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(54) Integrated system of insulation, ventilation and fixing for a roof

(57) Integrated system (10) of insulation, ventilation and fixing for a roof (20) which, between the load-bearing structure (200) and the roof covering (210), has at least one base layer (100); wherein said base layer is a plasterboard panel, glued to the insulating panel (110), in such a way as to provide stability and stiffness to this composite making the laying fast and practical; an insulating panel (110) with symmetrical "L"-shaped lateral rabbeting (112) to form a "U"-shaped groove on the edge of connection of adjacent panels, with rabbetings parallel to the gutter line; a first omega-shaped metal element (120), integrated between the rabbeting, facing downwards to join the structure with through-screws (123) from its inside at the same time fixing adjacent panels; an insulating filling element (130) and sealing butylic tape (131); a second omega-shaped metal element (140), of ventilation, facing upwards; a possible closing layer (150), for the support of the roof covering.

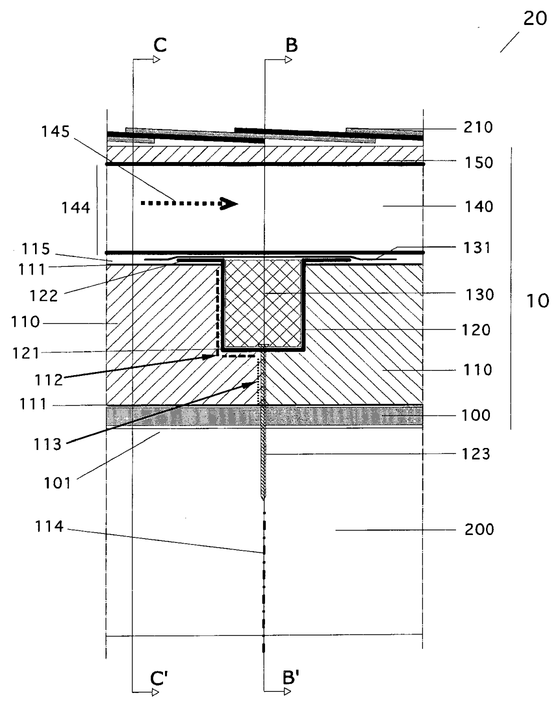

Fig. 1

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Description

[0001] The present invention relates to an integrated system of insulation, ventilation and fixing for a roof; furthermore, the present invention also relates to a building roof comprising said system.

Field of the invention

[0002] The invention finds specific application in the field of production of semi-finished components for building. The invention relates to the multi-layer and multi-function package, which is mounted between the load-bearing structure of the roof and the waterproofing roof covering, for thermal insulation, ventilation and support. In particular, a specific solution for a slanting roof is described which comprises laterally rabbeted insulating panels on which a double crossed framework of omega-shaped metal sections is integrated, said solution also being suitable for vertical walls of the ventilated type.

[0003] In principle, it is widely known that a suitable insulation is essential to make a roofing that reduces heat loss, produces significant operational saving, obtains considerable advantages in terms of living comfort and also performs a valid function of protection of the load-bearing structure. Generally, by the term insulation one means a layer of material having the main function of thermal insulation; often, in addition to this function there is also the noise reduction function for the purpose of obtaining an insulation of the thermal-acoustic type. The effectiveness of such insulation depends mainly on the characteristics of the material used, on the thicknesses used and also on the specific configuration of realization of the roof package. Nowadays, several insulating materials with high thermal and acoustic performances are available on the market, being supplied in various formats such as plates or rolls, and also of different thicknesses; however, it has been found that the known and conventional configurations of said roof package are improvable in many aspects such as, for example, the weight, the overall thickness, the cost, the thermo-hygrometric effectiveness in the various seasons and also the simple assembly.

[0004] In more detail, in the field of insulated roofings the solutions of the unventilated type, otherwise called hot roof, or the more modern solutions comprising a ventilation chamber, also called ventilated roof, are traditionally widely used. Said hot roof solutions substantially provide a layer of insulating material directly mounted on the load-bearing structure, for example the wooden beams of a slanting roof, then placing on it a waterproofing sheath which will thus be placed under the roofing, in direct contact. It has been widely demonstrated that such solutions of the unventilated type, although varying in the type of materials and in the thicknesses, can cause problems of the thermo-hygrometric type not ensuring the necessary migration of humidity outwards through said roof package. In fact, it is known that the excessive accumulation of humidity in the internal layers of the roof leads to a deterioration of the thermal insulating function of the insulation and also to the consequent formation of heat bridges, thus the formation of condensate and moulds also visible on the ceiling. Generally, for the purpose of limiting such problems, one inserts upstream of the ceiling, or under the insulating layer, a barrier to steam.

[0005] As an alternative, for the purpose of effectively solving the problems of the thermo-hygrometric type, nowadays one prefers to adopt said ventilated roof solution that, with an equal size of the insulation, provides significant advantages with respect to a similar hot roof made as described above. In more detail, a ventilated roof provides a space for air that flows from the bottom upwards on the whole pitch, between the insulating layer and the boarding that supports the roofing, being suitably sized according to the flow provided; said air space, also called ventilation chamber, therefore has suitable openings both on the lower level, corresponding to the gutter, and on the upper level, corresponding to the ridge, in such a way as to allow the advantageous crossing of the ascending air motion. In summer, inside said ventilation chamber, the air is heated by radiating under the roofing and circulates by natural convection, taking away the calories which otherwise would enter the garret; furthermore, such a ventilated solution is advantageous in winter as well as the humidity that transpires through the insulation is expelled by means of said ventilation chamber. For example, see the experimental results that are dealt with in the Italian publication entitled "Analisi parametrica del comportamento energetico di coperture ventilate in Italia", by the authors L. Danza and F. Salamone, of the C.N.R. Istituto per le Tecnologie della Costruzione.

[0006] Recently, the need to significantly reduce the energy consumption of the buildings and the consequent increased attention towards thermo-hygrometric comfort in the houses and towards new insulation solutions have led to an evolution in construction systems, which has also been favoured by the new building regulations. In particular, the firms operating in the building sector have proposed innovative roof stratigraphies with increasingly growing thicknesses; for example, solutions of high thermo-hygrometric performance ventilated roofs are known that provide stratigraphies comprising a thermal-insulating layer with a thickness up to 20 cm, the insulating material having a thermal conductivity of 0.032 W/mK, and a ventilation chamber having a thickness of at least 6 cm.

[0007] Furthermore, we remind that in the non-ventilated configurations in the presence of structures of the light type, for the purpose of preventing an excessive summer overheating of the structural elements, one prefers the insulating materials having a greater density with respect to the materials of the conventional type, as they are able to weaken and dephase the incoming thermal wave. Such a solution, however, imposes the use of insulating materials having higher conductivity

(0.038-0.040 W/mK), that is to say, less thermally insulating, being therefore necessary to increase the thickness of the insulating layer only up to 25 cm, with greater overall dimensions, greater weights and greater costs.

