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

(11) EP 0 682 161 B2

(12) **NEW EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the opposition decision:
17.04.2002 Bulletin 2002/16

(45) Mention of the grant of the patent:
01.07.1998 Bulletin 1998/27

(21) Application number: **95106504.4**

(22) Date of filing: **28.04.1995**

(51) Int Cl.[7]: **E04D 13/16**, E04D 11/02

(54) **Roof substructure for roofs covered with roofing boards and method for the construction of such a roof substructure**

Dachunterkonstruktion für mit Dacheindeckungsplatten gedeckte Dächer und Verfahren zur Herstellung der Dachunterkonstruktion

Sous-structure de toit recouvert de panneaux et méthode de construction d'une telle sous-structure

(84) Designated Contracting States:
AT BE CH DE FR LI NL

(30) Priority: **29.04.1994 DE 4415181**

(43) Date of publication of application:
15.11.1995 Bulletin 1995/46

(60) Divisional application:
98103743.5 / 0 852 275

(73) Proprietor: **ISOVER SAINT-GOBAIN**
92400 Courbevoie (FR)

(72) Inventors:
- **Tillessen, Rudolf**
  D-68259 Mannheim (DE)
- **Schlögl, Joachim**
  D-68305 Mannheim (DE)

(74) Representative: **Kuhnen & Wacker**
Patentanwaltsgesellschaft mbH,
Postfach 19 64
85319 Freising (DE)

(56) References cited:

CH-A- 661 555	**DE-A- 2 237 091**
DE-A- 3 615 109	**DE-B- 2 839 767**
DE-C- 3 612 858	**DE-U- 1 716 490**
DE-U- 9 402 188	**FR-A- 2 269 619**
FR-A- 2 545 162	**SE-B- 412 934**
US-A- 3 662 509	

- **Brochure: The Korrugal Energi Roof System, Korrugal SfB Nh4, 79/01, S-7, GAI-taket, ett komplett fleibelt taksystem för industribyggnader, Gränges Aluminium,Finspang(SE)**

EP 0 682 161 B2

Description

[0001] The invention relates to a steep-pitched roof decked with roof decking boards according to the preamble of Claim 1 and a method for constructing a steep-pitched roof according to the preamble of Claim 6.

[0002] Effective insulation of roofs, walls, facades and ceilings, whether in the case of newly constructing buildings or also in the case of reconstructing old buildings, is nowadays basically indispensable for reasons of thermal and/or acoustic insulation. In the prior art, and in structural engineering in general, there exist therefore a large number of suggestions for how to insulate these parts of buildings.

[0003] For example, a roof insulation system has been disclosed in DE-A 28 39 767, in which thermal insulating sheets which can be rolled as an insulating layer parallel to the eaves are placed on loosely and held in their position at specific intervals by supporting planks which likewise run parallel to the eaves. Owing to the supporting planks which are made of wood and are laid with a mutual spacing of about 2 m, there are, however, several interruptions in the thermal insulating layer laid on the exposed panel work, thus resulting in cold bridges or heat bridges in each case in the region of the supporting planks, via which bridges cold or heat can pass from the roof decking into the inside of the building.

[0004] In total, the effect of the insulating layer in the insulation system according to DE-A 28 39 767 is therefore diminished. If the supporting planks were to be omitted, no satisfactory insulating effect of the thermal insulating sheets laid would be provided either since the pressure of the roof, consisting of its own weight, snow and wind load, would then compress the thermal insulating sheets.

[0005] A thermal roof insulation system has been disclosed in DE-A 34 35 648, which to a very great extent eliminates the disadvantage of the cold bridges or heat bridges caused by the wooden supporting planks. For this purpose, DE-A 34 35 648 proposes firstly laying sheets of insulating material running parallel to the ridge or eaves on the exposed panel work mounted on the rafters, supporting planks running between the sheets of insulating material approximately in accordance with DE-A 28 39 767. Further supporting planks running perpendicular to the eaves or to the ridge are then nailed to these supporting planks, and strips or sheets of insulating material are then again laid between these further supporting planks, which strips or sheets run turned through 90° relative to the first strips or sheets. The battens for the roof decking are then mounted on the supporting planks of the second layer of insulating material running perpendicular to the eaves. The continuous heat bridges or cold bridges caused by the supporting planks are thus indeed reduced to point-like places in the subject-matter of DE-A 34 35 648 where the supporting planks of the first and second insulating layers running perpendicular to one another intersect, thus certainly improving the insulating properties of this known roof substructure compared to DE-A 28 39 767, but these improved insulating properties have to be produced at the expense of a number of disadvantages:

[0006] For example, the insulation system according to DE-A 34 35 648 is expensive due to the multiplicity of supporting planks and insulating sheets, and it is additionally also time-consuming and thus expensive to construct since the roof virtually has to be completely thermally insulated twice, once with the insulating layer of the first layer and then with the insulating layer of the second layer running perpendicular thereto. Furthermore, the weight of roof is increased by the dual-layer construction with the increased number of supporting planks required. The provision of the additional supporting planks is also disadvantageous from the point of view of fire protection.

[0007] The problems specified above no longer exist in a roof substructure according to DE-A 36 15 109. In this known roof substructure, the supporting planks running between the individual sheets of insulating material and serving as a bearing construction for the subsequent roof load can be dispensed with. In the roof substructure according to DE-A 36 15 109, individual boards of insulating material, which are provided with a lamination on their topside, said lamination being open to diffusion but waterproof, are laid in such a way on the exposed panel work mounted on the rafters that partial regions of the lamination open to diffusion which project or overlap in each case at a longitudinal or transverse edge cover adjacent boards of insulating material, thus resulting in a lamination of the entire insulating layer which is formed in a mutually covering imbricated manner and is waterproof, but is open to diffusion. The bearing battens, which run perpendicular to the ridge and eaves and then receive the transverse battens for laying the roof decking boards, are then laid directly on this lamination which is water repellent, but open to diffusion. The bearing battens are attached by nailing through the lamination, through the material of the insulating boards and through the exposed panel work the roof rafters located below.

