

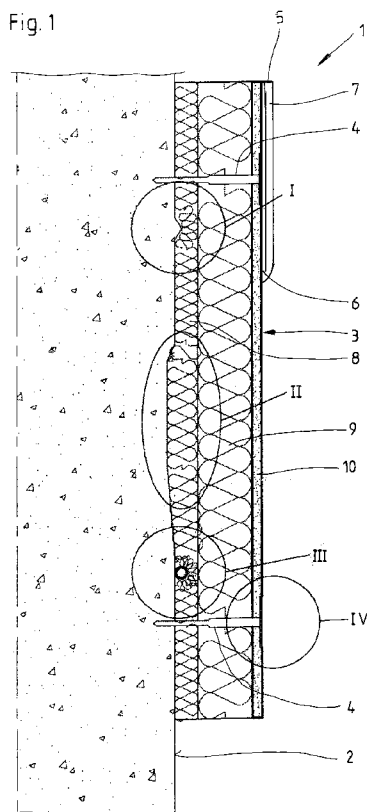


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(54) Title: INSULATION SYSTEM FOR COVERING A FACADE OF A BUILDING

Fig. 1



(57) Abstract: This invention relates to an improved insulation system for covering a facade of a building consisting of at least one insulation element (3), at least one mechanical fastener (4), which fastener fixes the insulation element (3) to the facade (2) of the building, and a rendering system (5) being arranged on the outer surface of the insulation element (3) whereby the insulation element has at least a first and a second layer being connected to each other; whereby the first layer being directed to the facade having a bulk density being lower than the bulk density of the second layer and whereby at least one layer is made of mineral fibres, especially stone wool fibres and a binding agent, or of cellular plastic, especially expanded polystyrene (EPS). To achieve an insulation system which has very good insulation characteristics, which can be produced for low costs and which can be fixed to the facade of a building without causing high labour costs the insulation element (3) has a third layer (10) made of mineral fibres and a binding agent, which third layer (10) has a bulk density being higher than the bulk density of the second layer (9) and which third layer (10) has a high receptiveness and/or adhesion for the rendering system (5) without using any surface primer, coating and/or an additive.

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Insulation system for covering a facade of a building

The invention relates to an insulation system for covering a facade of a building consisting of at least one insulation element, at least one mechanical fastener, which fastener fixes the insulation element to the facade of the building, and a rendering system being arranged on the outer surface of the insulation element. Said systems also being known as External Thermal Insulation Composite Systems (ETICS).

The insulation element has at least a first and a second layer being connected to each other, whereby the first layer being directed to the facade having a bulk density being lower than the bulk density of the second layer and whereby at least one layer is made of mineral fibres, especially stone wool fibres and a binding agent, or of cellular plastic, especially expanded polystyrene (EPS).

Such insulation systems are well-known in the prior art. In modern roof and facade constructions it is common to employ mineral fibre insulating products comprising an insulation layer and a rigid surface coating or layer on at least the one main surface of the product eventually facing the exterior of the insulated construction. Different insulation materials are known in the prior art as for example fibrous materials made of inorganic and/or organic fibres normally bound with a binding agent.

For example DE 20 2009 001 532 U1 discloses a dual density facade insulation board having a soft inner layer which absorbs unevenness of the substrate and a hard outer layer forming the main layer and having a bulk density between 180 and 280 kg/m³ on which a layer of render can be arranged. The soft inner layer has a bulk density between 30 and 80 kg/m³. Both layers can be made from wood fibres or mineral fibres. Such insulation boards have several disadvantages. If these boards are made of wood fibres they naturally have a very low fire resistance unless high amounts of flame retardants are used. Moreover their thermal properties are quite poor and the durability will be significantly reduced when being exposed to moisture.

The fire resistance of such boards being made from mineral fibres is much better. Nevertheless, a layer of mineral fibres with a bulk density of between 180 and 280 kg/m³ provides only low thermal resistance. To achieve sufficient thermal resistances with these layers it is necessary to use layers of great thickness. To use thick layers has the disadvantage that the weight of such insulation boards is high so that a lot of mechanical fasteners are necessary to fix these insulation boards onto the facade. To use insulation boards with high thicknesses together with a big amount of mechanical fasteners increases the price of such insulation systems namely the costs for the material and for the labour. Moreover such high density mineral fibre boards are known to provide very poor receptiveness for a rendering system which is why several attempts have been made in prior art as to improve the receptiveness by applying different surface primer, coatings and/or additives to the surface of the insulation elements. As an example reference is made to DE 296 169 64 U1 or DE 32 48 663 C.

Therefore, it is one object of the present invention to provide an insulation system for covering a facade of a building at low total installed costs, with good thermal insulating characteristics, which can be fixed to a building facade very easily and where a rendering system can easily be applied without causing high labour costs.

According to the invention this object is achieved with an insulation system for covering a facade of a building using an insulation element having a third layer made of mineral fibres and a binding agent, which third layer has a bulk density being higher than the bulk density of the second layer and which third layer forming the outer layer has a high receptiveness and/or adhesion for the rendering system without using any surface primer, coating and/or additive. Such high receptiveness and/or adhesion for the rendering system results in an high bond strength between the base coat of the rendering and the insulation element.

The insulation element being used in an insulation system according to the invention has therefore three layers whereby the outer layer has in comparison to the two further layers the highest bulk density so that this third layer is very durable. The second layer which has in comparison to the third layer a reduced bulk density has good insulation characteristics and can be made with a bulk density achieving these good insulation characteristics. Finally the first layer being the layer which is in contact with the building has a low bulk density so that this layer can absorb unevenness of the surface of the building substrate.

Therefore, the first layer being made flexible is able to handle unevenness in the building surface of up to 15 to 20 mm, depending on the thickness of this layer.

One of the main features of the invention is that the third layer has a high receptiveness and/or adhesion for the rendering system without using any surface primer, coating and/or an additive. Such higher receptiveness is caused by a specific homogeneity of said layer which causes beneficial adhesion properties. Homogeneity, respectively the homogeneity of a layer, in particular the third layer of the insulation system in the sense of this invention results in a specific consistency of properties throughout said layer and is based on an even distribution of the constituents, like e.g. the mineral fibres and a binding agent. A more detailed verification of the specific homogeneity is given further down in the description.