[0008] Considering all this, it is widely advantageous in tilted roofs to adopt a solution comprising a ventilation chamber with respect to the traditional hot roof solutions. In more detail, in the state of the art ventilation chambers are widely known which are made with small wooden splines fixed in a parallel way on the insulating layer, in the direction of maximum inclination, in adherence, in the form of spacers; generally, on such small splines a boarding is made for supporting the roofing or one fixes orthogonally on said splines a second framework of small wooden splines having a distance between centres selected according to the shingles, or tiles, to be supported. As an alternative, in the case of low-thickness insulations and to increase the solidity of the fixing, solutions of ventilation chambers are known with splines having an increased section, which are fixed directly to the load-bearing structure of the roof, in the direction of maximum inclination and above a supporting boarding, the insulating material being placed on said boarding between one spline and the other.

[0009] The most used insulating materials are, nowadays, the foamed polymers having a high thermal resistance, in a rigid form in the shape of plates of different thicknesses also coupled on both faces with a protection layer; for example, one should remember the panels of foamed polystyrene or of polyurethane foam coupled on the upper part and/or on the lower part with aluminium sheets, particular membranes or additional layers. As an alternative, insulating materials of natural origin are available, such as cork or mineral wools. In particular, one should remember the widespread configurations of panels of foamed polymer characterised by "L"-shaped, or male-female, side edges, in such a way as to couple in an interlocked way with the adjacent panel, partially overlapping to facilitate fixing, allow for thermal expansions and ensure greater insulation continuity; such a lateral shaping is generally called rabbeting.

Prior art

[0010] Recently, the companies that produce semi-finished components for building have marketed various evolved solutions of insulation and ventilation for tilted roofs or ventilated walls, which are produced industrially to comply with the thermo-hygrometric parameters provided by the regulations in force and also to facilitate the operations of installation. Some solutions, in particular, provide the integration of various functions such as insulation, ventilation and the direct fixing of the roofing, or individually improve some aspects such as the elimination of the heat bridges or the direct assembly of the shingles or the simplified housing of the splines. For example, see the solutions of insulating panels for a roof with rabbeted joint edge that also integrate in correspondence of the connection a transverse holed spline of closing, support and microventilation, marketed by some Italian companies, among which, we mention for example Venest spa, Ramon di Loria, www.venest.it, product Teknoroof, Brianza Plastica Spa Carate Brianza (MB) (www.brianzaplastica.it) under the names Isotec® and Xroof; moreover, there is the solution as in FR2571764 (Toulemonde) that provides a particular upside down "T" metal element also with a turned-up and perforated wing in such a way as to be inserted laterally between two adjacent panels, provided with thin side grooves, protruding upwards to support the roofing, spacing it. Still for example, also see the solution of fixing between the insulating panels with elongated brackets and perforated sections as in EP0653528 (Decker). Among the improved ventilation solutions also see the system with shaped panels in such a way as to house the splines as in US8769894 (Power et al.), or the system with rabbeted and laterally overlapped panels as in EP0953693 (Padovan) with a double framework of splines fixed in a simplified way; furthermore, there is the fixing solution as in DE29902930 (D. P. Corning) where a supporting profile is embedded in the thickness of the panel to fix to it the supporting orthogonal sections. Among the improved fixing solutions, see the solution proposed in US3667180 (Tischuk) with rigid and coated insulating panels, provided with rabbeted and "L"-shaped joint side edge to enable the fixing with a reduced thickness of material and also with the overlapping of the corresponding rabbeting of the adjacent panel, to eliminate the heat bridges and hide the head of the screw; moreover see the improved fixing between one panel and the other as in DE20216879 (ThyssenKrupp) being shaped laterally in such a way as to enable its connection and closing with a continuous upper guide.

[0011] For the purpose of determining the prior art relative to the proposed solution, with specific reference to said roof packages for tilted layers and by analogy also to the vertical walls of the ventilated type, a conventional check has been carried out, searching public archives, which has led to find some priority documents, set out below:

D1: JPH09170317 (Watanabe)
D2: EP0685612 (Proeckl)
D3: DE3622648 (Imhoff)
D4: X-wall™ (www.brianzaplastica.it)
D5: EP0959189 (Schlott)
D6: US8621810 (Glancy et al.)
D7: WO2014055725 (Glancy)

[0012] D1 describes a ventilation system for tilted roofs with metal stanchions fixed to the load-bearing structure between one panel and the other, of the omega-shaped type with the hollow facing downwards, being protruding from the thickness of the panels in such a way as to space out the roofing and also being provided with holes to facilitate the crossing of air.

[0013] D2 preposes an anchorage system of the insulating panels made up of a "U"-shaped element with the two ends embedded in the thickness, joined to the load-bearing structure with fastening elements that cross the entire thickness of the insulating material, and intended to support the sections that support the roofing.

[0014] D3 describes insulating panels with the edge inserted in particular sections with a central hollow to integrate fixing brackets, being provided with lower anchorage tongues to be anchored in said hollow between two coupled profiles, in correspondence of the connection between adjacent panels, and also provided with an upper tongue for supporting the perforated omega-shaped sections of support and ventilation of the roof covering.

[0015] D4 proposes an integrated solution of insulation and ventilation for external vertical walls, marketed by the Italian company Brianza Plastica Spa Carate Brianza (MB) (www.brianzaplastica.it) under the name X-wall™, which provides shaped interlocking panels also with a metal guide embedded in the thickness of each panel, in the shape of a track, for the purpose of fixing in a sliding way, by means of hammer head screws, a plurality of supporting squares for the "T"-shaped vertical metal stanchions on which the external coating is fixed, acting as spacers.

[0016] D5 describes insulating panels with the edge rabbeted in a complementary way on the two opposite sides and provided with a thin groove in such a way as to house an element that is fixed in adherence, with screws, to the load-bearing structure; said element enables the interlocking and the reciprocal connection of two adjacent panels without heat bridges, having an overall thickness smaller than the thickness of the panel to be covered by the protruding part of the rabbeting of said adjacent panel that is mounted as an interlocking after said fixing. On the upper extrados said panels have continuous elements embedded in the thickness and arranged in a zigzag manner for the purpose of fixing in the most appropriate position the perforated sections of support and ventilation of the roof covering.

