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(54) METHOD FOR PRODUCING DRY WALLS AND/OR DRY CEILINGS

(57) A method for producing a dry wall and/or a dry ceiling comprising a supporting framework and at least one board, comprising the steps of:
a) Providing and/or obtaining a supporting framework,
b) Providing and/or obtaining at least one board,
c) Applying an adhesive to the supporting framework and/or the board; and
d) Placing the board onto the supporting framework, such that the board and the supporting framework are connected to each other by the adhesive to obtain a bonded composite,
whereby a green strength of the adhesive is such that a structure of the bonded composite remains essentially intact when the bonded composite is lifted at the supporting framework and/or at the board immediately after step d).

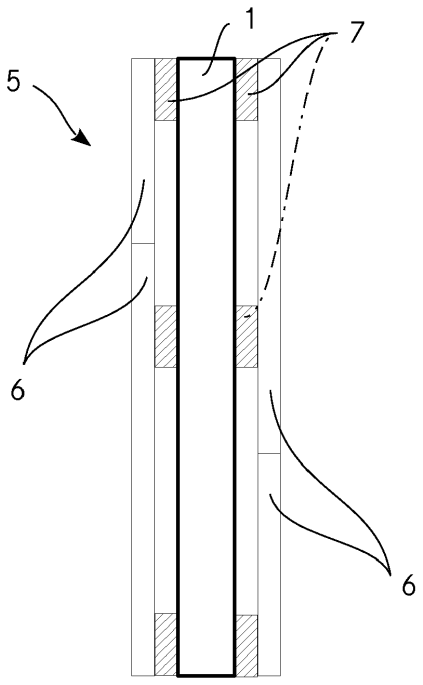

Fig. 2

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Description

Technical field

[0001] The invention relates to a method for producing a dry wall and/or a dry ceiling comprising a supporting framework and at least one board connected by an adhesive. Furthermore, the invention relates to a dry wall and/or a dry ceiling, comprising a supporting framework and at least one board connected by an adhesive.

Background art

[0002] For the production of a dry wall and/or a dry ceiling, usually a supporting framework is planked with a layer of boards, then fitted with insulation material. The boards may be for example plasterboards and/or gypsum fiberboards and are commonly attached to the supporting framework by fasteners such as nails, staples, and/or screws. Afterwards, the dry wall and/or dry ceiling is plastered to even out joints, fastener holes and/or further uneven surfaces. The production steps for dry walls are basically the same as for dry ceilings.

[0003] While dry walls and dry ceilings are widely used as popular construction components, there are some disadvantages associated with the common construction methods.

[0004] Apart from production on the construction site, dry walls and/or dry ceilings are frequently prefabricated and then transported to the installation site, often using lifting methods. During transportation the boards of the dry wall and/or the dry ceiling often form cracks, due to the lifting force acting on them, resulting in an esthetic imperfection which is costly to refurbish. These cracks have been observed to mainly occur on connection points, i.e. where the boards are attached to the supporting framework.

[0005] A further drawback is that the known production methods can be labor-intensive since the dry walls and/or dry ceilings have to be joined manually. This can be time-consuming, especially in large construction projects, and can contribute to increased labor costs and project timelines.

[0006] Furthermore, the dry walls and/or dry ceilings are often left with visible indentations or dimples in the surface caused by the fasteners. Even after the application of plaster and finishing techniques, these indentations may still be noticeable, especially in certain lighting conditions. This can detract from the overall aesthetics of the finished wall and/or ceiling.

[0007] Another drawback that has been observed concerns weakened connection points due to the wrong choice of fasteners or their incorrect application. If the wrong fastener is used or exposed to moisture, there is a risk of corrosion. This can lead to structural and stability issues of the wall. Furthermore, such penetrating fasteners need to be carefully and precisely applied, with a correct angle and depth, in order to ensure optimal stability of the finished wall and/or ceiling and to minimize esthetic impairment. This can only be done by hand and requires a high level of skill.

[0008] There is thus a need to provide improved solutions, which overcome the aforementioned drawbacks.

Disclosure of the invention

[0009] It is an object of the present invention to provide a method for producing a dry wall and/or a dry ceiling which can at least reduce the above-mentioned drawbacks. In particular, it is an object of the present invention to provide a method for producing a dry wall and/or a dry ceiling, which a) at least reduces crack formation, b) accelerates the production steps, c) improves good aesthetics and/or d) improves the stability of the dry wall and/or dry ceiling.