Mainly the beneficial adhesion properties of the third layer relate for example to lack of loose fibres and/or dust on the surface and/or concentration variations in the oil/binder distribution and/or the fibre bulk.

Two main factors involved in the adhesion are the binder distribution and the fibres orientation. Preferably the binder is distributed evenly in the product to avoid spots where the fibres would be more loosely attached to each other and could be easily pulled off the layer. Fibre pull out measured by a simple test where equal sizes of tape are weighed before and after being adhered to the wool shows that the amount of fibres pulled out measured by weight is only one third on the third layer compared to normal stone wool of the same density. For example the mass of loose fibres/dust collected on the surface of the third layer per m^2 only amounts to between 25 and 55 g/m^2 .

A further aspect of achieving a higher receptiveness and/or adhesion for the rendering system is based on the time for complete wetting of the layers. In mineral wool products the wetting dynamics is altered by the addition of oil. Lower oil content and an iso-structural fibre orientation ensures a uniform and low wetting time. The wetting time is half the wetting time of a traditionally made mineral wool/stone wool product made by traditional production.

According to a further aspect a homogeneous distribution in binder and oil throughout the surface of the third layer is of advantage. This homogeneous distribution in binder and oil gives fibres a better adhesion. Therefore, the amount of binder and oil can influence not only the wetting behavior but also the cohesion between the fibres in the third layer. Preferably the third layer has a uniform distribution of the binder throughout the surface. The adhesion strength of the layer reaches 0,19 to 0,22 kN for the third layer of the insulation element. Preferably a dry binder should be used for the third layer having a much more uniform distribution than a wet binder used for conventional layers made of mineral fibres and the binding agent. The reason is more precise control of the process bringing in the binder into the third layer.

Furthermore, a better friction in the third layer can be reached by increasing the friction between the fibres. Crosslinking of the fibres exhibits a higher friction force between the fibres and are able to trap the render of the rendering system and to retain the render. Furthermore, the crosslinking reduces loose fibres which increases the adhesion.

Last but not least the fibre orientation of the third layer is a main aspect for the high receptiveness and/or adhesion for the rendering system. A better adhesion is dependent on a homogeneous fibre orientation or crosslinking. To further verify this homogeneity the wool structure or fibre orientation of the main surface of the outer layer of a product according to the invention has been investigated in more details. As a result of these investigations a clear difference in the fibre orientation between a usual product produced by a traditional process and a product according to the invention can be ascertained. In particular the wool structure of the third layer is iso-structural in the xy-plane with fibres along the x- and the y-directions, which gives a strong network, i.e. a high cohesion and/or friction between fibres of the network. In contrast, prior art products have a preferred fibre orientation which will result in specifically varying properties along e.g. the x- and y-directions

Fig. 6 and 7 show histograms of a third layer according to the invention in Fig. 6 and a usual layer made of mineral fibres and binding agent in Fig. 7. These histograms are a result of a computational analysis of the scanned images of the product surface which have been treated by an image processing package, called Fiji. The fibre orientation has then been investigated by a plug in of Fiji, called Directionality.

Both figures show the direction of the fibres in two directions of the layer perpendicular to

each other and/or the values 90° and -90° for both directions. The two angles representing the same direction and indicating that the fibres are distributed in a (xy) plane (x-axis being along the length of the sample and y-axis being along the width of the sample). On the other hand, the third layer presents no major peaks, but peaks for all the angles from -90° to 90° . This indicates that the fibres have no preferential direction, but are evenly distributed in the product. Hence it can be noted that the homogeneity of the fibre orientation in the third layer is a result of the manufacturing of the third layer. Therefore the fibres are not pulled out of the surface during the application of the render because of the high friction between the fibres and their crosslinking.

All in all the third layer in an insulation system according to the invention in particular has a wool structure which is iso-structural in the xy-plane with fibres along the x- and the y-directions providing a strong network. The high receptiveness and/or adhesion for the rendering system is therefore based especially on a lower oil content resulting in a better penetration of the liquid of the render into the surface and therefore a lower wetting time and on the wool structure having a lower fibre pull-out value of for example between 25 g/m^2 , more often between 35 and 45 g/m^2 .

According to a further feature of the invention the bond strength between the third layer and the rendering layer amounts to between $0,010 \text{ N/mm}^2$ and $0,080 \text{ N/mm}^2$, especially between $0,010 \text{ N/mm}^2$ and $0,030 \text{ N/mm}^2$, preferably between $0,015 \text{ N/mm}^2$ and $0,025 \text{ N/mm}^2$, for example $0,020 \text{ N/mm}^2$. The insulation system according to the present invention having the before mentioned bond strength has moreover a high stability without using a big number of mechanical fasteners even if the insulation elements are only fixed by these mechanical fasteners without gluing the insulation onto the facade. This is achieved by a three-layered insulation element having special synchronized densities of the different layers which will be very advantageous while fixing it to the façade. Said adjusted densities on the one hand provide the needed rigidity and strength, e.g. pull-through strength for the mechanical fasteners in the third layer and on the other hand secure the good insulation characteristics of the second layer. Finally, the first layer which can be very slim in thickness compared to the other two layers and which of course has good insulation characteristics because of its low bulk density is able to equalize projections in the surface of the building facade. By choosing the synchronized densities in accordance with the present invention the insulation element even provides a controllable flexibility, i.e. a kind of spring-back effect which is very useful while leveling the surface of the ready installed insulation layer before applying the rendering system. Therefore costly

grinding of the insulation boards is completely avoided.

The bond strength between the layer of render, especially a base coat which is part of the layer of render respectively the rendering system, and the insulation element is measured in accordance with the Guideline for European Technical Approval ETAG No. 004 (e.g. edition 03/2000), paragraph 5.1.4.1.1. The results are expressed in N/mm^2 (MPa).