[0008] This roof substructure of DE-A 36 15 109 with the advantage of an insulating layer over the entire surface has proved to be very expedient, but the insulating boards must, for statical reasons in order to absorb the roof load, have a compression strength of at least 50 kN/m^2 which makes such a roof substructure relatively expensive. At the same time, a relatively high bulk density is thus required, which affects the thermal conductivity in relation to the thermal insulating capacity. In order to obtain a good insulating effect, the thermal insulating boards must therefore be of appropriately thick design. To achieve a heat transmission coefficient k (k-value) of 0.42, for example, a thickness of at least 80 mm is thus required. Any improved k-values desired require correspondingly thicker thermal insulating boards. With an increasing thickness of the individual thermal insulating boards, however, the total roof load also rises considerably. Furthermore, thick boards of this type are awkward to handle, to cut and to lay. Also, the thicker the thermal insulating boards are, an ever increasing shearing load results, which acts in the direction of the eaves and exerts bending moments on the attachment means of the insulating boards.

[0009] Furthermore, even though there are no inherent heat or cold bridges in DE-A 36 15 109, this roof substructure is built up of elements having a limited size (approximately 1120 x 600 mm). The size of these elements must be limited, for a single person could otherwise not handle them any more without problems or danger. This does, however, mean under practical circumstances that for decking the entire surface of a roof, a multiplicity of such insulating elements must be used. If, for example, insulating elements according to DE-A 36 15 109 having the above indicated dimensions are used for decking a roof of altogether 320 m^2, approximately 480 such insulating elements must be used to realize full-surface decking of the bearing formwork. The result is a multiplicity of joints between the individual elements, which run parallel and perpendicular to a roof edge, for example the eaves. Owing to prefabrication of the insulating elements and particularly to individual laying of the insulating elements, mutual contact between the individual abutting surfaces of the insulating elements in the area of these joints running parallel and perpendicular will never be fully guaranteed to be perfectly full-surface or without gaps, particularly in the case of inaccurate laying resulting in a multiplicity of heat or cold bridges in the insulating layer that are distributed over the entire roof.

[0010] It is conceivable to reduce the number of insulating elements per roof, for example to half by doubling their size, and thus reduce the number of individual butt joints, but then a single person would not be able any more to handle such an insulating element having a size of e.g. 2240 × 1200 mm without danger.

[0011] As already mentioned at the beginning, not only the insulation of facades and roofs, but also the insulation between storeys is increasingly gaining importance. Ceilings between single storeys, however particularly the ceiling between the top storey and the loft, are realized as layered insulated structures in the course of constructing new buildings, but also subsequently, particularly if higher demands to protection against impact sound are made, and/or if the space in the attic is to be used for storage or other purposes.

[0012] It is a known and widely common manner of proceeding in constructing a ceiling composed of a plurality of layers to lay a plurality of mutually spaced, parallel wooden beams on the supporting ceiling portion of the building. These wooden beams delimit between each other zones to be filled with insulating material which has the form of boards or sheets, or bulk material. On top of the wooden beams, and thus above the insulating layer, a top layer capable of bearing loads is then mounted, for example particle boards or gypsum plaster boards, which are screwed or nailed to the underlying wooden beams and form the cover for the layered ceiling capable of being walked on or otherwise bearing loads.

[0013] Although this type of construction is commonly applied, it suffers from a number of inherent disadvantages:

[0014] The wooden beams forming the supporting elements for the top layer are heavy and bulky parts which, particularly in the case of subsequent insertion of a ceiling composed of a plurality of layers to be constructed according to the known method, for example in the process of reconstructing an old building, often cannot even be transported to the location of installation through the inside of the building, i.e. the stairway, but require the expenses of transport to the location of installation by means of an extemal inclined hoist.

[0015] Laying the wooden beams is furthermore expensive as these must be screwed to the ceiling portion of the building. The reason for this is that wood, being a natural construction material, "works", which means that it can warp or tilt over the passage of time. In such a case, the top layer capable of bearing loads, i.e. the particle boards or the gypsum plaster boards or the like, will not be flushly supported any more and may locally bend when walked on, resulting in the occurrence of creaking or clattering sounds or the like. Screwing the wooden beams to the ceiling portion of the building, however, particularly in the case of concrete ceiling, requires expensive drilling and dowelling work.

[0016] If the ceiling portion of the building is uneven in itself, for example due to any major surface roughness in the concrete or due to the fact that the ceiling portion of the building is a wooden ceiling comprising more or less heavily warped boards, which is a common sight in old buildings, it must be ensured in a time-consuming manner, by underlying spacing wedges or the like when laying and fastening the wooden beams, that the top surfaces of all the wooden beams are within a horizontal plane after laying, in order to later on ensure correct laying of the particle boards or gypsum plaster boards likewise inside a horizontal plane.

[0017] Even if the insulating material introduced between the wooden beams fills the zones formed between the wooden beams closely fitting and essentially without a gap, the thermal and impact sound insulating properties of this known ceiling composed of a plurality of layers must be regarded as not always being satisfactory because the wooden beams have a low resistance against heat transmission on the one hand and a poor acoustic insulation capacity on the other hand. Impact sound is therefore directly transmitted from the top layer capable of bearing loads via the wooden beams to the underlying ceiling portion of the building and transmitted by the latter and radiated into a part of the building below, that is to say the storey underneath. Likewise, heat can travel from a part of the building situated underneath the layered ceiling through the ceiling portion of the building, the wooden beams providing poor thermal insulation, and the top layer capable of bearing loads.

[0018] Finally it is quite a considerable disadvantage of the known insulated ceiling according to the above description that due to the wooden beams, the behaviour in fire of such a ceiling is poorer.

[0019] In contrast, the object of the present invention is to provide a steep-pitched roof decked with roof decking boards and a method of producing such a roof having a roof substructure composed of a plurality of layers in such a way that, with a comparatively light layer of insulating material and, at the same time, improved thermal insulating capacity with smaller insulation thicknesses, a cost-effective roof substructure without any heat bridges or cold bridges can be achieved at small expense of time, money and work in the case of the roof substructure, and a ceiling which also is virtually free of heat bridges and also offers improved protection against impact sound can be achieved at small expense of time, money and work in the case of the insulated ceiling composed of a plurality of layers.