[0010] Surprisingly, it has been found that these objects can be achieved by the features of claim 1. Thus, the core of the invention is a method for producing a dry wall and/or a dry ceiling comprising a supporting framework and at least one board, comprising the steps of:

a) Providing and/or obtaining a supporting framework,

b) Providing and/or obtaining at least one board,

c) Applying an adhesive to the supporting framework and/or the board; and

d) Placing the board onto the supporting framework, such that the board and the supporting framework are connected to each other by the adhesive to obtain a bonded composite,

whereby a green strength of the adhesive is such that a structure of the bonded composite remains essentially intact when the bonded composite is lifted at the supporting framework and/or at the board immediately after step d).

[0011] Thus, the dry wall and/or the dry ceiling exhibit a stable structure even before the adhesive has fully cured.

[0012] The term "dry wall" refers to a constructive wall, e.g. used for room partitioning purposes, especially for an interior area. For the construction of a dry wall, no water-containing building materials, such as plaster, mortar, concrete, or clay, are required to obtain structural stability. Nevertheless, it is possible to plaster the dry wall with such kind of materials later on if desired and/or to make use of boards comprising such kind of materials.

[0013] A "dry ceiling" is meant to be a constructive ceiling. Just like for the construction of a dry wall, no water-containing building materials, such as plaster, mortar, concrete or clay, are required for the construction. Also for the dry ceilings, it is possible to plaster the ceiling with such kind of materials later on if desired.

[0014] A "supporting framework" refers to an inner framework construction of a dry wall and/or a dry ceiling comprising a frame with vertically, horizontally and/or diagonally arranged profile elements. In particular, the frame comprises a horizontal framing member that runs along the uppermost part of the supporting framework and is referred to as "top plate". Especially, the supporting framework further comprises a horizontal framing member that runs along the lowermost part of the supporting framework and is referred to as "bottom plate". The top plate as well as the bottom plate provide stability and serve as attachment points for vertically and/or diagonally arranged profile elements. Vertically placed profile elements are referred to as "studs" and horizontally placed profile elements are referred to as "blockings". The studs and blockings are placed in a defined distance to one another. Furthermore, the blockings are usually attached on both ends to studs.

[0015] The term "board" refers to a building element used for dry wall and/or dry ceiling construction. The boards are usually in the form of planar elements and are often made of gypsum and/or other dry materials and are available in various shapes and sizes. Usually, the boards are attached plane-parallel to the supporting framework. More precisely, the boards are attached to the studs, blockings, bottom plates and/or top plates of the supporting framework. In steps b), c) and d) one single board or several individual boards can be employed. In case of several boards the boards usually abut on each other with their edges to form a continuous board area on the supporting framework.

[0016] "Green strength" is meant to be the initial level of cohesion and adhesion that the adhesive possesses right after it has been applied but before it has fully cured.

[0017] "Remaining intact" in particular means that the board(s) in relation to the supporting structure remains in its initial position in which it was placed in step d).

[0018] "Immediately after step d)" in particular means 0 - 10 minutes after step d), especially 0.1 - 5 minutes after step d), particularly 0.5 - 1 minutes after step d).

[0019] As it turned out, the inventive method leads to a reduction in crack formation in the board and/or in the supporting framework, especially during transportation of the dry wall and/or the dry ceiling. Through use of the inventive adhesive, the structure of the board and or/the supporting framework does not have to be penetrated. Thus, the structural integrity of the board can be maintained, which drastically decreases the possibility of crack formation.

[0020] Furthermore, it has been observed that due to the inventive method, the production rate of a dry wall and/or a dry ceiling can be increased, since the application of the adhesive is simple, fast and/or can be executed in an automated manner.

[0021] Another advantage of the inventive solution is that the board shows at least less or no indentations and/or dimples at all after step d), since there is no need to penetrate the board, but the adhesive is only applied onto the surface of the supporting framework and/or the board. Thus, the inventive solution can provide a smooth and/or flat dry wall surface and/or dry ceiling surface. This improves the overall aesthetics of the dry wall and/or dry ceiling.

[0022] Thus, in a preferred embodiment, the board in not penetrated for bonding it to the supporting framework. Especially, there are no form and/or force-fit connection elements, in particular no nails and/or screws, used for bonding the board to the supporting framework. Thus, the dry wall and/or a dry ceiling preferably does not comprise such connection elements that penetrate the board(s). Nevertheless, the supporting framework as such still may comprise form and/or force-fit connection elements. Also, for special applications, it is possible to additionally make use of one or more form and/or force-fit connection elements to bond the board to the supporting framework.