It is another feature of the invention that the third layer has a bulk density of 190 kg/m^3 to 390 kg/m^3 , especially of 250 kg/m^3 to 320 kg/m^3 .

According to a further feature of the present invention at least the third layer is made of mineral fibres in an amount of 90 to 99 wt % of the total weight of starting materials in the form of a collected web and a binding agent in an amount of 1 to 10 wt % of the total weight of starting materials, whereby the collected web of mineral fibres is subjected to a disentanglement process, whereby the mineral fibres are suspended in a primary air flow, whereby the mineral fibres are mixed with the binding agent before, during or after the disentanglement process to form a mixture of mineral fibres and binding agent and whereby the mixture of mineral fibres and binding agent is pressed and cured to provide a consolidated composite with a bulk density of 190 kg/m^3 to 390 kg/m^3 , especially of 250 kg/m^3 to 320 kg/m^3 . The percentages mentioned are based on dry weight of starting materials. As a result of the before mentioned production processes a surprisingly homogenous layer of mineral fibres and a binding agent is achieved. Therefore the quality of the curing is significantly improved and uncured binder spots causing well known discolouration or so called brown spots on the rendering system are eliminated.

Such layers can be produced in a versatile and cost efficient method. By adjusting the density to which the layer is pressed, a variety of different layers can be tailor-made for specific purposes. Therefore, these layers have a variety of uses, predominantly as building elements. In particular the layers can be in the form of panels. In general, the layers are used in applications where mechanical stability and uneven surface finish as well as insulating properties are important. In some applications the layers can be used as acoustically absorbing ceiling or wall panels. In other applications, the layers can be used as insulating outer cladding for buildings. The precise quantity of mineral fibres is chosen so as to maintain appropriate fire resistance properties and appropriate thermal and/or acoustic insulation value and limiting cost, whilst maintaining an appropriate level of

cohesion, depending on the appropriate application. A high quantity of fibres increases the fire resistance of the element, increases its acoustic and thermal insulation properties and limits cost, but decreases the cohesion in the element. This means that the lower limit of 90 wt % results in an element having good cohesion and strength, and only adequate insulation properties and fire resistance, which may be advantageous for some composites, where insulation properties and fire resistance are less important. If insulation properties and fire resistance are particularly important the amount of fibres can be increased to the upper limit of 99 wt %, but this will result in only adequate cohesion properties. For a majority of applications a suitable composition will include a fibre amount of from 90 to 97 wt % or from 91 to 95 wt %. Most usually, a suitable quantity of fibres will be from 92 to 94 wt %.

The amount of binder is also chosen on the basis of desired cohesion, strength and cost, plus properties such as reaction to fire and thermal insulation value. The low limit of 1 wt % results in a layer with a lower strength and cohesion, which is however adequate for some applications and has the benefit of relatively low cost and potential for good thermal and acoustic insulation properties. In applications where a high mechanical strength is needed, a higher amount of binder should be used, such as up to the upper limit of 10 wt %, but this will increase the cost for the resulting product and further the reaction to fire will often be less favorable, depending on the choice of binder. For a majority of applications, a suitable layer will include a binder amount from 3 to 10 wt % or from 5 to 9 wt %, most usually a suitable quantity of binder will be from 6 to 8 wt %.

The mineral fibres used for such a layer could be any mineral fibres, including glass fibres, ceramic fibres or stone fibres but preferably stone fibres are used. Stone wool fibres generally have a content of iron oxide of at least 3 % and alkaline earth metals (calcium oxide and magnesium oxide) from 10 to 40 %, along with the other usual oxide constituents of mineral wool. These are silica; alumina; alkali-metals (sodium oxide and potassium oxide) which are usually present in low amounts; and can also include titania and other minor oxides. Fibre diameter is often in the range 3 to 20 microns, in particular 5 to 10 microns, as conventional.

An alternative third layer used in an insulation system according to the present invention is made of mineral fibres in an amount of from 24 to 80 wt % of the total weight of starting materials in the form of a collected web, an aerogel particulate material in an amount of

from 10 to 75 wt % of the total weight of the starting materials and a binding agent in an amount of from 1 to 30 wt % to the total weight of starting materials, whereby the mineral fibres are suspended in the primary air flow, whereby the aerogel particulate material is suspended in the primary air flow, whereby mixing the aerogel particulate with the suspended mineral fibres, whereby the mineral fibres are mixed with the binding agent before, during or after the mixing of the aerogel particulate material with the mineral fibres to form a mixture of mineral fibres, aerogel particulate material and binding agent and whereby the mixture of mineral fibres, aerogel particulate material and binding agent is pressed and cured to provide a consolidated composite with a bulk density of 190 kg/m³ to 390 kg/m³, especially of 250 kg/m³ to 320 kg/m³.

Preferably, the binding agent of the third layer is a dry binder, especially a powdery binder, e.g. phenol formaldehyde binder, phenol urea formaldehyde binder, melamine formaldehyde binder, condensation resins, acrylates and/or other latex compositions, epoxy polymers, sodium silicate, hotmelts of polyurethane, polyethylene, polypropylene and/or polytetrafluorethylene polymers. The use of a dry binder, preferably a phenol formaldehyde binder, as this type of binder is easily available and has proved efficient, has the advantage that mixing is easy and furthermore the need for maintenance of the equipment is low. Finally such binder is relatively stable and storable.

The percentages mentioned are based on dry weight of starting materials.

Such a layer can be manufactured in a very versatile and cost efficient way. A wide range of properties in terms of e.g. mechanical strength, thermal insulation capability etc. can be produced by altering the quantity of each component. This means that a variety of different layers can be made that are tailor-made for specific purposes.