[0020] This object is technically achieved in terms of device by the features of Claim 1 and in terms of method by the features or measures described in Claim 6.

[0021] For example, in the roof substructure according to the invention, the insulating layer is made up of at least two types of strips of the same material laid alternately individually and without gaps parallel to an edge of the roof, which can be laid individually and consecutively while made to contact each other without a gap. The one type of strip here serves to absorb the roof load of roof parts located above the insulating layer, is provided with a far higher compression strength and of a many times narrower design compared to the other type of strip, and manufactured from bonded mineral wool. The other type of strip is also manufactured from bonded mineral wool, primarily glass wool.

[0022] Owing to the fact that the two types of strips may be laid individually and consecutively, care can be taken that the individual types of strips contact each other with a press-in fit and thus entirely without a gap. Owing to the design of the two types of strips in the form of bonded mineral wool, which has a certain fluffiness or elasticity particularly in the case of the type of strip serving purely insulating purposes, this results in contact of the two types of strips free of heat or cold bridges.

[0023] In other words, instead of the single, prefabricated board elements in the case of the roof insulating system according to DE-A 36 15 109, which generate the heat bridges or cold bridges, or instead of the supporting planks between the individual sheets of insulating material in the known insulated ceiling, in the roof substructure according to the invention, the strips running between the strips preferably designed as pure insulating strips absorb the roof loads introduced via the bearing arrangement, for example base battens, or the static and dynamic live loads introduced via a top layer, for example particle boards or gypsum plaster boards.

[0024] It is essential, among others, that the strips for absorbing the load have a very high thermal insulating capacity and also impact sound insulation which is far better e.g. compared to supporting planks. It is an additional factor that the other strips, designed as insulating strips, are not loaded, such that the latter can either have the same or an even better thermal insulating capacity. Since the strips for absorbing the load are of a many times narrower design compared to the other strips serving purely insulating purposes, the reduced thermal insulating capacity in the region of the load-absorbing strips - the reduction being relatively small in any case - occurs in a region taking up a small percentage of the entire roof surface. In this case, the strips serving purely insulating purposes - approximately as when using wooden supporting planks - can be selected to have optimum properties in respect of their thermal insulating capacity since they are not involved in absorbing the roof load. As a result, it is once again possible to reduce the overall thickness of the insulating layer without having to tolerate a poorer k-value when doing so. The multiplicity of constructive joints running parallel and perpendicular to a roof edge as are present in DE-A 36 15 109 are also eliminated, which also positively contributes to improve the k-value. Finally, the use of an essentially relatively light additional insulating layer allows a significant reduction in material costs, and the load-absorbing strips provide a cost saving in respect of special supporting planks and their wage-intensive attachment.

[0025] The method according to the invention for constructing a roof substructure essentially comprises the steps of building up the insulating layer from at least two types of strips of the same material which are laid alternately individually and without gaps parallel to an edge of the roof, the one type of strip serving to absorb the roof load, introduced via a bearing arrangement, of the roof parts located above the insulating layer, and having a far higher compression strength in relation to the other type of strip, and being of a many times narrower design compared to the other type of strip. Furthermore, the strips for absorbing the load are arranged above the bearing formwork with a mutual spacing which corresponds to or is slightly smaller than the width of the other strips, the other strips then being pressed in without gaps between the load-absorbing strips in order to form a continuous insulating layer which is free of heat bridges.

[0026] What is essential here is that the strips serving purely insulating purposes are pressed in between the load-absorbing strips without a gap in order to form the continuous insulating layer free of heat bridges. This pressing in free of gaps is made possible by the fact that both types of strips consist of bonded mineral wool, such that the load-absorbing strips may be arranged with a mutual spacing which corresponds to or is slightly smaller than the width of the other strips, with the fluffiness and elasticity of the strips serving for insulating purposes making it possible to press in these strips between the load-absorbing strips without a gap and closely fitting and thereby form the continuous insulating layer without heat bridges.

[0027] The method according to the invention can be applied analogously in producing or constructing the insulated ceiling composed of a plurality of layers according to the invention, with the starting edge or reference edge, however, not being a roof edge but a building wall.

[0028] Advantageous further developments of the invention emerge from the respective subclaims.

[0029] The strips for absorbing the load have a compression strength of at least 50 kN/m^2. As a result, it is ensured that, despite the width of the load-absorbing strips being many times smaller compared to the other strips preferably serving purely insulating purposes, the roof loads introduced via the bearing arrangement, or the static and dynamic loads generated by pieces of furniture, walking on etc. introduced via the top layer, can reliably be absorbed and distributed without said loads, while doing so, excessively pressing in the load-absorbing strips and thus also the other strips located between them.

[0030] At least the strips of bonded glass wool can be produced in either sheet or board form. However, the sheet form is preferred since this allows more rapid laying between the load-absorbing insulating strips.

[0031] If the roof substructure according to the invention is to be constructed for a steep-pitched roof, the two types of strips are laid parallel to that edge of the roof which is defined by the ridge and/or eaves. As a result, the load-absorbing strips can be used directly for attaching the bearing arrangement, designed as base battens, for the remaining roof construction, that is to say battens and roof decking boards. In this case, the strips for absorbing the are attached to the exposed panel work more or less fixedly depending on the roof slope, which can be carried out, for example, by point-type tacking using staples or the like. This is begun starting from the ridge, by attaching the first load-absorbing strip of higher bulk density parallel to said ridge on the exposed panel work covered by the vapour barrier. The second load-absorbing strip of higher bulk density then follows parallel to the first and parallel to the ridge, specifically with a spacing which corresponds to the width - with a slight underdimension - of the strip serving purely insulating purposes. The strip made of bonded glass wool serving purely insulating purposes is then pressed or clamped into the strip-shaped zone thus created. The third strip of higher bulk density then follows, and so on until the entire roof surface has the alternating insulating layer.

[0032] In the method according to the invention, in laying the sheets or boards of mineral wool serving for insulating purposes, any excess lengths projecting in the region of an end face of the roof can advantageously be cut off. These cut-off excess lengths can then form the beginning when laying the next strip serving insulating purposes. As a result, laying is possible which is to a very great extent without waste and thus without losses.