[0017] D6 and D7 propose an integrated system of insulation, ventilation and fixing for ventilated walls of the continuous façade type, comprising rabbeted insulating panels with a double framework of metal sections; the panels provide an interlocking rabbeting of the complementary type on the two opposite sides, where on one side the edge has the thickness depressed to house the wing of a continuous "Z"-shaped element of fixing with screws to the load-bearing structure through the remaining thickness of the panel, and wherein on the other side the rabbeting protrudes realizing the overlapping once drawn near. In D6 said "Z"-shaped profile is increased to vertically come out of the connection between the panels, spacing the omega-shaped sections that are fixed to it vertically, and to support the external coating such as a corrugated sheet; in D7 said "Z"-shaped profile does not exit the extrados of the panels, remaining coplanar once adjacent, being horizontally mounted to support and fix vertically the omega-shaped supporting sections of the external coating.

[0018] It is therefore reasonable to consider as known the solutions of insulation, ventilation and fixing, for tilted roofs and/or ventilated walls, which comprise:

- rigid insulating panels with lateral rabbeting of the interlocking type with complementary profile of the two opposite edges for the purpose of realizing the fixing with overlapping and also to limit the heat bridge;
- rabbeted interlocking and coated insulating panels that integrate above the connection edge perforated elements of connection, arranged parallel to the gutter line, for the support and microventilation of the roof covering;
- insulating panels with opposite edges inserted in side metal sections of stiffening and fixing, equal to each other, able to couple to each other symmetrically housing metal brackets with tongues, for the fixing and the raising of the upper framework that is of perforated omega-shaped metal sections; double framework of wooden splines, such as the conventional squared-section splines, where the first framework is between the panels, of equal thickness, or is above the panels, the second framework being fixed orthogonally above the first to make the ventilation chamber and support the roof covering with a suitable distance between centres;
- a first wooden boarding at the intrados of the insulating panels, above the load-bearing structure, and also a second wooden boarding above said second framework, or under the roof covering;
- a single framework of metal sections fixed to the load-bearing structure with a greater height with respect to the insulating panels, which are of a limited thickness, to realize a ventilation chamber above the extrados of the insulating layer, being perforated to facilitate the passage of air;
- a single framework of metal sections fixed to the load-bearing structure with a lower height with respect to the insulating panels, which are rabbeted and laterally grooved to facilitate the assembly with interlocking in said sections and which also incorporate in the extrados splines intended to screw further sections for the support and ventilation of the roof covering;
- a double framework of metal sections, where a first framework is fixed to the load-bearing structure in such a way as to constrain the panels and also to support a second framework, which is orthogonal with respect to the first, to realize said ventilation chamber under the roof covering;
- a double framework of metal sections for roofs, where the first framework is of "U"-shaped sections having the two ends embedded in the panel, with screws that cross the entire thickness;

- a double framework of metal sections for ventilated walls, where the first framework is of omega-shaped sections embedded in the single panel in the form of a lane for the purpose of anchoring to it the hammer head screws that fix a plurality of metal brackets which are intended to support the second framework, like spacers, being realized with "T"-shaped sections;
- a double framework of metal sections for ventilated walls, where the first framework is of "Z"-shaped sections inserted in connection between one panel and the other, following said interlocking rabbeting profile of the single panel for the purpose of fixing it with screws and allowing said overlapping, resulting continuous and coplanar to the extrados of the panels or raised to facilitate ventilation, and wherein the second framework is of omega-shaped sections.

Drawbacks

[0019] Generally, it is widely known to the operators of the building sector that in the traditional solutions for insulating roofs the use of thermal insulating materials with high conductivity and high thickness leads to a considerable increase in the overall weight and thickness of the whole construction system of the roof. Consequently to this problem, the need to adopt thicknesses and high heights of the sheet metals, for example of copper, is particularly disadvantageous with huge additional costs of the material and of the installation, as well as considerable difficulties in the management of all the inserts provided on the roof for the purpose of fixing.

[0020] It is also known that the greater the thickness of the stratigraphy of the roof the greater are the possibilities to create heat and sound bridges in the insertion of each window - body.

[0021] Moreover, the known solutions with high insulating power for fixing in an effective way to the load-bearing beams the insulating panels of great thickness, generally provide the use of screws having such a length and diameter as to yield the load-bearing element, being even more serious in the frequent case of wooden beams.

[0022] In more detail as to the most evolved known solutions of insulation and ventilation, as for example in D1-D7, it has been found that today specific construction systems for tilted roofs, of the industrialized type with semi-finished elements are not available, such as insulating panels and metal sections, which are configured and integrated with each other in such a way as to be highly effective in thermal insulation, in ventilation and also in the fixing of the whole roof package according to the regulations in force. The known construction systems, in particular, are not suffciently effective in the case of limited weights and thicknesses; for example, they do not allow to comply with the current regulations with respect to thermal insulation in the various Italian climatic zones, adopting a package having a weight equal or lower than 40 Kg/m^2 and a thickness equal or lower than 18 cm, between the boardings above the load-bearing structure and under the roof covering.

[0023] Furthermore, it has been found that the known solutions with a double metal framework are problematic in laying; in particular it has been found that also in the improved solutions for vertical ventilated walls, although not specific for said roof package that is to say having different functional requirements but with some structural analogies, there are some difficulties of assembly and handling of the components: for example, see D4 in which there are several supporting brackets for the second framework, with a plurality of sliding fixing elements, and there is also provided the interlocking of the panels on the asymmetrical rabbeting as the fixing track is spaced from the connection, or see D6 and D7 in which an asymmetrical element is provided which is inserted in correspondence of the connection in the form of a framework, being it necessary first to interlock the panel and then to fix the element to the load-bearing structure, with possible errors of positioning and alignment and also with a connection where only one edge of the panel is steadily fixed to the load-bearing structure while the other is only interlocked. Furthermore, it can be observed that in D4 and D7 the first framework is of the discontinuous type and also that in D6 the second framework is horizontal and does not realize a real ventilation chamber but only an air space, the ventilation function being performed by the first framework that exits the extrados of the panels.

[0024] An aim of the present invention is also to avoid the above-mentioned drawbacks.

Summary of the invention

[0025] This and other aims are achieved by the present invention according to the characteristics as in the appended claims, solving the mentioned problems by means of an integrated system (10) of insulation, ventilation and fixing for a roof (20) that, between the load-bearing structure (200) and the roof covering (210), includes at least:

- a base layer (100), wherein said base layer is a plasterboard panel, glued to the insulating panel (110), in such a way as to provide stability and stiffness to this composite making the laying fast and practical;
- an insulating panel (110) with lateral rabbeting (112) in the shape of a symmetrical "L" to form a "U" groove on the connection edge of adjacent panels, with rabbetings parallel to the gutter line;
- a first omega-shaped metal element (120), integrated between the rabbetings, facing downwards to join the structure with through-screws (123) from its inside at the same time fixing adjacent panels;
- an insulating filling element (130) and sealing butylic tape (131);
- a second omega-shaped metal element (140), of ventilation, facing upwards;

- a possible closing layer (150), for the support of the roof covering.

