of individual non-bonded flocs are made of glass wool, stone wool, slag wool and cellulose. More preferably, the insulating particles are blowing glass wool flakes barley presenting compressive strength in order to fill the insulation space homogeneously.

DESCRIPTION OF THE DRAWINGS

[0098] These and other features and advantages of the invention will be seen more clearly from the following detailed description of a preferred embodiment provided only by way of illustrative and non-limiting example in reference to the attached drawings.

Figure 1 This figure shows a sectional view of an insulating structure assembly according to an embodiment of the invention.

Figure 2 This figure shows a sectional view wherein a simultaneous perforation of a construction hole and a mounting hole is performed as a first stage of an example of an insulation structure assembly.

Figure 3 This figure shows a sectional view wherein an insulation layer is fixed to a rigid construction inserting a spacer fastening means as a second stage of an example of an insulation structure assembly.

Figure 4 This figure shows a sectional view wherein a fastening screw is inserted inside a construction hole as a third stage of an example of an insulation structure assembly.

Figure 5 This figure shows a sectional view of a fourth stage of an example of an insulation structure assembly.

DETAILED DESCRIPTION OF THE INVENTION

[0099] As will be appreciated by one skilled in the art, aspects of the present invention may be embodied as a method and an insulating structure.

[0100] Figure 1 shows a first embodiment of a rigid construction (2) which corresponds to a wall or roof of a building. Said building of this embodiment does not present any type of previous insulation layer.

[0101] According to the prior art, the method for insulating a building is by gluing or screwing a panel or slab, previously made of an insulation material, directly to the wall or roof. Said panel or slab may present a distal layer visible once fixated and a proximal layer in contact with the rigid construction.

[0102] According to the invention, the insulating structure (1) comprises a first insulating layer (3) made of mineral wool fixated to a rigid structure (2) by means of spacer fastening means (4) which leaves an insulation space (5). The space allows the set of insulating layers (3) are not forced from the external surface of the rigid construction. According to this embodiment, the insulation space (5) is filled with insulating particles (6) increasing the insulation of the insulating structure (1) and, it has been tested that the insulating particles (6) prevent the flow of air that may increase the inner pressure if the flow rate is high.

[0103] According to an embodiment, in a first step shown in figure 2, the rigid construction (2) and the insulating layer (3) are simultaneously drilled along an axis (X-X') which result into perforating a construction hole (2.1) in the rigid construction (2) and an aligned mounting hole (3.1) in the insulating layer (3) along the axis (X-X') when said insulating layer (3) is in its operative location.

[0104] In a next step shown in figure 3, a spacer fastening means (4) is inserted through both the mounting hole (3.1) and the construction hole (2.1) previously perforated respectively in the insulating layer (3) and the rigid construction (2) being finally fixed to the rigid construction (2).

[0105] In a preferred embodiment, the spacer fastening means (4) comprises a fastening screw (4.1), preferably made of metal, and a hollow shank (4.2), and preferably made of plastic. The hollow shank (4.2) presents an inner cavity which provide space for lodging the fastening screw (4.1)

[0106] The spacer fastening means (4) or a plurality of them are intended for fixing the insulating layer (3), at a predetermined distance, to a rigid construction (2). Said spacer fastening means (4) should be previously selected having its length long enough to respect the predetermined distance and taking into account both the depth of construction hole (2.1) and the thickness of the insulating layer (3).

[0107] On one hand, the previously mentioned spacer fastening means also comprises an end portion, identified as threaded tip (4.1.1), and adapted to be fixed to the rigid construction (2). On the other hand, the previously mentioned hollow shank (4.2) comprises a wide helical threaded (4.2.1) ended in a plate (4.2.2).

[0108] The helical thread (4.2.1) is screwed into the insulating layer (3) using a specific tool (not shown in this figure), which allows to rotate the hollow shank (4.2) while keeping the fastening screw (4.1) fixed into the rigid construction (2), until the plate (4.2.2) rests on the outer surface of said insulating layer (3).