Mixing the fibres and the aerogel particulate material as a suspension in an air flow provides a surprisingly homogeneous composite, especially considering the considerable differences in the aerodynamic properties of these materials. This high level of homogeneity in the layer results generally in an increased level of mechanical strength relative to the layers of the prior art for a given combination of quantities of the layers. The increased homogeneity of the layer also has other advantages such as aesthetic appeal and consistency of properties throughout a single layer. As a result of mixing the aerogel particulate material with the mineral fibres when suspended in an air flow the aerogel

particulate material is allowed to penetrate into the tufts of fibres that are present. In contrast, when the mixing process involves physical contact of, for example a stirrer with the fibres, the fibres tend to form compact balls, which the aerogel particulate material cannot penetrate easily. The result of this can be that, in cases where the mixing process involves physical contact, the final product contains areas where the aerogel and the fibres are visibly separated in distinct zones.

The layers have a variety of uses as it is described above standing.

Aerogel when used in the broader sense means a gel with air as the dispersion medium. Within that broad description, however exist three types of aerogel which are classified according to the conditions under which they have been dried. These materials are known to have excellent insulating properties owing to their very high surface areas, and high porosity. They are manufactured by gelling a flowable sole gel-solution and then removing the liquid from the gel in a manner that does not destroy the pores of the gel.

Preferably the first layer of the insulation element is made of mineral fibres, especially stone wool fibres and a binding agent, which first layer has a bulk density of from 30 kg/m^3 to 55 kg/m^3 , especially of 45 kg/m^3 . Such a first layer has a high flexibility and is bendable so that such a first layer can equalize higher protrusions in the surface of the facade, such as wires being fixed outside of the building as it is known in connection with satellite antennas etc.

According to a further feature of the invention the second layer of the insulation element has a bulk density of from 60 kg/m^3 to 85 kg/m^3 , especially of 75 kg/m^3 . Such second layer being preferably made of mineral fibres, especially stone wool fibres has excellent insulation characteristics. Therefore, to achieve good insulation characteristics of the building the thickness of such layer can nowadays be in a range of up to 100 mm. However, even fulfilling future requirements with higher thicknesses the total weight of an insulation element using such a second layer is so low that the insulation element can be fixed without gluing but only with mechanical fasteners.

It is a further feature of the invention that the mechanical fastener has a screw-like shaft and a plug and/or a plug-plate which plug and/or plug-plate is arranged in the third layer of the insulation element in that the plug and/or plug-plate is flush with the outer surface of

the third layer of the insulation element. For this purpose the third layer of the insulation needs the before mentioned bulk density so that the plug and/or plug-plate can be arranged flush with the outer surface of the third layer. This arrangement has the big advantage that the rendering system can be provided with a low thickness because the plug and/or plug-plate has not to be embedded into the layer of render, i.e. the base coat and no pre-priming of the plug-plate is required.

Preferably the insulation element is fixed to the facade only by at least one mechanical fastener per square meter of the insulation element. To reduce the specific number of the mechanical fasteners has the advantage that the cost for the material and the cost for the labour used to build up such an insulation system is decreased.

According to a further feature of the invention the rendering system is a multi-layer coat system containing at least a base coat and a finishing coat. Moreover a reinforcement mesh may be embedded in the base coat.

The before described insulation system provides in comparison to the prior art a faster installation time, an improved reliability by reduction of defects and errors, good insulation characteristics and thus an enhanced comfort and improved indoor climate. Moreover a lower system price and a shorter site time. Furthermore, this insulation system according to the present invention has an increased receptiveness for mortar. No brown spots occur and the insulation element has a controllable flexibility.

The invention will be described in the following by way of example and with reference to the drawings in which

Fig. 1 is a schematic drawing of an insulation element being part of an insulation system for covering a facade of a building.

Fig. 2 is an enlarged drawing of a part of the insulation system according to circle I in Fig.1

Fig. 3 is an enlarged drawing of a part of the insulation system according to circle II in

Fig. 1

Fig. 4 is an enlarged drawing of a part of the insulation system according to circle III in Fig. 1

Fig. 5 is an enlarged drawing of a part of the insulation system according to circle IV in Fig. 1

Fig. 1 shows a part of an insulation system 1 for covering a facade 2 of a building. The insulation system consists of several insulation elements 3 of which only one insulation element 3 is shown in Fig. 1. The insulation element 3 is fixed with only mechanical fasteners 4 to the facade 2. These mechanical fasteners 4 will be described later.

Furthermore the insulation system consists of a rendering system 5 being shown only partly in Fig. 1 and consisting of a base coat 6 and a finishing coat 7. The rendering system 5 is based on mortar and can be modified with an adhesive resin.

The insulation element 3 consists of a first layer 8, a second layer 9 being arranged on the first layer 8 and a third layer 10 being arranged on the second layer 9. The third layer 10 is made of mineral fibres and a binding agent and has a bulk density being higher than the bulk density of the second layer 9 which is made of mineral fibres and a binding agent. The bulk density of the third layer 10 is 300 kg/m^3 . This third layer 10 has a small thickness of approximately 15 mm. The third layer 10 is fixed to the second layer 9 for example by gluing.

The second layer 9 which is made of stone wool fibres and a binding agent has a bulk density of approximately 75 kg/m^3 so that this second layer 9 has good insulation characteristics, especially a good total thermal resistance.

The mineral fibres of the second layer 9 can be arranged parallel to the surfaces of the insulation element 3 which are substantially running parallel to the facade 2. For certain uses it may be of advantage to arrange the mineral fibres of the second layer 9 perpendicular to these surfaces. The advantage of the arrangement of the mineral fibres perpendicular to these surfaces is that the insulation element 3 has an increased compression strength in comparison to an insulation element 3 having a second layer 9

with an orientation of the mineral fibres parallel to these surfaces.

Nevertheless a second layer 9 of an insulation element 3 with a fibre orientation substantially parallel to these surfaces has improved thermal insulation characteristics in comparison to an insulation element 3 with a second layer 9 having a fibre orientation perpendicular to the surfaces.

The first layer 8 which is made of mineral fibres and a binding agent and which is fixed to the second layer 9 and which is in contact with the facade 2 has a bulk density of approximately 45 kg/m^3 so that this first layer 8 has a high flexibility and is highly compressible.