Aims

[0026] In this way, by the considerable creative contribution the effect of which constitutes an immediate technical progress, various advantages are achieved.

[0027] A first aim consists in reducing the overall weight and thickness of said roof insulation and ventilation package, the thermal insulating panels and the relative fixing system being included inside a stratigraphy made up of multiple elements which synergically contribute to obtaining a highly performing integrated system with respect to the reaction to fire, to thermal insulation both in winter and in summer and to sound-proofing, and also with respect to seismic resistance.

[0028] A second aim consists in fixing in an effective way insulating panels having a great thickness to the load-bearing beams, using screws of reduced length and diameter so as not to yield the load-bearing element, said aim being particularly important in the case of wooden beams. Such a solution is a considerable advantage with respect to the conventional systems having screws that cross the entire thickness of the insulating panel and that therefore must be sized to bear bending moment efforts that are directly proportional to the length of the screw.

[0029] A third aim consists in solving the known executive problems connected with the complexity and the time necessary for the assembly of the whole insulation and ventilation package; in particular, one aims at considerably facilitating the laying operations providing a limited number of operations and also using elements of the symmetrical type, such as the metal sections of the first and second panels or the insulating panels with symmetrical rabbeting without interlocking, which can be positioned rapidly in an intuitive way.

[0030] A fourth aim consists in reducing the overall costs, also reducing the height of the sheet metal elements, as well as from the internal side and particularly for the use of plasterboard panels, to provide a valuable aspect equal to a finishing.

[0031] A fifth aim consists in reducing the impact of the heat and sound bridges, with particular reference to the openings of the roof such as windows and chimneys.

[0032] These and other advantages will appear from the following detailed description of a preferred solution with the aid of the enclosed schematic drawings whose details are not to be considered limitative but only illustrative.

Content of the drawings

[0033]

Figure 1 shows a schematic vertical section of a roof comprising the integrated system of insulation, ventilation and fixing provided by the invention, being made on the section plane A-A' as in Fig. 2, that is to say, transversely with respect to the first metal framework placed parallel to the gutter line;

Figure 2 shows a schematic vertical section of a roof comprising said integrated system, being made on the section plane B-B' as in Fig. 1, that is to say, longitudinally with respect to the first metal framework and transversely with respect to the second metal framework;

Figure 3 shows a schematic vertical section of a roof comprising said integrated system, being made on the section plane C-C' as in Fig. 1, that is to say, in correspondence of the load-bearing beam and second metal framework, of ventilation, arranged in the direction of maximum inclination.

Practical realization of the object of the invention

[0034] Also with reference to the figures (Fig. 1-3), the integrated system (10) of insulation, ventilation and fixing for a roof (20) mainly provides that, between the load-bearing structure (200) and the roof covering (210), a homogenous layer of panels of insulating material (110) of great thickness is fixed in an effective way to the load-bearing beams through a hollow created laterally and symmetrically on each panel, in the form of an "L"-shaped rabbeting, using screws of limited length and diameter so as not to yield the load-bearing element. In particular, the placing side-by-side of two adjacent panels forms a "U"-shaped groove, in the form of an upwardly opened channel, which allows to integrate in the thickness and without heat bridges a first metal element (120) having an omega-shaped section with the head facing downwards.

[0035] Such a metal element (120), repeated for each parallel groove with constant pitch, forms a first metal framework that is placed parallel to the gutter line of the roof and is steadily fixed to the load-bearing beams also locking at the same time, along the whole rabbeted edge, the pair of adjacent panels (Fig. 1). Said framework is substantially inserted in the thickness of the panel by the extrados (115), except for the tongues of said metal element (120) that press in adherence from the extrados and act as a wide and continuous support for a second metal framework that is fixed on the upper part to form an effective ventilation chamber (144). Once fixed, therefore, said metal elements (120) are filled from above with insulating elements (130) in the whole free volume for the purpose of ensuring substantially homogenous thermal and hygrometric performances on the whole surface of the roof. Once insulated, said metal element is sealed with butylic tape (131) in such a way that the extrados surface (115) becomes completely waterproof. Furthermore, further second metal elements (140) having an omega-shaped section with the head facing upwards, are orthogonally fixed in adherence, on said first metal elements (120) in the direction of maximum inclination of the roof or according to the ventilation flow (145) towards the ridge. On such sections, one therefore fixes the boarding that supports the roof covering (210) which acts as a roof waterproofing and which, preferably but not exclusively, is of the thin multilayer and continuous type with Canadian tiles (Fig. 2.3).

[0036] In more detail with reference to the insulating panels (110), it is provided that each insulating panel (110) has at the extrados (115), symmetrically in correspondence of two opposite longitudinal edges (113), a rabbeting (112) in the form of an "L"-shaped hollow that locally reduces the thickness of the panel in such a way as to obtain, once the panels have been drawn near in adherence on the edge of contact (113), that is to say, in correspondence of the plane of connection (114), a rectilinear and continuous groove having a "U" section open upwards, in the form of a channel; said "U" groove, being therefore formed by said "L"-shaped rabbetings (112) which are frontally opposite and symmetrically mirrored with respect to the plane of connection (114). Such a solution allows to house in said groove an omega-shaped metal element (120) having sizes substantially corresponding to said hollow, in such a way as to adhere to said rabbetings (112) with the head (121) on the bottom of the hollow and the wings (122) that press on the extrados (115) of the panel (110) from outside, for a distributed fixing along the whole edge of the element (120-2) and at the same time on the double row of adjacent panels (110) (Fig.1).

[0037] The system made up of the rabbeted insulating panel and of the omega-shaped metal element is then fixed on the load-bearing beam (200) by means of threaded screws (123) of limited length, being limited between the inside the head (121) of the omega and the load-bearing beam, holing the edge of connection (113) in correspondence of the "L"-shaped lateral rabbeting (112) and passing through the base layer (100), if present.

[0038] In the preferred embodiment configuration, there are insulating panels (110) made of a rigid foam of a highly thermal-insulating material, being for example of the Polyurethane type, also known by the English acronym PUR, or of the Polyisocyanurate type, also known as PIR or POLYISO, preferably coupled on both faces by a special superficial coating (111) of the protective type, conventionally called facer in the English language, which enables to further reduce thermal conductivity with respect to the traditional insulating materials and which is also impermeable to gases; said coating (111), being preferably an aluminium sheet or, as an alternative, a synthetic membrane. As a non-exhaustive example particularly suitable for the invention is a panel of the type marketed by the Italian company Venest Spa Ramon of Loria (TV) (www.venest.it), under the name AVF, of the closed-cell rigid foam POLYISO and having an initial thermal conductivity measured according to the reference regulation EN12667 equal to 0.022 W/mK.