[0109] The hollow shank (4.2) is rotatable respectively to the fastening screw (4.1) but also adapted to be locked in the axial longitudinal direction of the fastening screw (4.1) thanks to axial retention.

[0110] In a next step, depicted in Figure 4, the threaded tip (4.1.1) of the fastening screw (4.1) is inserted inside the construction hole (2.1) of the perforated rigid construction (2). In the same embodiment, the hollow shank (4.2) of the spacerfastening means is set inside the insulating layer (3) and the plate (4.2.2) is resting on the exterior surface of said insulating layer (3).

[0111] At least a spacing means (5.1) is set between the rigid construction (5) and the insulating layer (3). Since the length of the spacing means (5.1) has been previously adjusted to the dimensions of the gap generating the insulation space (5), the resulting distance between the rigid construction (2) and the insulating layer (3) is correctly determined.

[0112] In this preferred embodiment, said configuration creates an insulation space (5) between the rigid construction (2) and the insulation layer (3). Next, the insulation space (5) is filled with insulation particles (6) through a previously perforated filling hole (3.3) in the insulating layer (3).

[0113] The filling hole (3.3), perforated in the insulating layer (3), or a plurality of them are intended for filling the insulation space (5) with insulating particles as homogenously as possible.

[0114] In a preferred embodiment, the insulation particles (6) filling the resultant insulation space (5) are in form of non-bonded flocs.

[0115] As shown in the Figure 5, once the insulation space is fully filled with insulation particles (6), the used filling hole (3.3) of the previous step is covered by covering means (3.4) rendering a leveled surface ready for receiving a finishing layer (3.5).

[0116] The plurality of filling holes (3.3), previously performed on the insulating layer (3), are covered by said covering means (3.4). Said covering means (3.4) are pieces of the extracted portions from the previously performed filling hole (3.3) in the insulating layer (3).

[0117] After covering the filling holes (3.3) with the covering means (3.4) the resulting outer surface is flat, free of cavities or holes, but may show irregularities, mainly at the location of the covering means (3.4). According to a preferred embodiment, the outer surface of the insulating layer (3) with the covering means (4) is covered with at least one layer of a base coat (3.2) providing a high-quality surface. In a further step, the outer surface with the at least one layer of base coat (3.2) is covered by a finishing layer (3.5). According to a preferred embodiment, between the base coat (3.2) and the finishing layer (3.5), a glass fiber layer is interposed improving the mechanical properties of the construction, specifically improving the resistance to external aggressions of environmental elements and the rigidity.

Claims

1. Method for manufacturing an insulating structure (1), configured for the insulation of a rigid construction (2), the method comprising:

    a) providing an insulating layer (3) made of mineral wool comprising mineral fibers,
    wherein

    - the thickness of the insulating layer (3) is between 20 and 40mm;
    - the density of the mineral wool is between 60 and 150 kg/m3, and

    b) perforating at least one construction hole (2.1) in the rigid construction (2);
    c) providing a mounting hole (3.1) in the insulating layer (3);
    d) aligning each construction hole (2.1) with the mounting hole (3.1) of the insulating layer (3);
    e) fixing at least one spacer fastening means (4), said fastening means (4) comprising:

    - a hollow shank (4.2) comprising a helical thread (4.2.1) running along its outside with a maximum major diameter (D) of at least 50 mm and adapted to penetrate into the insulating layer (3),
    - a fastening screw (4.1) comprising a threaded tip (4.1.1) adapted to be fixed to the rigid construction (2)
    - wherein the hollow shank (4.2) and the fastening screw (4.1) are adapted to be locked relative to each other in the axial longitudinal direction of the fastening screw (4.1), while being freely rotatable relative to each other;

    wherein the spacer fastening means (4) are fixed through the aligned holes (2.1, 3.1) to the rigid construction (2) by means of the threaded tip (4.1.1) at one end and to the insulating layer (3) by means of the helical thread (4.2.1) at the opposite end leaving a predetermined insulation space (5) in-between.