Because of the characteristics of the third layer 10, especially the high bulk density the bond strength between the third layer 10 and the rendering system 5 is $0,020 \text{ N/mm}^2$. To achieve this bond strength the third layer 10 is made according to a first alternative of mineral fibres in an amount of around 96 wt % of the total weight of starting material in the form of a collected web and a binding agent in an amount of 4 wt % of the total weight of starting materials, whereby the collected web of mineral fibres is subjected to a disentanglement process, whereby the mineral fibres are suspended in a primary air flow, whereby the mineral fibres are mixed with a binding agent before the disentanglement process to form a mixture of mineral fibres and binding agent and whereby the mixture of mineral fibres and binding agent is pressed and cured to provide a consolidated composite with a bulk density of 300 kg/m^3 .

According to a second alternative the third layer 10 is made of mineral fibres in an amount of about 70 wt % of the total weight of starting materials in the form of a collected web, an aerogel particulate material in an amount of 25 wt % of the total weight of starting materials and a binding agent in an amount of 5 wt % of the total weight of starting materials, whereby the mineral fibres are suspended in a primary air flow, whereby the aerogel particulate material is suspended in the primary air flow, thereby mixing the aerogel particulate material with the suspended mineral fibres, whereby the mineral fibres are mixed with the binding agent before mixing of the aerogel particulate material with the mineral fibres to form a mixture of mineral fibres, aerogel particulate material and binding agent and whereby the mixture of mineral fibres, aerogel particulate material and binding agent is pressed and cured to provide a consolidated composite with a bulk density of 300

kg/m³.

The mechanical fastener 4 has a screw-like shaft 11 and a plug-plate 12 being arranged at one end of the shaft 11. The plug-plate 12 is arranged in the third layer 10 of the insulation element 3 in that the plug-plate 12 is flush with the outer surface of the third layer 10 of the insulation element 3. Fig. 5 shows the mechanical fastener 4 with the shaft 11 and the plug-plate 12 being arranged flush with the outer surface of the third layer 10.

Because of the low bulk density the first layer 8 of the insulation element 3 has characteristics which allow to equalize unevenness of the facade 2 as can be seen in Fig. 2 to 4 by examples. Fig. 2 shows a protrusion 13 of the façade, like e.g. a concrete ridge, which is equalized by the first layer 8 in that the first layer 8 is compressed in the area of the protrusion 13.

Fig. 3 shows an offset 14 of the facade 2 which is equalized by the first layer 8 of the insulation element 3 in that the first layer 8 is compressed in the area of the part of the offset 14 erecting to the insulation element 3.

Finally, Fig. 4 shows a cable 15 fixed on the facade 2 and being covered by the insulation element 3. As can be seen from Fig. 4 the first layer 8 of the insulation element 3 is compressed in the area of the cable 15.

- 1 insulation system
- 2 facade
- 3 insulation element
- 4 mechanical fastener
- 5 rendering system
- 6 base coat
- 7 finishing coat
- 8 first layer
- 9 second layer
- 10 third layer
- 11 shaft
- 12 plug-plate
- 13 protrusion
- 14 offset
- 15 cable

Claims

1. Insulation system for covering a façade of a building consisting of at least one insulation element, at least one mechanical fastener, which fastener fixes the insulation element to the façade of the building, and a rendering system being arranged on the outer surface of the insulation element whereby

- the insulation element has at least a first and a second layer being connected to each other;

- the first layer being directed to the façade having a bulk density being lower than the bulk density of the second layer;

- at least one layer is made of mineral fibres, especially stone wool fibres and a binding agent, or of cellular plastic, especially expanded polystyrene (EPS) ,

characterized in that

the insulation element (3) has a third layer (10) made of mineral fibres and a binding agent, which third layer (10) has a bulk density being higher than the bulk density of the second layer (9) and which third layer (10) has a high receptiveness and/or adhesion for the rendering system (5) without using any surface primer, coating and/or an additive.

2. Insulation system according to claim 1,

characterized in that the adhesion between the third layer (10) and the rendering system (5) has a bond strength between $0,010 \text{ N/mm}^2$ and $0,080 \text{ N/mm}^2$, especially between $0,010 \text{ N/mm}^2$ and $0,030 \text{ N/mm}^2$, preferably between $0,015 \text{ N/mm}^2$ and $0,025 \text{ N/mm}^2$, for example $0,020 \text{ N/mm}^2$.

3. Insulation system according to claim 1,

characterized in that the third layer (10) has a bulk density of 190 kg/m^3 to 390 kg/m^3 , especially of 250 kg/m^3 to 320 kg/m^3 .

4. Insulation system according to any preceding claim, characterized in that at least the third layer (10) is made of mineral fibres in an amount of 90 to 99 wt % of the total weight of starting materials in the form of a collected web and a binding agent in an amount of 1 to 10 wt % of the total weight of starting materials, whereby the collected web of mineral fibres is subjected to a disentanglement process, whereby the mineral fibres are suspended in a primary air flow, whereby the mineral fibres are mixed with the binding agent before, during or after the disentanglement process to form a mixture of mineral fibres and binding agent and whereby the mixture of mineral fibres and binding agent is pressed and cured to provide a consolidated composite with a bulk density of 190 kg/m^3 to 390 kg/m^3 , especially of 250 kg/m^3 to 320 kg/m^3 .