[0033] Further details, aspects and advantages of the present invention emerge from the following description with reference to the drawing, in which:

Figure 1 shows a sectional illustration along line I-I in Figure 3 to illustrate a construction of a roof substructure according to the invention;

Figure 2 shows a sectional illustration along line II-II in Figure 1 and 3; and

Figure 3 shows a perspective and, in some parts, cutaway view of a roof substructure according to the invention.

[0034] The following description of an embodiment of a roof substructure according to the present invention is given with reference to a practical example, in which a steep-pitched couple roof is insulated using the roof substructure according to the invention. The insulation of other roof types, however, is equally possible.

[0035] A roof substructure denoted in total by 2 in the drawing has the construction which can be seen, in particular, in Figures 1 and 2. In the example illustrated, the roof substructure serves to insulate a couple roof decked with roof decking boards. Couple roofs are distinguished in a known manner by a exposed panel work 4 which is designed, for example, in the form of tongue-and-groove boards which are nailed to the individual rafters 6 over the entire surface. The exposed panel work 4 is followed by a covering layer 8 which not only serves as a vapour barrier, but also provides the required draught-proofing. A reinforced bitumen roof sheeting mat V13 can be used, for example, as the covering layer 8 which is nailed at seams and joints to overlap in a concealing manner.

[0036] An insulating layer 10 is then built up on the covering layer 8. As can best be seen in Figures 1 and 3, the insulating layer 10 consists of at least two types of laid strips which are laid, according to Figures 1 and 3, between a roof eaves 12 or an eaves beam 14 at that point and a roof ridge 16 without gaps and alternately parallel to said roof ridge and to the eaves 12. In this case, the one type of strip 18 serves to absorb the roof load introduced via base battens 20 serving as a bearing arrangement for the remaining roof construction (in particular battens 21 and roof decking boards), and the other type of strip 22 serves purely insulating purposes. As can best be seen from Figures 1 and 3, in this case the strips 18 for absorbing the load are of a many times narrower design compared to the strips 22 serving purely insulating purposes. For example, the strips 18 have a width of 150 mm and the strips 22 have a width of 600 mm.

[0037] The strips 18 for absorbing the load have a compression strength of at least 50 kN/m^2 and consist, in a preferred design, of bonded mineral wool. The strips 22 located between them and serving purely insulating purposes preferably also consist of bonded glass wool.

[0038] A film 24 which is water repellent and open to diffusion is laid in sheets in an overlapping manner on the insulating layer 10 (Figure 2). The individual battens of the base battens 20 are predrilled in the region of the load-absorbing strips 18 and nailed through the insulating layer 10 with the rafters 6 located below it by means of rafter nails 26. The base battens 20 then serve to receive the battens 21 for the roof decking.

[0039] To produce the roof substructure 2 according to the invention or the insulating layer 10, the procedure is as follows:

[0040] The laying of the insulating layer 10 begins at the ridge 16 in the direction of the eaves 12. When the required preparatory work has been completed, i.e. when the exposed panel work 4 has been attached to the rafters 6 and the covering layer 8 has been mounted thereon, a row of load-absorbing strips 18 is firstly attached to the corresponding rafters 6 through the exposed panel work 4 and through the covering layer 8 at that point. For this purpose, the load-absorbing strips 18 can be tacked on, for example, using so-called staples. In this case, the spacing between the individual strips 18 is slightly smaller (e.g. 1 cm) than the width of the strips 22 to be laid between the load-absorbing strips 18 and serving purely insulating purposes, in order thus to achieve a clamping effect of the strips 22 between the strips 18 which is free of heat bridges. When the last strip 18 has been tacked to the rafters 6 through the covering layer 8, the strips 22 serving purely insulating purposes are pressed into the zones between the load-absorbing strips 18 with a press-in fit and without joints. The spacing between the last load-absorbing strip 18, seen in the direction of the eaves, and the eaves beam 14 generally does not correspond precisely to the width of a strip 22 serving purely insulating purposes, but is usually smaller to a greater or lesser extent, as indicated in Figures 1 and 3. The last strip 22 of pure insulating material, located in the region of the eaves, therefore has to be cut to an appropriately narrower size.

[0041] Another possibility of building up the insulating layer 10 is to tack the load-absorbing strips 18 on in the rafters 6 through the covering layer 8 as the insulating layer gradually "travels" in the direction of the eaves 14. More precisely, the first load-absorbing strip 18 is firstly tacked on starting from the ridge 16. The second load-absorbing strip 18 is subsequently tacked on with a suitable spacing (see above) from the first load-absorbing strip 18, and the first zone between these strips 18 is filled with the first strip 22 serving the insulating purposes. The third load-absorbing strip 18, seen from the ridge 16, is then tacked on with a suitable spacing from the second load-absorbing strip 18, and the second zone between these strips 18 is filled with the second strip 22 serving the insulating purposes, and so on.

[0042] The load absorbing strips 18 are available in a specific length, for example 2 m, a specific width of, for example, 150 mm and appropriate thicknesses of, for example, 80 to 180 mm, graded in increments of 20 mm. The width of the strips 22 serving purely insulating purposes is, for example, 600 mm and their thickness corresponds to the thickness of the respective load-absorbing strips 18, that is to say, for example, is within the range of 80 to 180 mm in increments of 20 mm. The strips 22 serving purely insulating purposes can be built up of insulating material in board form or sheet form. The use of glass wool in sheet form is preferred, which can be cut off in the case of an excess length projecting at the end face and forms the beginning at that point when the next strip 22 serving insulating purposes is laid. Laying of the sheet-type or board-type glass wool material to build up the strips 22 serving purely insulating purposes is thus possible to a very great extent without waste and without losses.