[0039] The invention provides that in correspondence of the edge of connection (113) between adjacent panels there is a thickness of the insulating material comprised between 2 cm and 6 cm. Preferably, the invention provides an insulating panel (110) of PUR or PIR having a thickness of 10 cm, being it in fact sufficient to comply with the current legislative restrictions concerning thermal insulation in all the Italian climatic zones. In particular, it is provided that such a panel has said rabbeting (112) having a depth of 6 cm in such a way as to insert in it an omega-shaped metal element (120) having a height of 6 cm, excluding the wings (122); such a configuration therefore provides, under said rabbeting, a remaining thickness of the panel of 4 cm which allows to significantly reduce the sizes of the through-screws (123) of fixing to the load-bearing structure (200), for example the wooden truss of a slanting roof, with also lower bending moment efforts, although maintaining a sufficient insulating layer below said metal sections (120), in correspondence of the edge of connection (113) (Fig. 1).

[0040] In more detail, said screws (123) are sized to pass through 4 cm of insulating material (123), under the rabbeting (112), and through the base panel (100) up to the load-bearing beam (200) and bear the efforts connected to the operation of the whole roof; the diameter and the length of these screws (123) are therefore particularly limited with respect to the conventional solutions because the roof provided by the invention is of the light type and also because the thickness of the insulating material is limited, as described above. For example, it has been advantageously found that in the anchorage on wooden beams (200) screws (123) are sufficient having a length of about 120 mm with a diameter of 6.5 mm; in particular, we remind that in the construction systems of the conventional type and with equal insulating effectiveness there is a length which is at least double of said screws, for the purpose of crossing insulating panels having a thickness of at least 20 cm and with diameters consequently suitable for the efforts. Furthermore this invention provides that, in the case of concrete load-bearing beams, said screws are of a length of about 100 mm with a diameter of 7.5 mm; in the case of a metal load-bearing structure, on the other hand, it is sufficient to have screws of a length of about 80 mm with a diameter of 6.3 mm.

[0041] The invention (10, 20), in the preferred embodiment configuration (Fig. 1-2), provides that said omega-shaped metal elements (120) constituting the first framework are placed and fixed with the through-screws (123), in correspondence of the plane of connection (124) between one panel and the other, having a distance between centres of 120 cm.

[0042] Once fixed, said omega-shaped sections (120) having the hollow facing upwards are filled with a filling element (130) of insulating material, for the purpose of closing all their free volume and ensure a homogenous thermal insulation on the whole surface of the roof; said filling element, being of a thermal-insulating material equivalent to the panels (110), such as said PUR or PIR, in the form of countershaped splines or foam (Fig. 1-2).

[0043] Once insulated, said insulated omega-shaped sections (120, 130) are sealed with a special butylic tape

(131) in such a way that the extrados surface (115) of the whole insulating layer, which is formed by said superficial coating (111) of the type called facer of aluminium, with said butylic tape (131) applied in correspondence of each metal element of the first framework, form a completely waterproof layer and is also homogenous in the shape and in the behaviour; it is observed that advantageously said extrados is substantially coplanar, with only the wings (122) of each metal element (120) of the first framework that protrude from their thickness to facilitate the fixing of the successively superimposed framework.

[0044] On said first omega-shaped metal elements (120) constituting the first framework said second omega-shaped metal elements (140) are fixed in an orthogonal direction with respect to them and directed towards the opposite side, or with the respective wings (122, 142) in adherence to facilitate the support and the fixing with mechanical elements (143), preferably forming a ventilation chamber (144) having a height of 6 cm. On said sections one therefore lays the upper closing layer (150), for example a supporting boarding for a roof covering (210) made up of Canadian tiles. In particular it is observed that such a solution allows to ensure a high thermal-acoustic comfort with an encumbrance of 18 cm of thickness and a weight of preferably 40 kg/m^2, or between 35 kg/m^2 and 40 kg/m^2.

[0045] In the preferred embodiment configuration, said first omega-shaped metal elements (120) are made of galvanized sheet having a thickness of 6/10 mm and a height of 6 cm, while said second omega-shaped metal elements (140) are of a section having a thickness of 10/10 mm and a height of 6 cm.

[0046] Particularly suitable for the invention is a closing layer (150) made of wooden panels with oriented scales of the type called Plywood Osb, the English acronym for oriented strand board, said scales being glued with synthetic resin and pressed in various layers also with crossed orientation for greater resistance; preferably, one uses panels having a thickness of 15 mm and also impregnated with a polyurethane additive having a protective and fire-retardant function.

[0047] Set out below are advantageous examples of the invention (10, 20), being particularly referred to a roof package made on load-bearing beams (200), such as the wooden beams of a pitched roof, placed horizontally.

[0048] Example 1:

- Plasterboard panel (100) of class A1 of reaction to fire;
- Insulating panel (110) of polyurethane of the AVF type with lateral rabbeting (112) in the shape of a symmetrical "L" in the two opposite edges to realize a continuous groove with a "U" section between adjacent panels placed parallel to the gutter line of the roof;
- First omega-shaped metal element (120) having a thickness of 6/10 mm inserted in the rabbeting with the head down;
- Insulating spline (130) of polyurethane of the AVF type for closing the first omega-shaped element;
- Butylic tape (131) applied on the insulated omega-shaped element.
- Second omega-shaped metal element (140) having a thickness of 10/10 mm for the ventilation chamber, placed in an orthogonal direction with respect to the first omega-shaped element and with the head up.
- Plywood - Osb Panel (150) having a thickness of 15 mm;
- Continuous and multilayer roof covering (300), of the type called Canadian tile.

[0049] The tests carried out according to the current European regulations on such a roof stratigraphy have evidenced that it is particularly advantageous both in applicative terms, having a weight of 40 kg/m^2 (or from 35 kg/m^2 to 40 kg/m^2) and a thickness of 18 cm, and in terms of thermal-acoustic performance, and also of performance with respect to the reaction to fire. In more detail of the results obtained, a package made as described above obtains an average U-value of 0.217 W/m2K, an average periodic U-value lower than 0.2 W/m2K, and also passes all the checks to be done for condensation, said tests being performed in the most restrictive conditions provided by the check systems. Furthermore, said package obtains an average value of soundproofing of 41 dB, and also obtains a fire reaction class of B - s1 - d0 from the internal side and of B - roof - t1 from the external side. As an alternative, the solution as in Example 1 can have the plasterboard panel (100) that is of the type in class A2 of reaction to fire, of the single layer type or even double layer type, for a thickness of at least 15 mm.