[0023] Furthermore, the inventive method accelerates the process of installation of the dry wall and/or dry ceiling, since they can be transported directly after their assembly. Thus, there is no need to wait for the adhesive to cure, before it is possible to continue with the next installation steps. This can be time and cost saving, especially in large construction projects.

[0024] In addition, the inventive adhesive ensures that the connection between the board and the supporting framework withstands the force exerted on it during transportation. Thus, the inventive method improves the structural integrity of the dry wall and/or dry ceiling.

[0025] Another advantage of the inventive solution is that no screw and/or nail indentations are created. Thus, there is no need of filling these indentations, which reduces the working time as well *as* the consumption of resources.

[0026] Furthermore, with adhesives showing viscoelastic properties, additional protection for the dry wall and/or dry ceiling can be provided, as the damping effect of the adhesive can prevent impact and/or vibration damages.

[0027] After step d), in particular, at least 5 %, especially at least 10 %, for example at least 15%, of the surface area of the board facing the supporting framework is in contact with the adhesive. This ensures a good adhesion between board and supporting framework. This can e.g. be achieved by providing a supporting framework with a supporting surface area

facing the board that is at least at least 5 %, especially at least 10 %, for example at least 15 %, of the surface area of the board facing the supporting framework and applying the adhesive in step c) all over the surface area of the supporting framework facing the board.

[0028] Especially in step c), the adhesive is applied with an automatic system, e.g. a robotic system. Likewise further steps a), b) and/or d) can be performed with an automatic system. Thus, the overall method can be implemented in an automatic manner.

[0029] Preferably, in step d) the board is placed onto the supporting framework in a vertically upright position.

[0030] However, it is also possible to place the board onto the supporting framework in a horizontal position.

[0031] In a further preferred embodiment, the surface weight of the board on the supporting framework is at least 0.1 - 40 g/cm^2, preferably at least 0.2 - 20 g/cm^2, most preferred 0.5 - 10 g/cm^2 or 0.6 - 5 g/cm^2.

[0032] This ensures that the connection between the board and the supporting framework is such that they adhere stably to each other. It is however also possible that the surface weight is less than 0.1 g/cm^2 or more than 40 g/cm^2.

[0033] In particular, after step d) the adhesive has a layer thickness of 1 - 5 mm, preferably of 2 - 4 mm, most preferred of 3 mm.

[0034] This thickness provides the bonded composite with an adequate amount of adhesive to show optimal adhesion qualities while simultaneously avoiding unnecessary amounts of adhesive, thus preventing a waste of resources.

[0035] It is however also possible that the layer thickness amounts to less than 1 mm or more than 5 mm.

[0036] Preferably, the board is a wall board and/or a ceiling board.

[0037] In another preferred embodiment the board is a cement board, composite board, wooden board, especially a chipboard, a gypsum plasterboard and/or a gypsum fiberboard.

[0038] Wooden boards have versatile advantages, since wood i) is sustainable due to its renewability, ii) has a warm and natural appearance that adds a timeless aesthetic to a place, iii) is relatively easy to work with, iv) has natural insulating properties, v) has excellent strength characteristics, vi) accepts a variety of finishes such as stains, paints and/or sealants, vii) is biodegradable, viii) reduces noise transmission and viii) requires less energy in its production than alternative materials. The advantages of chipboard are furthermore that it has a uniform composition throughout the entire board and that it can provide a consistent quality.

[0039] Gypsum plasterboards are beneficial since gypsum is inherently fire-resistant. Furthermore, gypsum plasterboards can provide an even and smooth surface finish. This allows for easy painting or wallpaper application, resulting in aesthetically pleasing interiors. Additionally, gypsum plasterboards i) have good acoustic properties, providing a level of sound insulation, ii) are lightweight, making them easy to handle, transport and/or install, iii) provide some degree of thermal insulation, iv) can be treated with additives that make them resistant to mold, mildew and/or moisture, v) are environmental friendly, since gypsum is a naturally occurring mineral, vi) are relatively easy to repair and/or replace and vii) allow for the easy integration of utilities such as electrical wiring and plumbing.

[0040] Gypsum fiberboards exhibit generally the same advantages as gypsum plasterboards. Furthermore, gypsum fiberboards are moisture resistant, have low volatile organic compound emissions and are inherently resistant to mold and mildew.

[0041] Cement boards are particularly suitable for wet rooms with high moisture loads. Composite boards may for example be a solid composite board comprising a gypsum layer and an insulation layer, the insulation layer especially made from mineral fiber insulation and/or synthetic material

[0042] However, it is also possible to use other materials than those suggested in the present description.