[0043] When the insulating layers 10 have been built upon both sides of the roof according to one of the procedures mentioned, the gap remaining in the region of the ridge 16 between the two load-absorbing strips 18 at that point is also stuffed with insulating material 28. Subsequently, the film 24 which is open to diffusion is laid in sheet form with appropriate overlaps 30 on the two insulating layers 10 overthe entire insulating or roof surface and is sealed off in the regions of the overlaps 30 using self-adhesive strips. In this case, the film 24 and its individual sheets on one side of the roof extend by a specific amount beyond the ridge 16 onto the other side of the roof and vice versa so that the layer which is formed by the film 24 and is open to diffusion, but is waterproof, is closed over the entire surface. As already mentioned, the individual battens of the base battens 20 are then predrilled in the region of the load-absorbing strips 18 and the base battens 20 are nailed using the rafter nails 26 through the material of the load-absorbing strips 18 into the material of the individual rafters 6. The base battens 20 then receive the bearing battens 21 for the roof decking.

[0044] The introduction of the roof load onto the rafter zone of the roof, formed by the rafters 6, thus takes place via the base battens 20 and the load-absorbing strips 18. Since the load-absorbing strips 18 have a compression strength of at least 50 kN/m^2, they also have sufficient compression strength to absorb the roof load - composed of the load caused by roof parts located above the insulating layer 10 and snow and/or wind load - and introducing it into the rafters 6 without any substantial compression of the load-absorbing strips 18 and thus of the strips 22 serving purely insulating purposes occurring when doing so.

[0045] It is also possible to use the combinations, according to the invention, of compression-resistant strips made of bonded mineral wool and sheets serving only purely insulating purposes and likewise made of bonded mineral wool, but having a far lower bulk density for insulating facades on buildings. In this case, instead of the basic battens 20, as in the couple roof described, a lattice structure is laid overthe entire roof surface, which lattice structure spans the insulating surface and is embedded in an undercoat rendering. Subsequently, the entire surface is provided with an exterior rendering so that the layer of external rendering thus formed is then supported via the lattice structure on the individual compression-resistant strips.

[0046] Furthermore, the combination according to the invention can also be used advantageously for facade constructions in which claddings, such as shingles attached to batten grids or prehung renderable bearing panels are used. In the exemplary use of bearing panels, the facade construction can also be designed to be ventilated, specifically by the compression-resistant strips being of thicker design than the strips serving purely insulating purposes, so that ventilation slots remain free between the bearing panels and the insulating sheets. As shown by the further examples of use specified, the combination according to the invention can be used universally. In general terms, the above statements in respect of a roof insulation using the roof substructure according to the invention apply essentially also to a facade insulation. The same advantages can be achieved, that is to say advantages in respect of cost saving, weight reduction, simple construction, continuous freedom from heat bridges and non-flammability of the insulating layer.

Claims

1. Steep-pitched roof constructed as couple roof covered with roofing boards, having a roof substructure comprising:

    a bearing formwork (4) attached to a roof construction (6),

    a film-type vapour barrier (8) laid on the bearing formwork (4),

    an insulating layer (10) of bonded mineral wool which is laid together with the vapour barrier (8), and

    a film (24) which is water repellent and open to diffusion, and is laid on the insulating layer (10) such as to cover the latter,

    characterized in that

    a) the insulating layer (10) is made up of at least two types of strips (18, 22) laid alternately and parallel to an edge of the roof,

    b) the material of both types of strips (18, 22) is bonded mineral wool,

    c) the first type of strips (18) is shaped as beam and serves to absorb the roof load, introduced via a bearing arrangement (20), of the roof parts located above the insulating layer (10), wherein said bearing arrangement (20) is fixed through the first type of strips (18) by rafter nails (26) on the roof construction (6), and wherein said first type of strips (18) has a substantially higher compression strength in relation to the other type of strips (22), and is of a several times narrower design than the strips (22) of the second type,

    d) the second type of strips (22) is shaped as sheet coming from a roll and consists of mineral wool compacted to a substantially lesser degree than the first strips (18), which is pressed in between the first strips (18) in the course of installation, and

    e) the strips (18, 22) can be laid individually and consecutively such as to contact each other without any gaps.

2. Roof according to claim 1, **characterized in that** the first strips (18) for absorbing the load have a compression strength of at least 50 kN/m^2.

3. Roof according to claim 1 or 2, **characterized in that** the strips (18, 22) consist of glass wool.

4. Roof according to one of claims 1 to 3, **characterized in that** the edge of the roof is defined by the ridge and/or eaves.

5. Roof according to claim 4, **characterized in that** the first strips (18) for absorbing the load are attached to the rafters (6) above the exposed panel work (4).

6. Method of constructing a steep-pitched roof constructed as couple roof covered with roofing boards, having a roof substructure, in particular a roof substructure according to one of claims 1 to 5, wherein:

    a bearing formwork (4) is attached to a roof construction (6),

    a film-type vapour barrier (8) is laid on the bearing formwork (4),

    an insulating layer (10) of bonded minered wool is laid on the vapour barrier (8), and

    a film (24) is laid on the insulating layer, which film covers the latter, is of water repellent design and is open to diffusion,

***characterized by** the following steps:*

building up the insulating layer (10) from at least two types of strips (18, 22) of mineral wool material which are laid alternately individually and without gaps parallel to an edge of the roof, wherein a first type of strips (18) is shaped as beam and serves to absorb the roof load, introduced via a bearing arrangement (20), of the roof parts located above the insulating layer (10), wherein said bearing arrangement (20) is fixed through the first type of strips (18) by rafter nails (26) on the roof construction (6), and wherein said first type of strips (18) has a substantially higher compression strength in relation to a second type of strips (22), and is of a several times narrower design in relation to the second type of strips (22), wherein said second type of strips (22) is shaped as sheet coming from a roll,

wherein furthermore the first type of strips (18) is arranged above the bearing formwork (4) with a mutual spacing which is slightly smaller than the width of the second type of strips (22), and

pressing-in of the second type of strips (22) without gaps between the first type of strips (18) to form a continuous insulating layer-(10) which is free of heat bridges.

7. Method according to one of claims 6, **characterized in that** an excess length projecting in the region of a roof end face in the course of laying the second type of strips (22) is cut off and forms the beginning upon laying the next strip (22).