Example 2:

[0050] In a second example, said Plywood panel (150), of the Osb type, is impregnated with a polyurethane additive having a protective and fire-retardant function in such a way as to allow to resist to flame resistance tests for at least 5 minutes. Example 3:

[0051] In a third example, said plasterboard panel (100) of class A1 is coupled to the insulating panel (110) through the use of a polyurethane glue, for example of the type marketed by the Italian company Collanti Concorde S.r.l. Vittorio Veneto (TV) (www.collanticoncorde.it) under the name of Protopur AE100, alternatively by means of the use of a vinylic glue, for example of the type marketed by the company Pigal S.p.A. Crespellano (BO) (www.pigal.it) under the name of VINIL 303.

Example 4:

[0052] In a fourth example, said plasterboard panel (100) of class A1 is installed in place in a double layer, in such a way that said soundproofing power in place increases by two more decibels.

Example 5:

[0053] In a fifth example, should a particular fire reaction class from inside not be required, said integrated system (10) can include a base layer (100) made up of decorative panels, such as a wooden boarding of machined plates or matchboards with the aesthetically valuable exposed face (101), instead of said plasterboard panels; with respect to said first example, the values obtained in the thermo-hygrometric tests remain equivalent.

Example 6:

[0054] In a sixth example, should it not be necessary to finish the roof towards the inside in an aesthetically agreeable way, said integrated system (10) can be without said first base layer (100).

[0055] Furthermore, it is observed that all the above-described stratigraphies can be refined towards the outside with a closing layer (150) of Plywood of a smaller thickness, if suitable to support the overlying weight, or with tile-holding stingers combined with a technology of discontinuous covering of the traditional type such as earthenware tiles or cement shingles.

[0056] In case of particular fire resistance needs or high acoustic standards, as for example in schools, between the beams of the load-bearing structure (200) under said base layer (100) one can easily integrate an additional functional layer, for example made up of a cased plasterboard structure with mineral wools, in the form of a false ceiling.

Reference

[0057]

(10) integrated system of insulation, ventilation and fixing for a roof;
(100) base layer, for the support of the insulating panels;
(101) exposed face;
(110) insulating panel;
(111) superficial protective coating of the type called facer;
(112) "L"-shaped lateral rabbeting;
(113) lateral edge of connection of the panels;
(114) plane of connection between adjacent panels;
(115) panel extrados;
(120) first omega-shaped metal element, constituting a first framework;
(121) head of the first omega-shaped element;
(122) wing of the first omega-shaped element;
(123) through-screw, of fixing from the inside of the first metal element; (130) filling element of insulating material;
(131) butylic tape;
(140) second omega-shaped metal element, of ventilation, constituting a second framework;
(141) head of the second omega-shaped element;
(142) wing of the second omega-shaped element;
(143) fixing element of the wing;
(144) ventilation chamber;
(145) ventilation flow towards the ridge of the roof;
(150) closing layer, for the support of the roof covering; (20) building roof;
(200) load-bearing structure of the roof;
(210) roof covering.

Claims

1. Integrated system (10) of insulation, ventilation and fixing for a building roof (20), being placed between the load-bearing structure (200) of the roof and the roof covering (210), which includes from the bottom upwards at least:

- a possible base layer, for the support of the insulating panel;
- an insulating panel, provided with a protective layer on the upper and lower faces and also provided with a lateral rabbeting in correspondence of the edge of connection to the adjacent panel;
- a first metal element, partially included in the thickness of the panel and fixed to said load-bearing structure of the roof to form a first framework;
- a second metal element, of ventilation, fixed in adherence on said first element in a way orthogonal to it to form a second framework and to create a ventilation chamber under said roof covering;
- a possible closing layer, for the support of the roof covering (210);

said integrated system (10) being **characterised in that** said insulating panel (110) has at the extrados (115), on two edges opposite to each other, "L"-shaped (112) lateral rabbetings (112) symmetrical to each other in such a way as to obtain, joining them frontally in adherence on the edge of connection (113) between two adjacent insulating panels (110), a rectilinear and continuous groove having a "U" section facing upwards being symmetrical with respect to the plane of connection (114); said "L"-shaped lateral rabbetings (112) having such a depth as to leave under them a thickness of insulating material between 2 cm and 6 cm in correspondence of the edge of connection (113); said "L"-shaped lateral rabbetings (112) being placed in a direction parallel to the gutter line of the roof (20); said first metal element (120) being integrated in said "L"-shaped lateral rabbetings (112) between adjacent insulating panels (110), having an omega-shaped section substantially corresponding to said adjacent rabbetings to be inserted into them in adherence with the head (121) facing downwards and the wings (122) lying outside on said protective layer (111); said first omega-shaped metal element (120) being fixed to said load-bearing structure (200) from inside the head (121), with through-screws (123) on the plane of connection (114) between adjacent insulating panels (110), in such a way as to cross the thickness of the metal and of the insulating material under it in correspondence of said edge of connection (113) and at the same time fixing steadily said contiguous panels also pressing their edge in a continuous and homogenous way by means of said wings (122); and wherein in said first metal element (120) there is a filling element (130) having an insulating and closing function; and wherein on said so insulated metal element (120) a sealant of the butylic tape type (131) is applied; and wherein, in adherence on said butylic tape (131) already applied on said first metal element (120), said second metal element (140) of ventilation is fixed orthogonally to it or in the direction of maximum inclination and has an omega-shaped section with the head (141) facing upwards and the wings (142) facing downwards in such a way as to be mechanically fixed to the underlying wings (122) of said first metal element (120).

2. Integrated system for roofs according to claim 1, **characterised in that** said insulating panel (110) is a plate of a foamed material of the polyurethane type with an aluminium protective coating on the lower and upper faces; and wherein said insulating panel (110) has an overall thickness of 10 cm and a thickness under said rabbeting (112) of 4 cm in correspondence of the edge of contact (113) between adjacent panels; and wherein said first omega-shaped metal element (120) is of a galvanised sheet having a thickness of 6/10 mm and a height of 6 cm; and wherein said omega-shaped second metal element (140) is a section having a thickness of 10/10 mm and a height of 6 cm; and wherein the distance between centres between said omega-shaped metal elements (120) of the first framework is of 120 cm.

3. Integrated system for roofs according to claims 1 and 2, **characterised in that** said base layer (100) is a plasterboard panel, glued to the insulating panel (110), in such a way as to provide stability and stiffness.