2. A method according to claim 1 wherein the mineral fibers of the insulating layer (3) are predominantly oriented in a plane perpendicular to the thickness of said insulating layer (3);

3. A method according to claim 1 wherein at least 50% of fibers of the insulating layer (3) are perpendicularly oriented to the thickness of the insulating layer (3), more preferably more than 60% of the fibers, more preferably at least 70% of the fibers, even more preferably more than 80% of the fibers or more than 90% of the fibers.

4. A method according to any of claims 1 to 3 wherein the mounting holes (3.1) are performed in the insulating layer (3) in step b) when perforating the rigid construction (2) passing through the insulating layer (3).

5. A method according to any of claims 1 to 3 wherein the mounting holes (3.1) are performed in the insulating layer (3) during the manufacturing process of said insulating layer (3).

6. A method according to any of the preceding claims wherein the insulation space (5) left during step e) is predefined by spacing means (5.1).

7. A method according to previous claim wherein the spacing means (5.1) are a support tool being temporally interposed between the rigid construction (2) and the insulating layer (3) when fixing the spacer fastening means (4) to the insulating layer (3).

8. A method according to any of the preceding claims wherein the insulation space (5) is filled with insulating particles (6).

9. A method according to claim 8 wherein the insulating particles (6) filling the insulation space (5) form a continuous layer.

10. A method according to claims 8 or 9, wherein the filling of insulation space (5) with insulating particles (6) is performed by injecting the insulating particles (6) through the insulating layer (3).

11. A method according to any of the preceding claims further comprising the step of performing at least one filling hole (3.3) on the insulating layer (3) for the filling of the insulation space (5) with insulating particles (6).

12. A method according to the preceding claim, further comprising the step of covering the insulating layer (3) with a base coat (3.2) before filling the insulation space (5) with insulating particles (6).

13. A method according to claim 11 or 12, further comprising the step of covering the filling hole (3.3) with covering means (3.4) after filling the insulation space (5) with insulating particles (6).

14. A method according to any of claims 11 and 13, wherein the covering means (3.4) are a portion of the insulating layer (3) extracted from said insulating layer (3) for performing the at least one filling hole (3.3).

15. A method according to any claims 11 to 14, further comprising the step of covering the insulating layer (3) and the covering means (3.4) with a base coat (3.2) before applying a finishing layer (3.5).

16. Insulating structure assembly (1) for insulating a rigid construction (2), the assembly comprising:

an insulating layer (3) made of mineral wool and provided with a mounting hole (3.1) wherein

- the thickness of the insulating layer (3) is between 20 and 40mm; and,
- the density of the mineral wool is between 60 and 150 kg/m3;

at least one spacer fastening means (4), said fastening means (4) comprising:

- a hollow shank (4.2) comprising a helical thread (4.2.1) running along its outside with a maximum major diameter (D) of at least 50 mm and penetrating into the insulating layer (3),
- a fastening screw (4.1) comprising a threaded tip (4.1.1) fixed to the rigid construction (2),
- the hollow shank (4.2) and the fastening screw (4.1) adapted to be locked relative to each other in the axial longitudinal direction of the fastening screw (4.1), while being freely rotatable relative to each other;

said spacer fastening means (4) passing through the mounting hole (3.1) and fixing the insulating layer (3) to the rigid construction (2) such that the rigid construction (2) and the insulating layer (3) are separated by an insulation space (5).

17. An insulating structure assembly (1) according to the preceding claim, wherein the insulation space (5) is filled with insulating particles (6) preferably an intermediate mild insulating layer (6.1) comprising insulating particles (6) such as flocs.

18. An insulating structure assembly (1) according to claim 16 or 17, wherein the spacer fastening means (4) are configured with an adjusting portion when axially locking the fastening screw (4.1) and the hollow shank (4.2).

19. An insulating structure assembly (1) according to any of claims 16 to 18 wherein the insulating layer (3) comprises at least a filling hole (3.3) for filling the insulating particles (6) and covering means (3.4) adapted to close the filling hole (3.3).