Patentansprüche

1. Als Sparrendach ausgebildetes Steildach mit Dacheindeckungsplatten und einem Unterdach, mit:

einer auf der Dachkonstruktion (6) befestigten Tragschalung (4),

einer auf der Tragschalung (4) verlegten folienartigen Dampfsperre (8),

einer Dämmschicht (10) aus gebundener Mineralwolle, die zusammen mit der Dampfsperre (8) verlegt ist, und

einer wasserabweisenden und diffusionsoffenen Folie (24), die auf der Dämmschicht (10) verlegt ist und diese abdeckt,

dadurch gekennzeichnet, daß

a) die Dämmschicht (10) aus mindestens zwei Arten von alternierend und parallel zu einer Dachkante verlegten Streifen (18, 22) aufgebaut ist,

b) das Material der beiden Streifenarten (18, 22) gebundene Mineralwolle ist,

c) die erste Streifenart (18) als Tragbalken ausgebildet ist und zur Aufnahme der über eine durch die erste Streifenart (18) hindurch mittels Sparrennägeln (26) an der Dachkonstruktion (6) befestigten Traganordnung (20) eingeleiteten Dachlast der über der Dämmschicht (10) liegenden Dachteile dient, wobei die erste Streifenart (18) im Verhältnis zu der anderen Streifenart (22) eine wesentlich höhere Druckfestigkeit aufweist und gegenüber der anderen Streifenart (22) um ein Mehrfaches schmäler ausgebildet ist,

d) die zweite Streifenart (22) als Rollfilz ausgebildet ist und aus Mineralwolle besteht, die in einem wesentlich geringeren Maße als die ersten Streifen (18) verdichtet ist, und die im Zuge der Verlegung zwischen die ersten Streifen (18) eingedrückt wird, und

e) die Streifen (18, 22) einzeln nacheinander verlegbar und dabei spaltfrei aneinander anlegbar sind.

2. Dach nach Anspruch 1, **dadurch gekennzeichnet, daß** die ersten Streifen (18) für die Lastaufnahme eine Druckfestigkeit von mindestens 50 kN/m^2 aufweisen.

3. Dach nach Anspruch 1 oder 2, **dadurch gekennzeichnet, daß** die Streifen (18, 22) aus Glaswolle bestehen.

4. Dach nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, daß** die Dachkante bei einem als Sparrendach ausgebildeten Steildach durch First und/oder Traufe definiert ist.

5. Dach nach Anspruch 4, **dadurch gekennzeichnet, daß** die ersten Streifen (18) für die Lastaufnahme an den Sparren (6) über der Sichtschalung (4) befestigt sind.

6. Verfahren zum Errichten eines als Sparrendach ausgebildeten Steildaches mit Dacheindeckungsplatten und einem Unterdach, insbesondere einem Unterdach nach einem der Ansprüche 1 bis 5, bei dem:

auf einer Dachkonstruktion (6) eine Tragschalung (4) befestigt wird;

auf der Tragschalung (4) eine folienartige Dampfsperre (8) verlegt wird;

eine Dämmschicht (10) aus gebundener Mineralwolle auf der Dampfsperre (8) verlegt wird;

und
auf der Dämmschicht eine diese abdeckende und wasserabweisend ausgebildete, diffusionsoffene Folie (24) verlegt wird,

gekennzeichnet durch *die folgenden Schritte:*

Aufbauen der Dämmschicht (10) aus mindestens zwei Arten von Streifen (18, 22) aus Mineralwollematerial, die alternierend einzeln und spaltfrei parallel zu einer Dachkante verlegt werden, wobei eine erste Streifenart (18) zur Aufnahme der über eine **durch** die erste Streifenart (18) hindurch mittels Sparrennägeln (26) an der Dachkonstruktion (6) befestigten Traganordnung (20) eingeleiteten Dachlast der über der Dämmschicht (10) liegenden Dachteile dient, wobei die erste Streifenart (18) und im Verhältnis zu einer zweiten Streifenart (22) eine wesentlich höhere Druckfestigkeit aufweist und gegenüber der zweiten Streifenart (22) um ein Mehrfaches schmäler ausgebildet ist;
wobei weiterhin die erste Streifenart (18) über der Tragschalung (4) in einem gegenseitigen Abstand voneinander angeordnet wird, welcher geringfügig kleiner als die Breite der zweiten Streifenart (22) ist, und

spaltfreies Eindrücken der zweiten Streifenart (22) zwischen die erste Streifenart (18) zur Bildung einer durchgehenden, wärmebrückenfreien Dämmschicht (10).

7. Verfahren nach Anspruch 6, **dadurch gekennzeichnet, daß** eine im Zuge der Verlegung der zweiten Streifenart (22) im Bereich einer Dachstirnseite überstehende Überschußlänge abgeschnitten und bei der Verlegung des nächsten Streifens (22) den dortigen Anfang bildet.

Revendications

1. Toit en pente raide construit en tant que toit à fermettes couvert de voliges et ayant une substructure de toit comprenant:

un coffrage porteur(4)attaché à la construction du toit (6),
un pare-vapeur (8) du type film posé sur le coffrage porteur (4),
une couche isolante (10) de laine minérale collée qui est posée en même temps que le pare-vapeur (8), et
un film (24) qui est hydrofuge et permet la diffusion, et est posé sur la couche isolante (10) de manière à la recouvrir, **caractérisé en ce que**

a) la couche isolante(10) est constituée d'au moins deux types de bandes (18, 22) posées alternativement et parallèles à un bord du toit,
b) le matériau des deux types de bandes (18, 22) est de la laine minérale collée,
c) le premier type de bandes (18) est en forme de poutre et sert à absorber la charge du toit, introduite par un arrangement porteur (20) fixé par clous de chevrons (26) à travers le premier type de bandes (18) à la construction du toit (6), des parties du toit situées au-dessus de la couche isolante (10), le premier type de bandes (18) ayant une résistance à la compression substantiellement plus élevée par rapport à l'autre type de bandes (22), et ayant une conception plusieurs fois plus étroite par rapport au deuxième type de bandes (22),
d) le deuxième type de bandes (22) est en forme de feutre en rouleau et est constitué de laine minérale, compactée à un degré substantiellement moindre que les premières bandes (18), qui est comprimée entre les premières bandes (18) au cours de l'installation, et
e) les bandes (18, 22) peuvent être posées individuellement et consécutivement de manière à se toucher les unes les autres sans espaces.