4. Building roof (20) that, from the bottom upwards, has a stratigraphy that comprises:

- a load-bearing structure (200), alternatively of the plate continuous type or of the discontinuous type with parallel beams arranged in the direction of maximum inclination, that is to say, orthogonal with respect to the gutter line;
- a base layer (100), supporting the insulating panels (110);
- insulating panels (110), of a rigid foamed material coupled on the upper and lower faces with a protective layer (111), at the extrados (115) provided with an "L"-shaped lateral rabbeting (112) on two opposite edges in such a way as to obtain, on the plane of connection (114) between two adjacent panels, a continuous groove having a "U" section and such a depth as to leave under it a thickness of insulating material between 2 cm and 6 cm in correspondence of the edge of connection (113); said "L"-shaped lateral rabbetings (112) being arranged in a direction parallel to the gutter line of the roof (20) with a constant distance between centres, being determined by the width of the insulating panel (110);
- a first framework made up of first omega-shaped metal elements (120) parallel to each other, inserted in adherence between said rabbetings (112) with the head (121) facing downwards and with the wings (122) up which remain outside and lying on said protective layer (111), said metal elements (120) being fixed with through-screws (123), from inside said head (121) to the underlying load-bearing structure (200);
- a filling element (130) of an insulating material, which closes said omega-shaped metal elements (120);
- butylic tape (131), which seals from the top said insulated omega-shaped metal elements (120);
- a second framework made up of second omega-shaped metal elements (140) parallel to each other, of ventilation, arranged in an orthogonal direction with respect to the said metal elements (120) of the first framework or in the direction of maximum inclination of the roof (20), with the head (141) facing upwards in such a way as to lay and fix its own wings (142) to said underlying wings (122);
- a closing layer (150) supporting the roof covering;
- a waterproofing roof covering (210).

5. Building roof (20) according to claim 4, wherein said insulating panel (110) is a plate of a foamed material of the polyurethane type with an aluminium protective coating on the upper and lower faces; and wherein said insulating panel (110) has an overall thickness of 10 cm and a thickness under said rabbeting (112) of 4 cm in correspondence of the edge of contact (113) between adjacent panels; and wherein said first omega-shaped metal elements (120) are of galvanized sheet having a thickness of 6/10 mm

and a height of 6 cm; and wherein said second omega-shaped metal elements (140) is a section having a thickness of 10/10 mm and a height of 6 cm; and wherein the distance between centres between said omega-shaped metal elements (120) of the first framework is of 120 cm.

6. Building roof (20) according to claims 4 and 5, wherein said base layer (100) is of the protective type of plasterboard panels of the class A1 type of reaction to fire, in a single layer or double layer, for a thickness of at least 15 mm.

7. Building roof (20) according to claims 4 to 5, wherein said base layer (100) is of the protective type of plasterboard panels of the class A2 type of reaction to fire, in a single layer or alternatively in a double layer, for a thickness of at least 15 mm.

8. Building roof (20) according to claims 4 and 5, wherein said base layer (100) is of the decorative type of wooden boarding.

9. Building roof (20) according to claims 4 and 5, wherein said closing layer (150) is of panels of the type called Plywood - Osb also impregnated with a polyurethane or vinyl additive having a protective and fire-retardant function.

10. Building roof (20) according to claims 4 and 5, wherein said roof covering (210) is of the bituminous sheath and/or Canadian tile continuous type.

11. Building roof (20) according to claims 4 and 5, wherein said roof covering (210) is of the discontinuous type with tiles or shingles supported by transverse stringers.

12. Building roof (20) according to claims 4 and 5, wherein said filling element (130) is of a thermal-insulating material equivalent to said panels, in the form of small countershaped splines or foam.

13. Building roof (20) according to claims 4 and 5, wherein between the beams of the load-bearing structure (200) below said base layer (100) an additional functional layer is integrated for the purpose of insulation and/or sound absorption which is made up of a cased plasterboard structure with mineral wools inside it, in the form of a false ceiling.

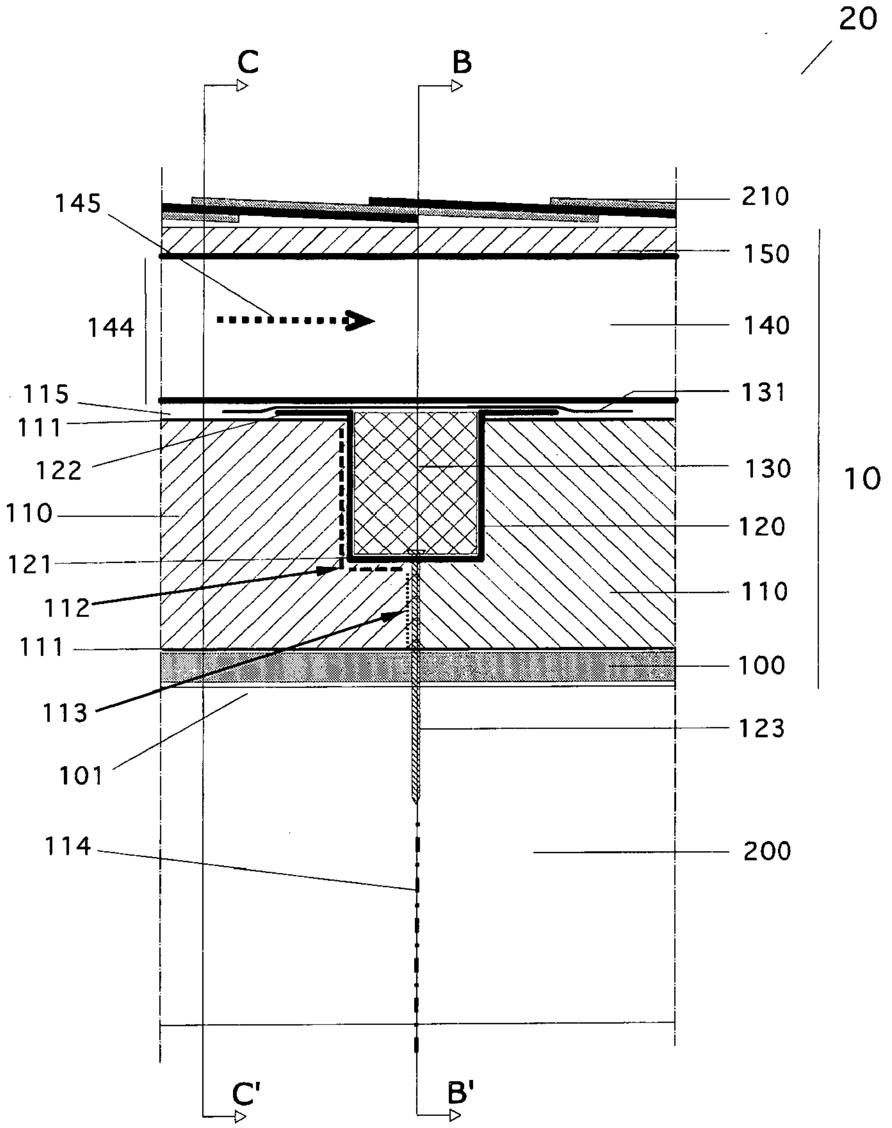
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Fig. 1