20. An insulating structure assembly (1) according to previous claim wherein the covering means (3.4) is a portion of the insulating layer (3) adapted to close the filling hole (3.3).

21. An insulating structure assembly (1) according to any of claims 16 to 20 wherein the insulating particles (6) are made of mineral wool or EPS balls.

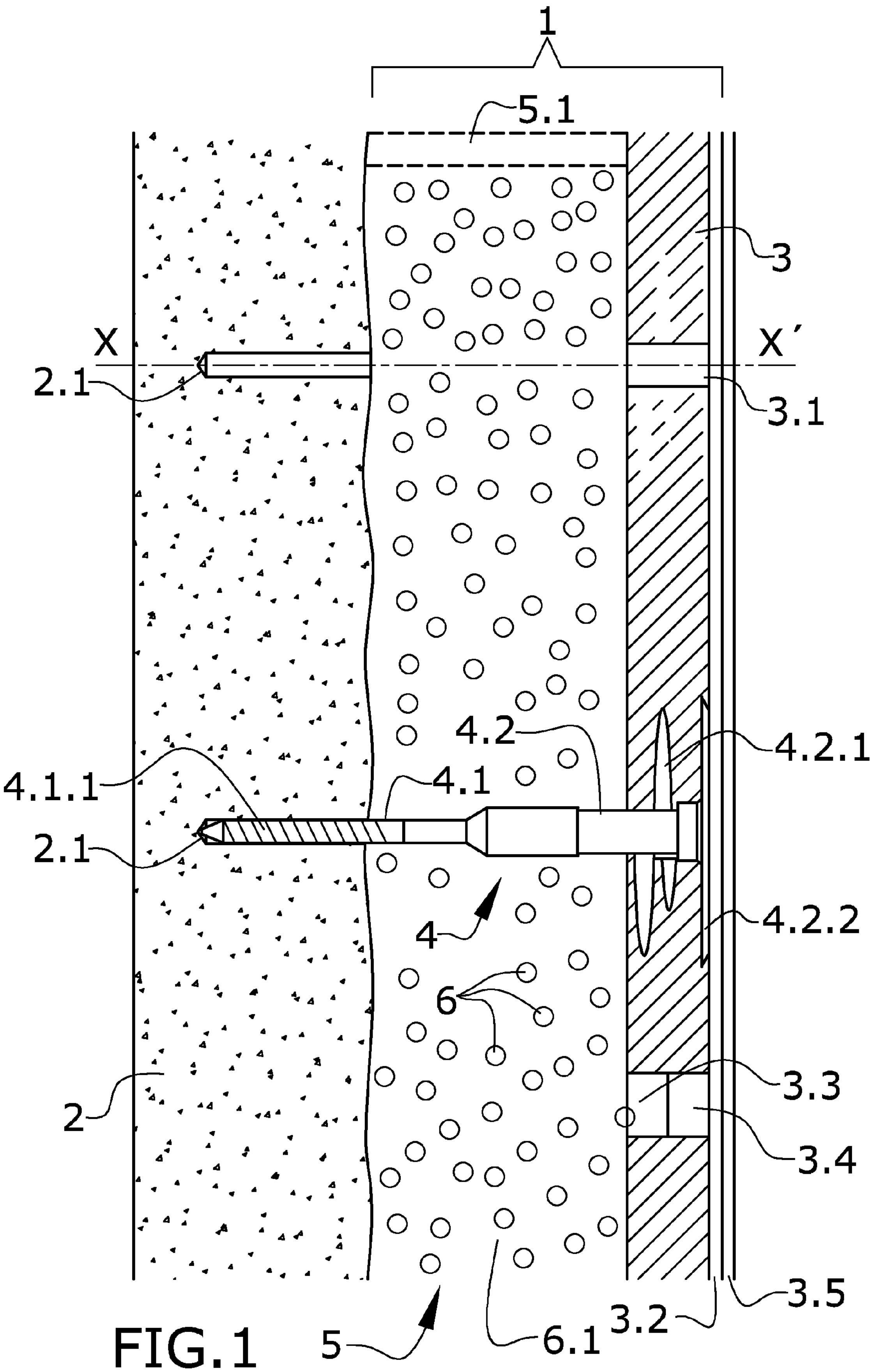

FIG.1

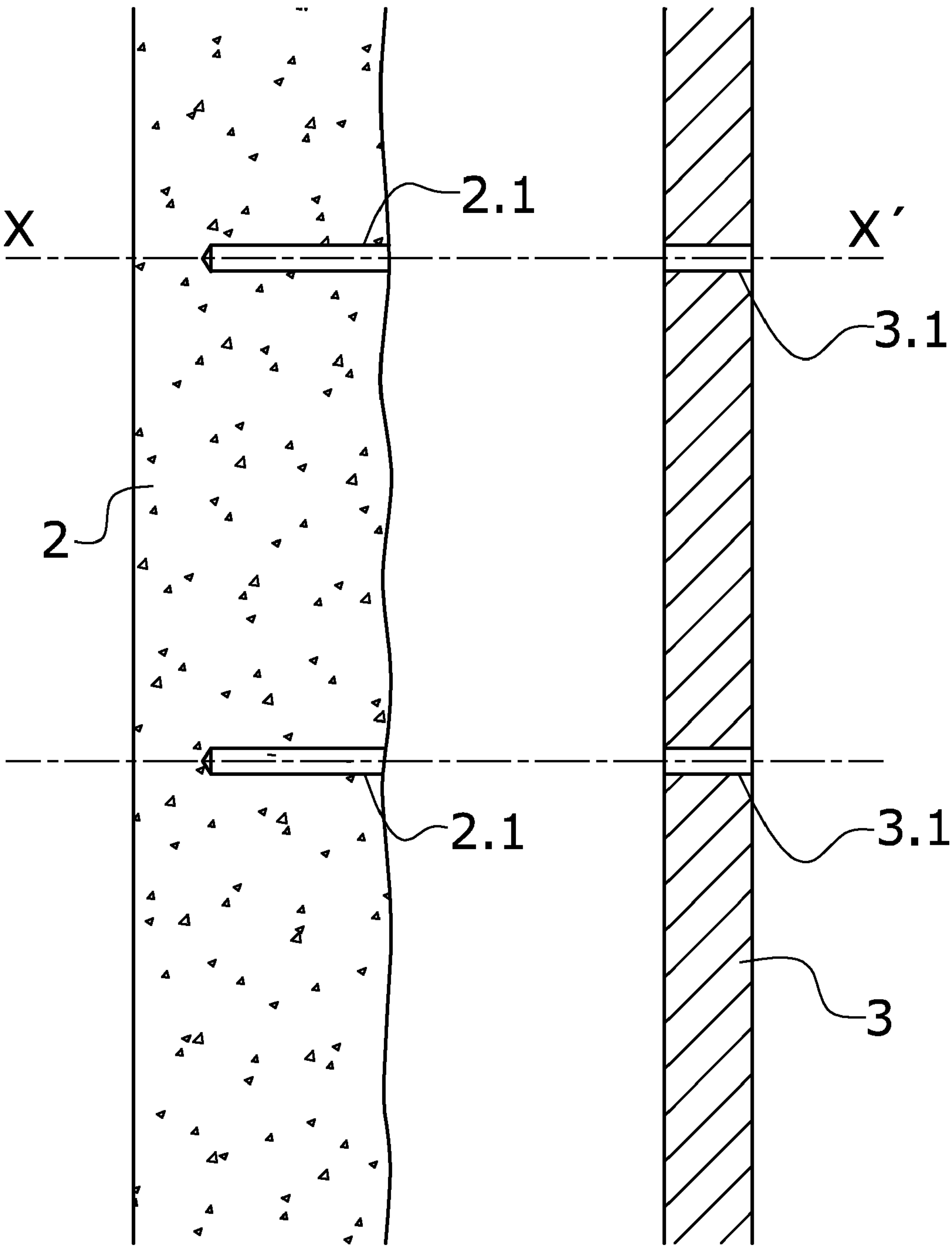

FIG.2

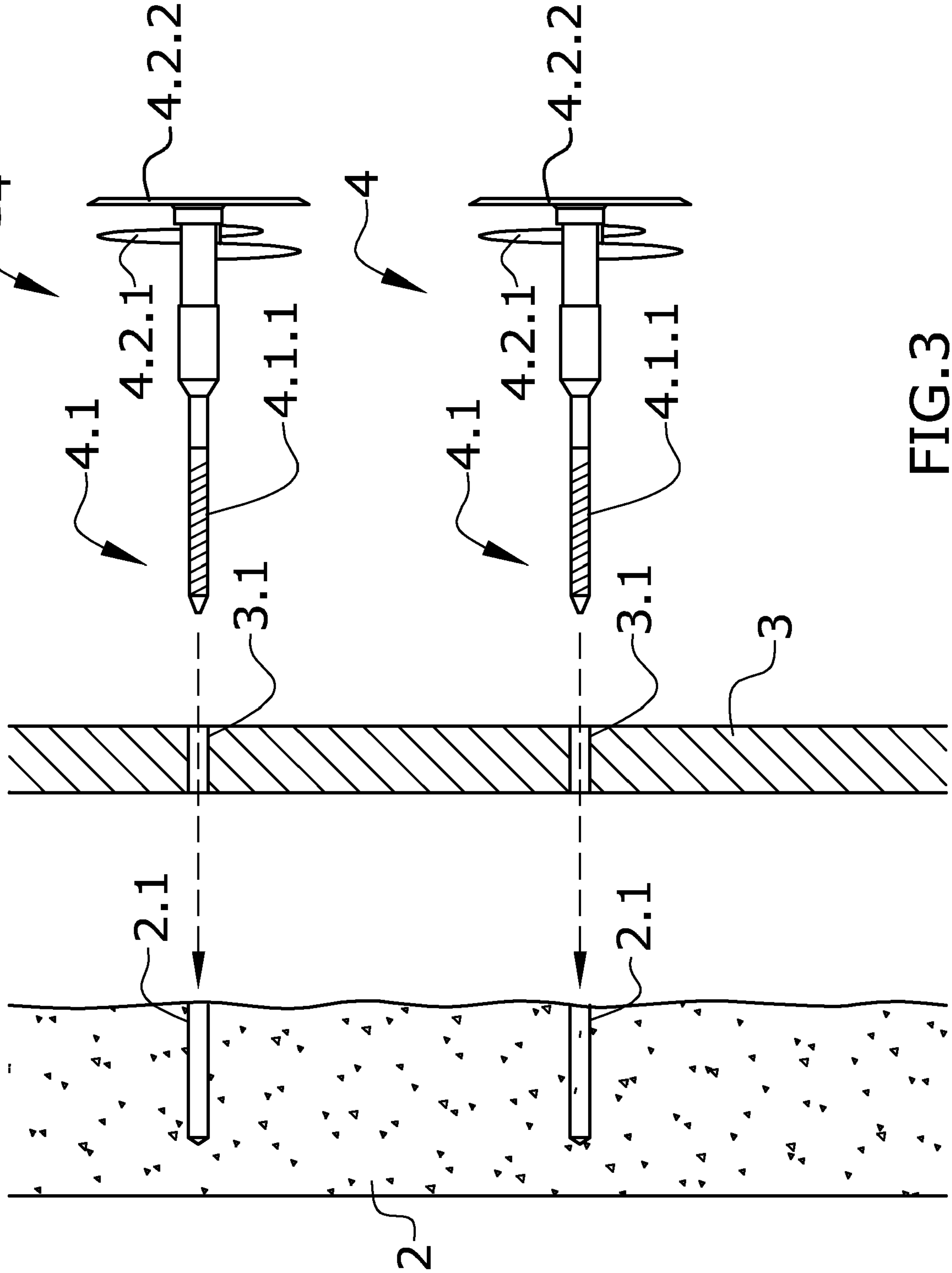

FIG.3

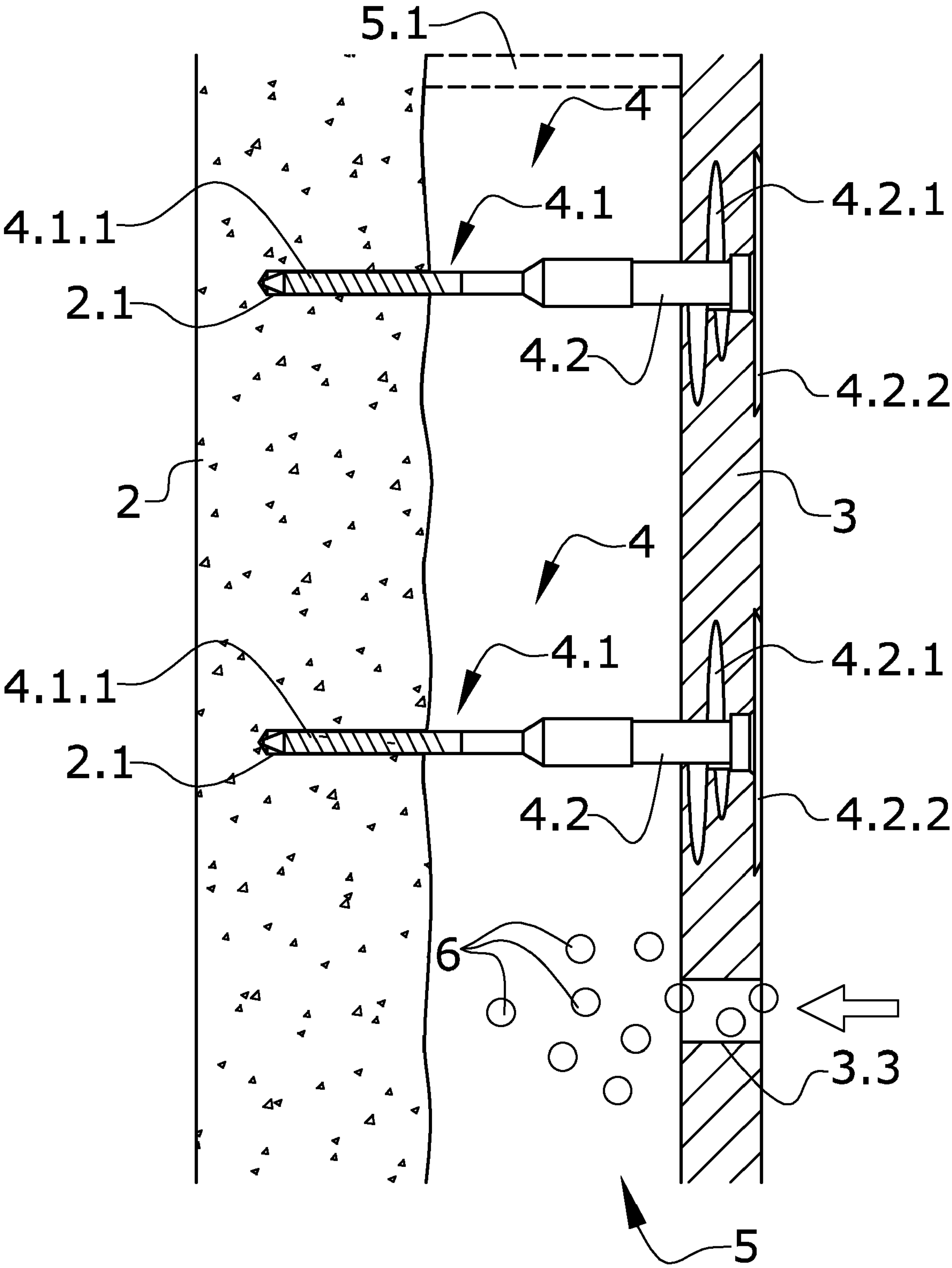

FIG.4