5. Insulation system according to claims 1 to 3,

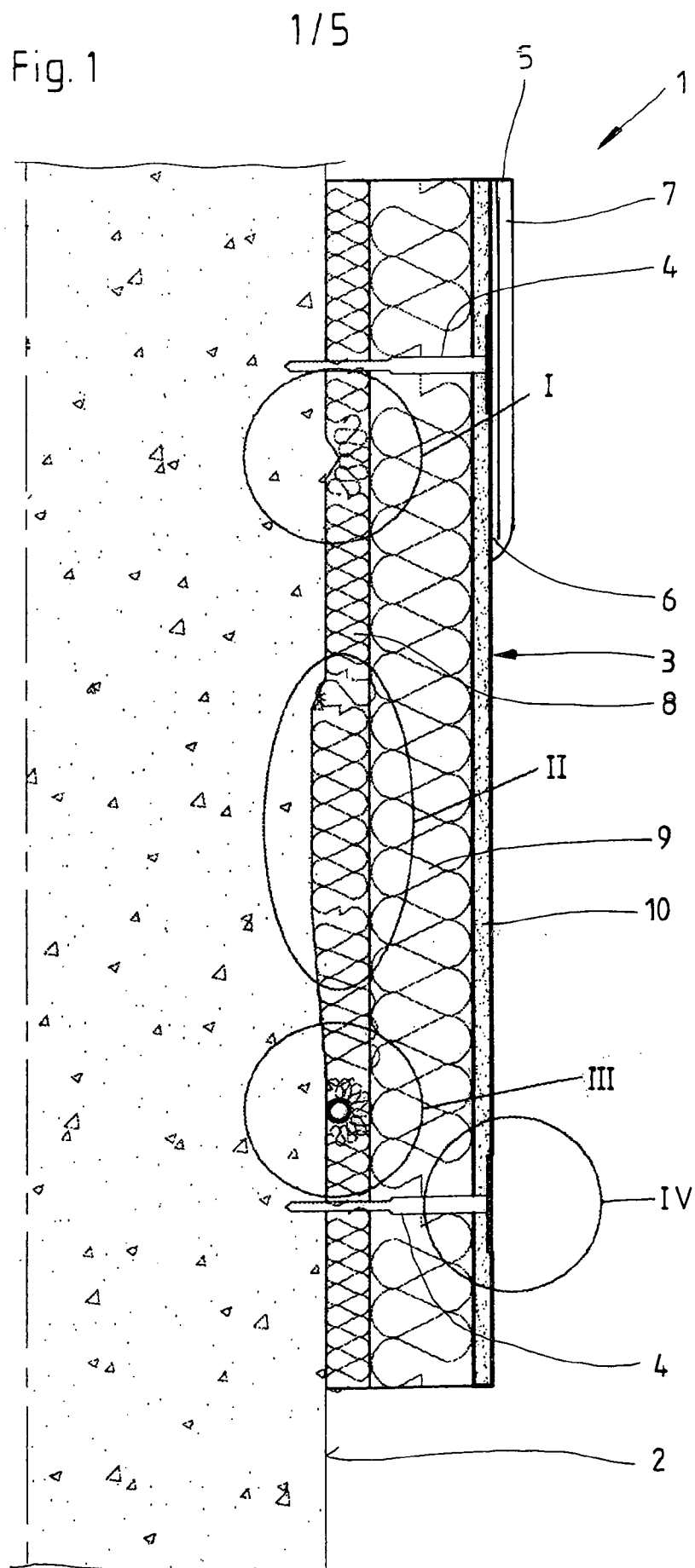
characterized in that at least the third layer (10) is made of mineral fibres in an amount of from 24 to 80 wt % of the total weight of starting materials in the form of a collected web, an aerogel particulate material in an amount of from 10 to 75 wt % of the total weight of starting materials and a binding agent in an amount of from 1 to 30 wt % of the total weight of starting materials, whereby the mineral fibres are suspended in a primary air flow, whereby the aerogel particulate material is suspended in the primary air flow, thereby mixing the aerogel particulate material with the suspended mineral fibres, whereby the mineral fibres are mixed with the binding agent before, during or after the mixing of the aerogel particulate material with the mineral fibres to form a mixture of mineral fibres, aerogel particulate

material and binding agent and whereby the mixture of mineral fibres, aerogel particulate material and binding agent is pressed and cured to provide a consolidated composite with a bulk density of 190 kg/m^3 to 390 kg/m^3 , especially of 250 kg/m^3 to 320 kg/m^3 .

6. Insulation system according to any preceding claim wherein the first layer (8) of the insulation element has a bulk density of from 30 kg/m^3 to 55 kg/m^3 , especially of 45 kg/m^3 .
7. Insulation system according to any preceding claim wherein the second layer (9) of the insulation element (3) has a bulk density of from 60 kg/m^3 to 85 kg/m^3 , especially of 75 kg/m^3 .
8. Insulation system according to any preceding claim wherein the mechanical fastener (4) has a screw like shaft (11) and a plug and/or a plug plate (12), which plug and/or plug plate (12) is arranged in the third layer (10) of the insulation element (3) in that the plug and/or plug plate (12) is flush with the outer surface of the third layer (10) of the insulation element (3).
9. Insulation system according to any preceding claim wherein the third layer (10) of the insulation element (3) is fixed, especially glued to the second layer (9) of the insulation element (3).
10. Insulation system according to any preceding claim wherein the insulation element (3) is fixed to the facade (2) by at least one mechanical fastener (4) per square

meter of the insulation element (3).

11. Insulation system according to any preceding claim wherein the binding agent of the third layer is a dry binder, especially a powdery binder, e.g. phenol formaldehyde binder, phenol urea formaldehyde binder, melamine formaldehyde binder, condensation resins, acrylates and/or other latex compositions, epoxy polymers, sodium silicate, hotmelts of polyurethane, polyethylene, polypropylene and/or polytetrafluorethylene polymers.
12. Insulation system according to any preceding claim wherein the rendering system (5) is a multi-layer system containing at least a base coat (6) and a finishing coat (7).
13. Insulation system according to any preceding claim, whereby the second layer (9) has fibres being substantially oriented parallel to the surfaces of the second layer (9) which are connected to the first layer (8) and third layer (10).