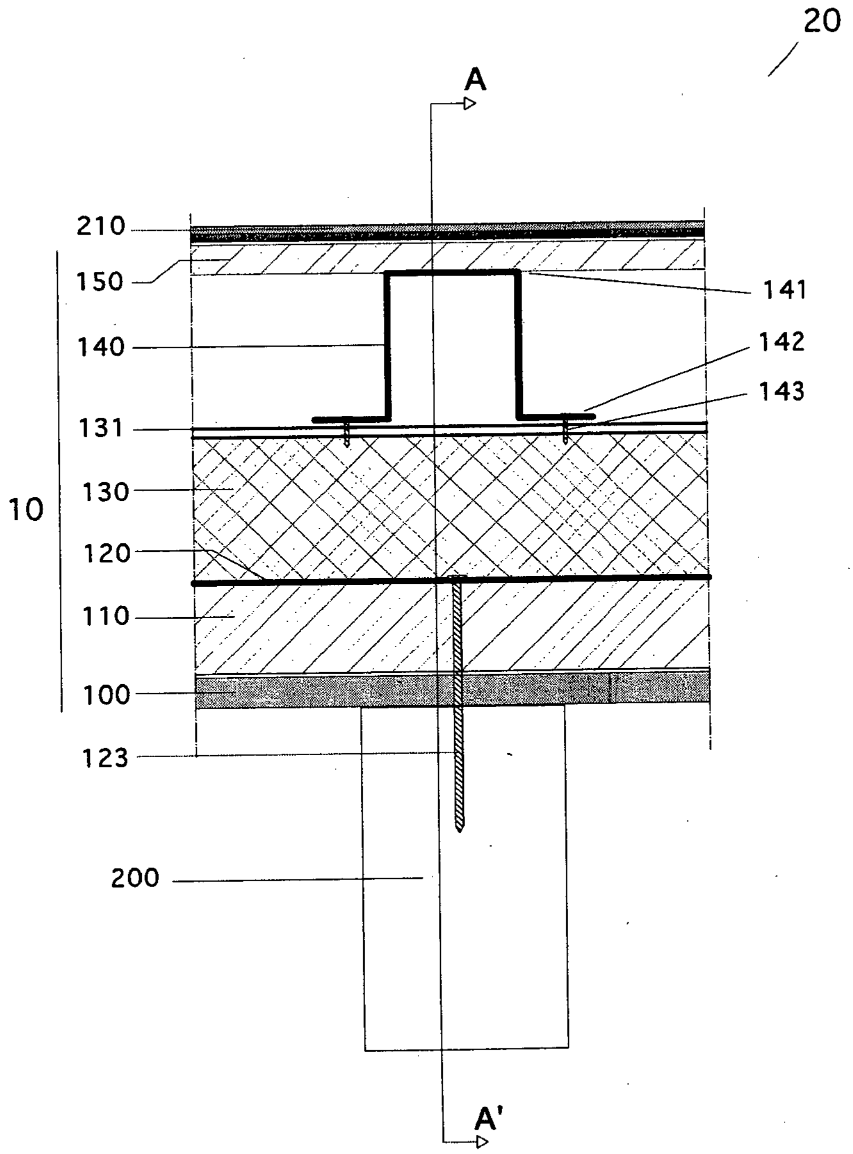

Fig. 2

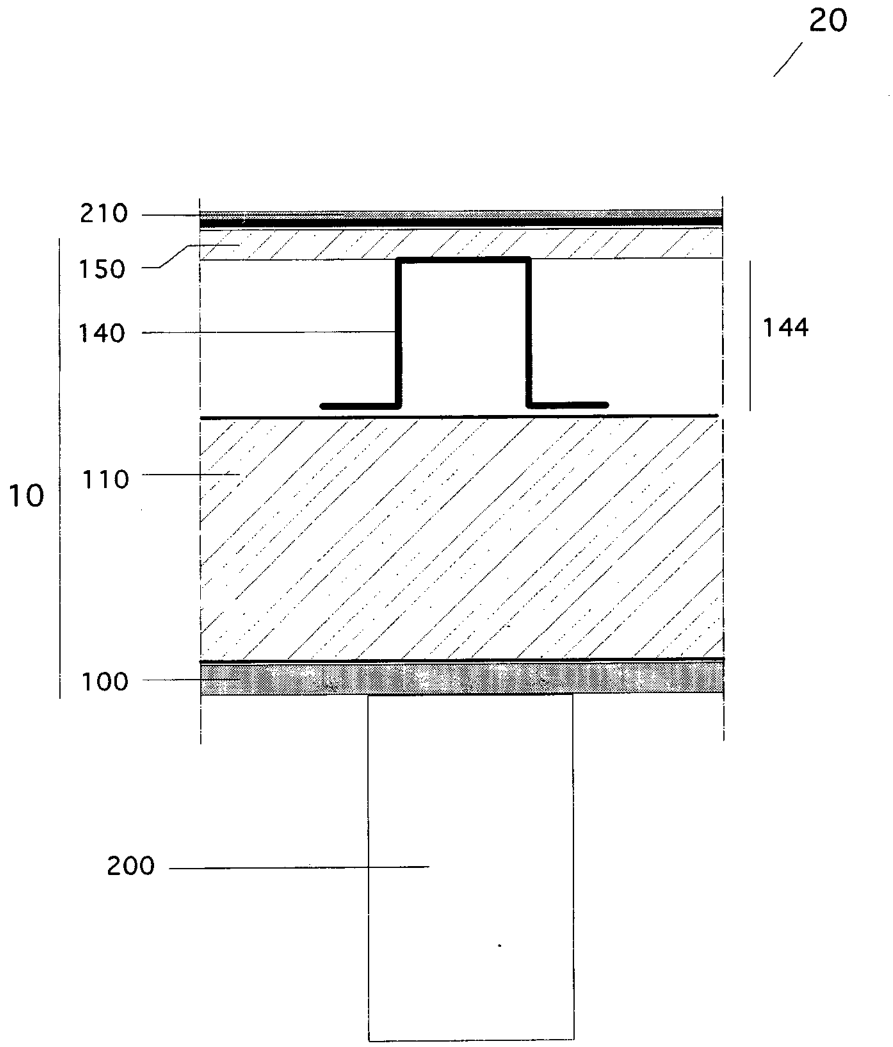

Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 14 00 2728

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TECHNICAL FIELDS SEARCHED (IPC)
E04D

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	13 March 2015	Leroux, Corentine

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