2. Toit selon la revendication 1, **caractérise en ce que**, les premières bandes (18) pour absorber la charge ont une résistance de compression d'au moins 50 kN/m^2.

3. Toit selon la revendication 1 ou 2, **caractérisé en ce que** les bandes (18, 22) sont constituées de laine de verre.

4. Toit selon l'une des revendications 1 à 3, **caractérisé en ce que** le bord du toit est défini par l'arête et/ou les saillies de toit dans le cas d'un toit en pente raide construit en tant que toit à fermettes.

5. Toit selon la revendication 4, **caractérisé en ce que** les premières bandes (18) pour absorber la charge sont attachées aux chevrons (6) au-dessus de l'ouvrage de panneaux exposés (4).

6. Procédé de construction d'un toit en pente raide construit en tant que toit à fermettes pour toits couvert de voliges et ayant une substructure de toit, en particulier une substructure de toit selon l'une des revendications 1 à 5, dans lequel :

un coffrage porteur (4) est attaché à une construction du toit (6),

un pare-vapeur (8) du type film est posé sur le coffrage porteur (4),
une couche isolante (10) de laine minérale collée est posée sur le pare-vapeur (8), et
un film (24) est posé sure la couche isolante de manière à la recouvrir, et est de conception hydrofuge et permet la diffusion, **caractérisé par** les étapes suivantes:

construction de la couche isolante (10) à partir d'au moins deux types de bandes (18, 22) du matériau de laine minérale, qui sont posées alternativement individuellement et sans espaces parallèlement à un bord du toit, un premier type de bandes (18) servant à absorber la charge du toit, introduite par un arrangement de support (20) fixé par clous de chevrons (26) à travers le premier type de bandes (18) à la construction du toit (6), des parties du toit situées au-dessus de la couche isolante (10), le premier type de bandes (18) ayant une résistance à la compression substantiellement plus élevée par rapport à un deuxième type de bandes (22), et ayant une conception plusieurs fois plus étroite par rapport au deuxième type de bandes (22),

en outre, le premier type de bandes (18) étant arrangé au-dessus du coffrage porteur (4) avec un espacement mutuel qui est légèrement plus petit que la largeur du deuxième type de bandes (22), et
installation par pression du deuxième type de bandes (22) sans espaces entre le premier type de bandes (18) pour former une couche isolante continue (10) qui es exempte de ponts thermiques.

7. Procédé selon revendication 6, **caractérisé en ce qu'**une longueur excessive faisant saillie dans la région d'une face d'extrémité de toit au cours de la pose du deuxième type de bandes (22) est découpée et forme le début lors de la pose de la bande suivante (22).