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Fig. 2

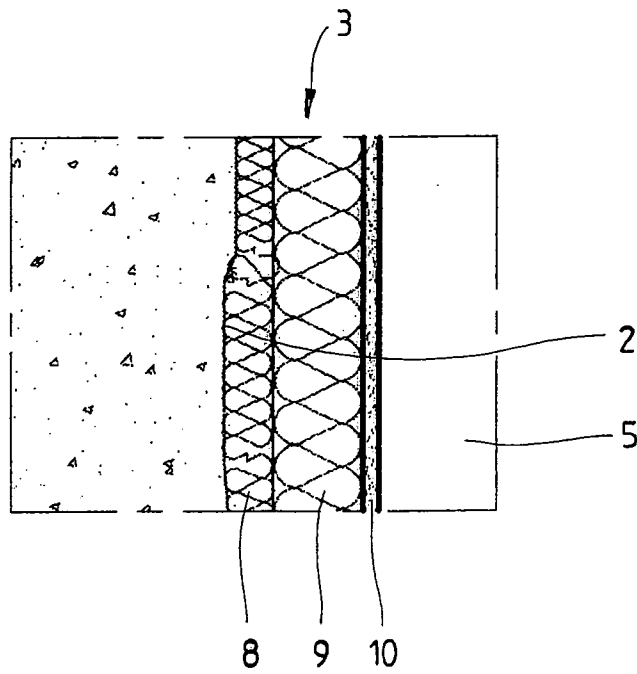
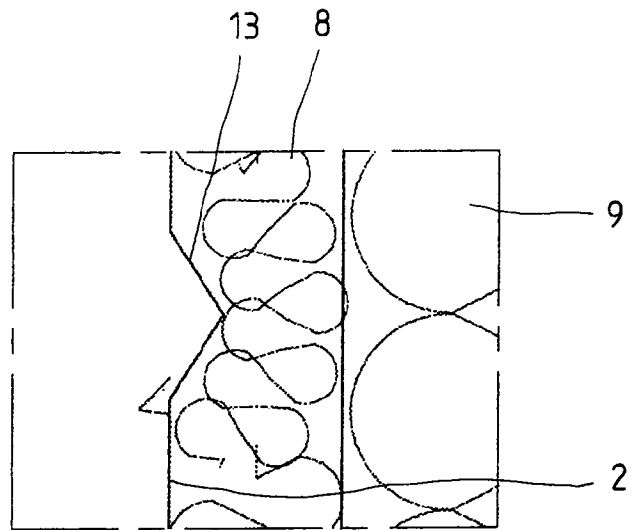


Fig. 3

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Fig. 4

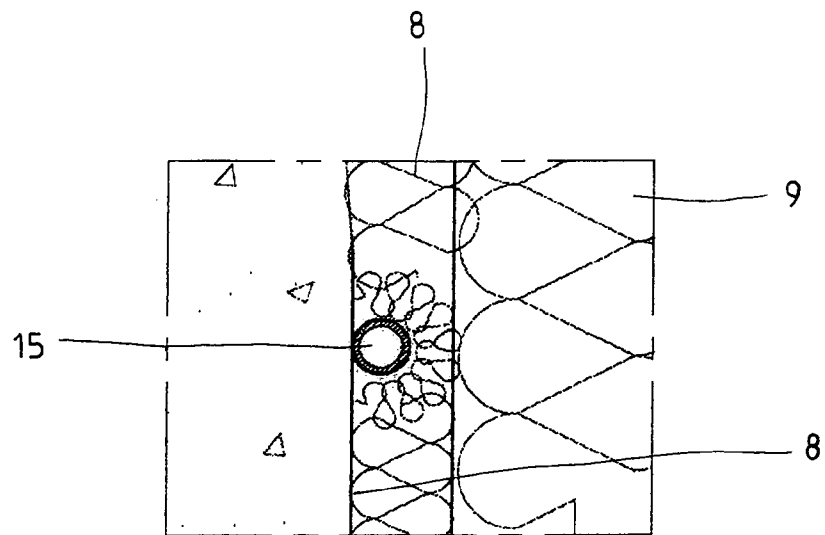
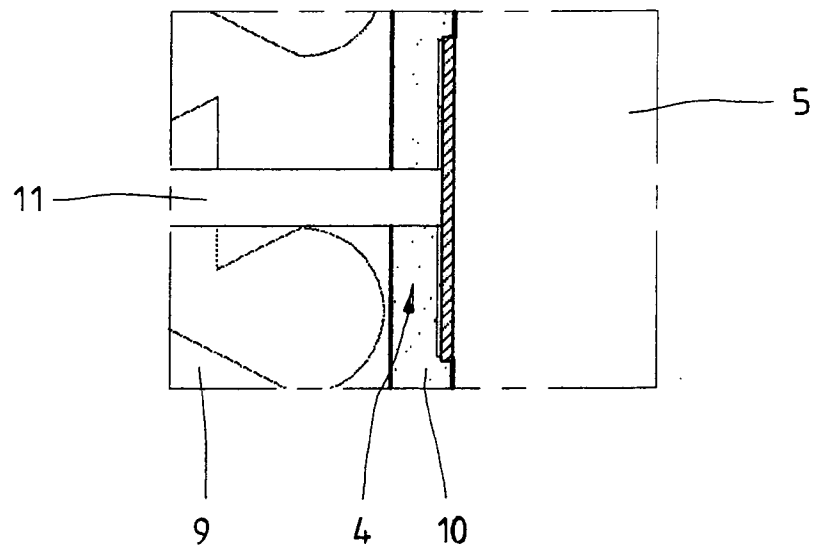
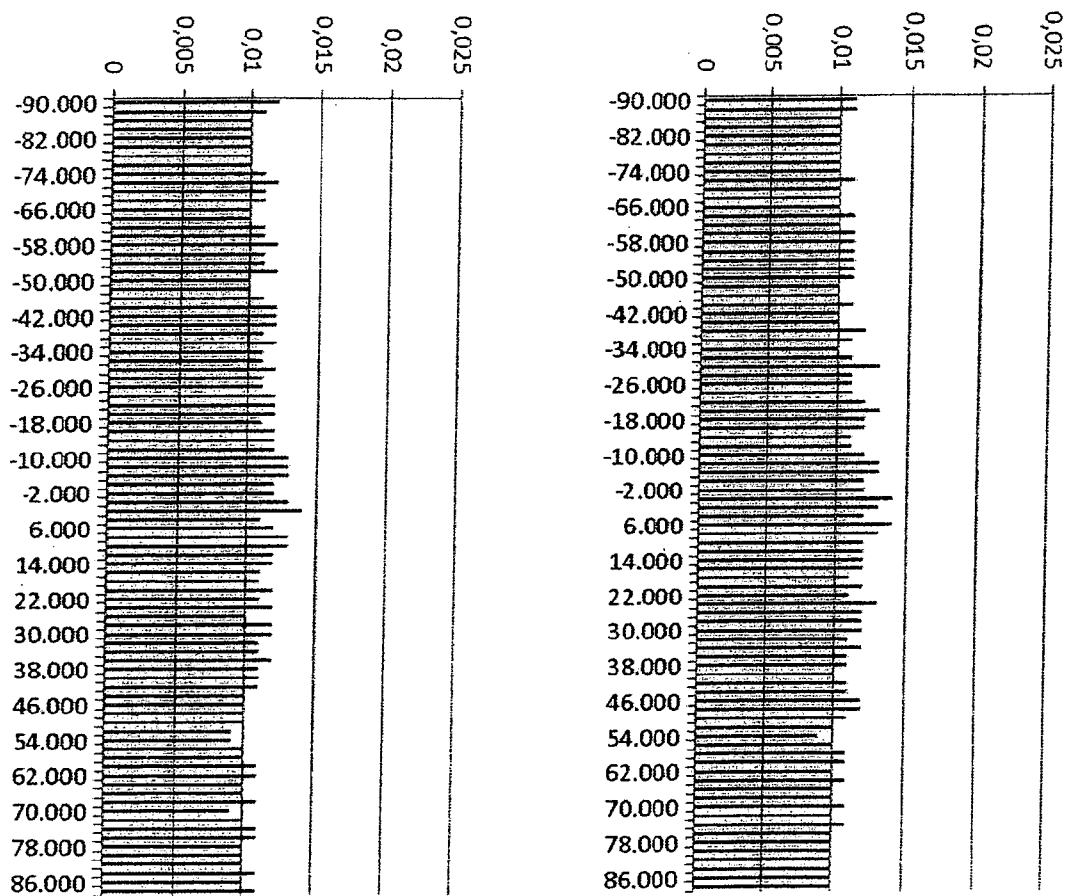