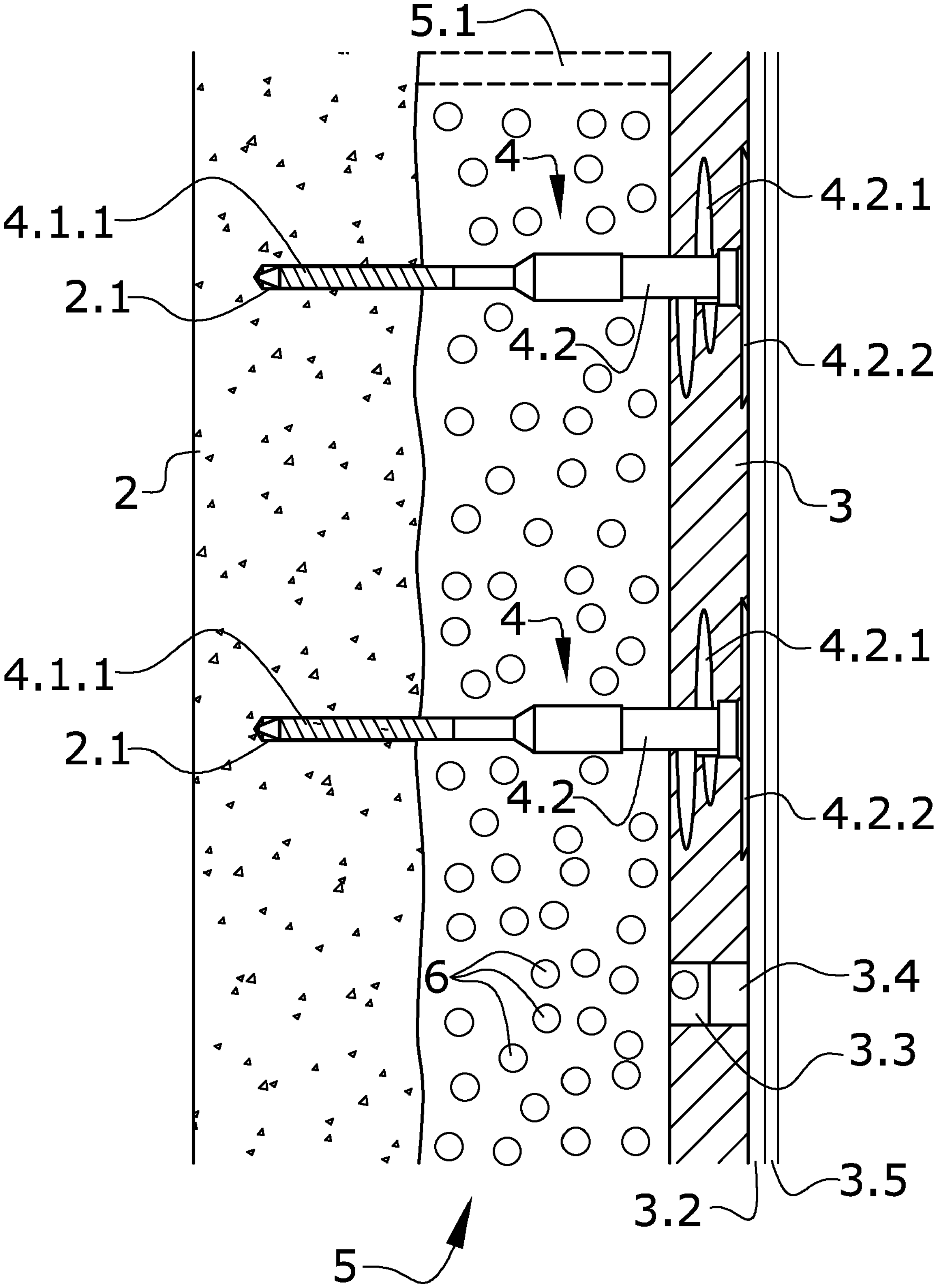

FIG.5

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EUROPEAN SEARCH REPORT

Application Number
EP 20 38 3035

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The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	12 May 2021	Dieterle, Sibille

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