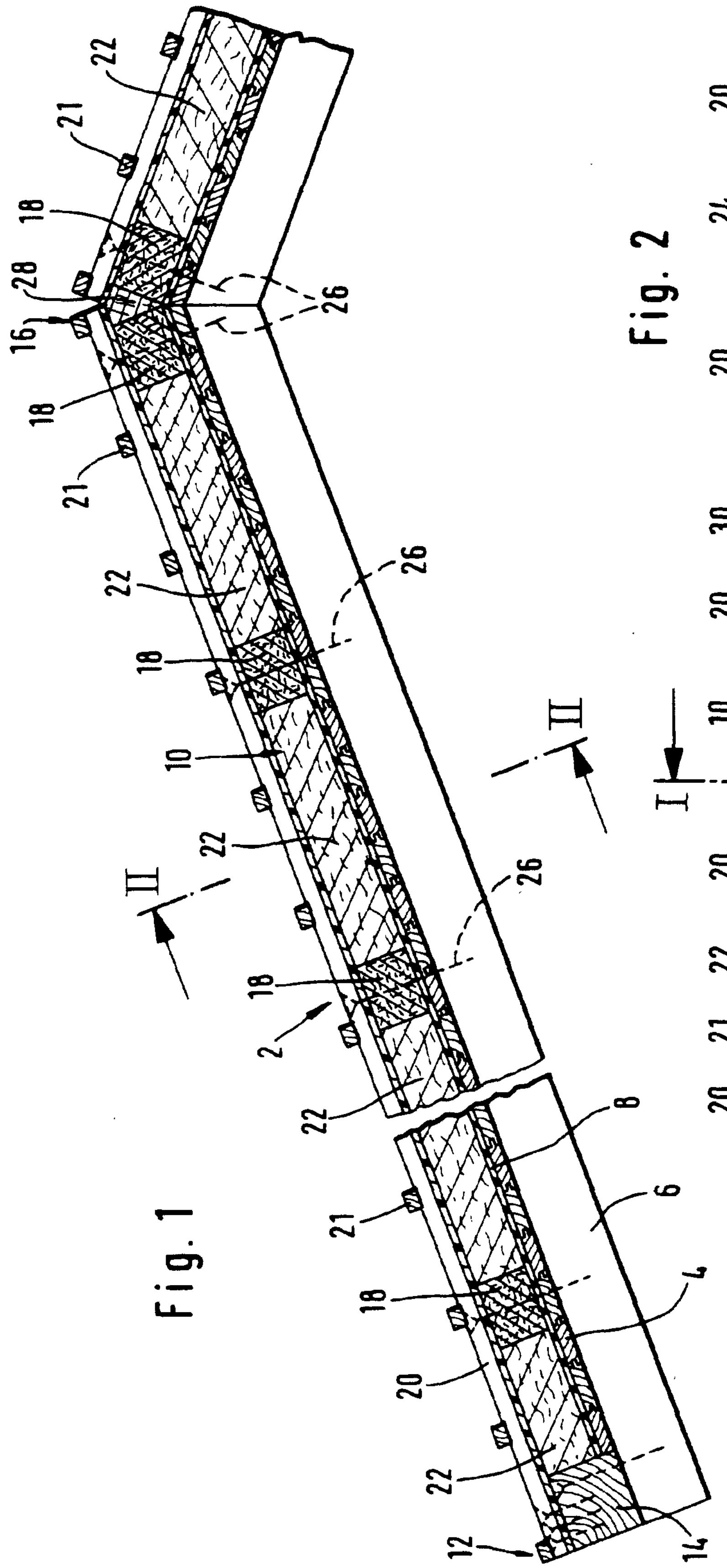

Fig. 1

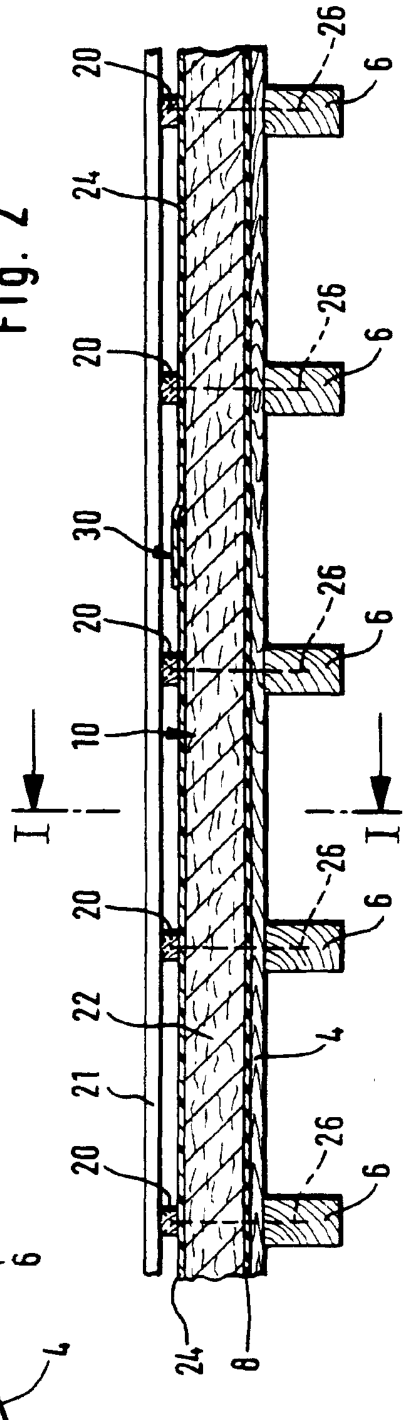

Fig. 2

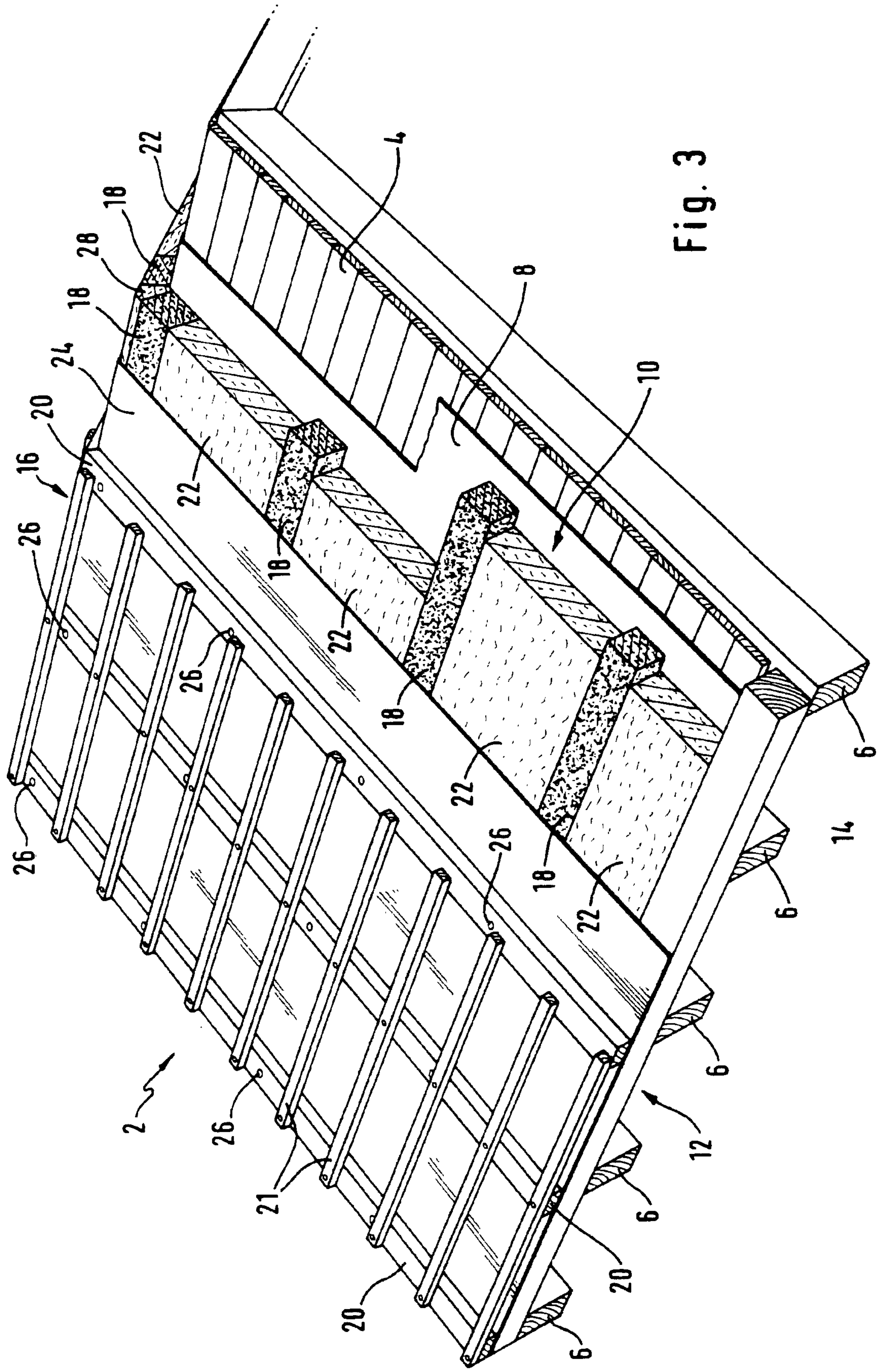

Fig. 3