Fig. 5



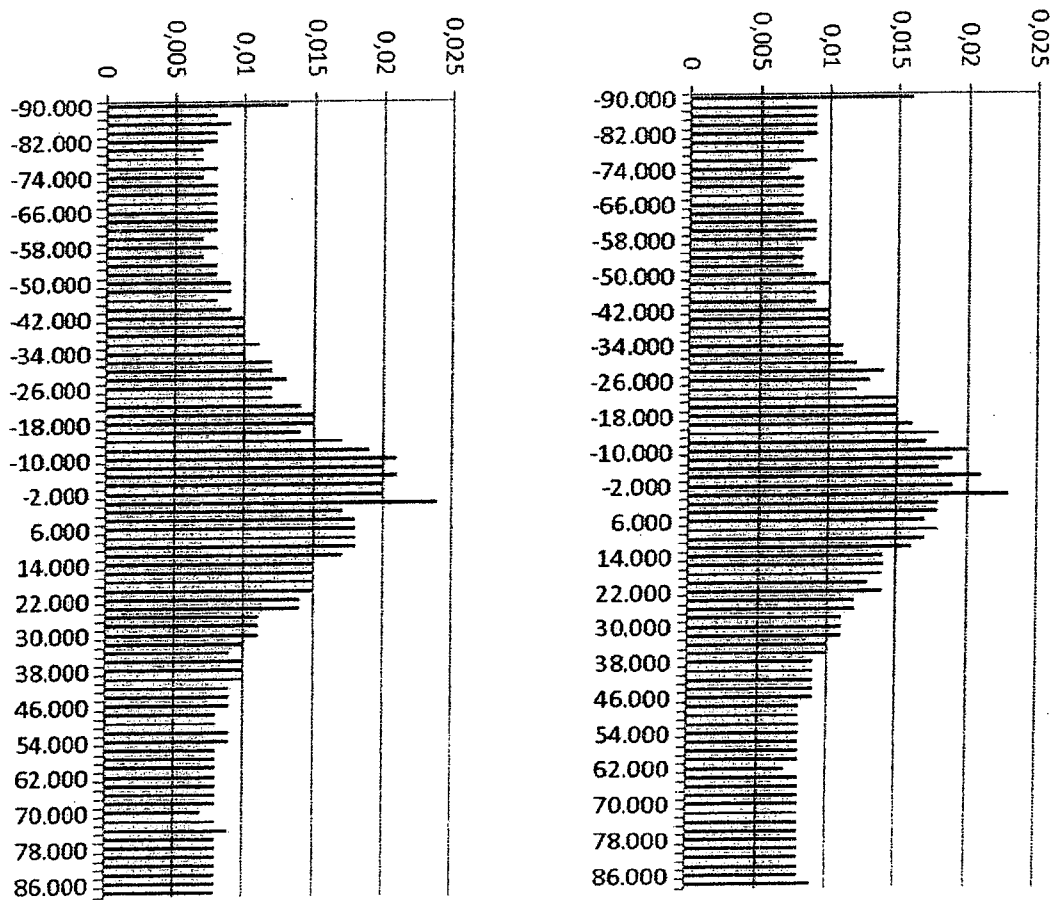
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Fig. 6



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Fig. 7



INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2012/000430

A. CLASSIFICATION OF SUBJECT MATTER
 INV. E04B1/76
 ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
 E04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 2 180 104 A1 (ROCKWOOL INT [DK]) 28 April 2010 (2010-04-28) paragraph [0046] - paragraph [0123]; figures 1-6	1-13
A	----- EP 1 219 755 A2 (SAINT GOBAIN ISOVER G & H AG [DE]) 3 July 2002 (2002-07-03) paragraph [0001] - paragraph [0039]; figure 2	1-13
A	----- EP 2 112 293 A1 (MURJAHN AMPHIBOLIN WERKE [DE]) 28 October 2009 (2009-10-28) paragraph [0001] - paragraph [0027]; figure 2	1-13



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

3 May 2012

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Lopes, Claudia

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2012/000430

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