[0043] Especially, the supporting framework comprises interconnected studs, blockings, bottom plates, top plates and/or intermediate spaces.

[0044] In a special embodiment, the supporting framework comprises at least one stud, at least one blocking, at least one bottom plate, at least one top plate and/or at least one intermediate space.

[0045] The structure of the supporting framework helps distribute loads evenly across the framework. It ensures that the weight of the dry wall and/or the dry ceiling and any additional loads, e. g. shelvings and/or cabinets, are adequately supported and transferred to a construction foundation.

[0046] However, it is also conceivable that the supporting framework has another structure.

[0047] In particular, the intermediate spaces contain insulation material, preferably organic, mineral and/or synthetic insulation material.

[0048] It is also possible, however, that the intermediate spaces do not contain any insulation material at all.

[0049] In another favored embodiment, the insulation material comprises mineral wool, wood fiber, cellulose, rockwool, glass wool, calcium silicate, mineral foam, extruded polystyrene, expanded polystyrene, polyurethane and/or aerogel.

[0050] Particularly, the supporting framework is made of wood, metal and/or synthetic material.

[0051] With reference to the beneficial properties above, wood can have the mentioned positive effects also on the supporting framework structure. Metal can exhibit beneficial properties such as a long lifespan, corrosion resistance, lightweight (for some metals such as aluminium), resistance to pests and a high tensile strength. Synthetic materials are characterized by being lightweight, having a high durability, being cost-effective, being water resistant and having

consistent properties.

[0052] However, it is also possible to use materials deviating from the materials described above for the supporting framework. In particular, the adhesive is configured such that, directly after application to a vertical surface it can hold a flat planar element with a surface weight of at least 20 g/cm^2 or more pressed onto the adhesive to form a layer thickness of the adhesive of 3 mm and a full surface bonding between the vertical surface and the flat planar element, whereby the element bonded in this way does not slip more than 10 mm during 1 minute. Thereby, the element is not supported and/or held by any additional fastening and/or holding mean and the slipping is measured in vertical direction.

[0053] This ensures that the structure of the bonded composite remains mainly stable directly after bonding. Further, it facilitates the plannability regarding the following installation of the bonded composite.

[0054] Further preferred, the adhesive is configured such that the element does not slip more than 8 mm, especially preferred not more than 6 mm.

[0055] Preferably, the adhesive belongs to the group of polyurethane adhesives and/or silane-functional polymer (STP) adhesives. Such adhesives can be formulated to exhibit suitable properties in the uncured state, for example, green strength, viscosity, and thixotropy, and after curing they form elastic, tough materials with excellent vibration and impact dampening properties.

[0056] The polyurethane adhesives comprise polyurethane polymers. The term "polyurethane polymer" comprises all the polymers which are prepared according to the so-called diisocyanate polyaddition method. This also includes polymers which are nearly or completely free of urethane groups. Examples of polyurethane polymers are polyether polyurethanes, polyester polyurethanes, polyether polyureas, polyureas, polyester polyureas, polyisocyanurates, and polycarbodiimides

[0057] The term "silane-functional" denotes compounds comprising silane groups. "Silane-functional polymers" accordingly are polymers comprising at least one silane group. The term "silane group" denotes the silicon-containing group bound to the organic residue of the silane, which is bound via the Si-C bond. These adhesives are especially favourable since they can be formulated to exhibit a high green strength and a high viscosity. Those properties ensure that on the one hand the bonded composite can exhibit an immediate adhesive effect right after the application. Thus, an immediate connection between the board and the supporting framework can be achieved. On the other hand, it can be prevented that the adhesive drops down the board surface and/or the supporting framework surface after being applied.

[0058] In an especially preferred embodiment, the adhesive is a one-component adhesive, especially a one-component polyurethane adhesive and/or a one-component silane-functional adhesive. A "one-component" composition is a composition in which all components of the composition are present in the same container and which, as such, is storage-stable. However, it is also possible to implement the inventive method with a two-component adhesive, especially a two-components polyurethane adhesive and/or a two-components silane-functional adhesive.

[0059] Especially, suitable and preferred adhesives used for this purpose include Sikaflex®-118, Sikaflex®-119, Sikaflex®-258, Sikaflex®-263 and/or Sikaflex®-545. These adhesives are commercially available from Sika AG (Switzerland).

[0060] It is however not excluded that the adhesives may belong to other adhesives groups.

[0061] Especially, the inventive adhesive may exhibit i) a high viscosity at low shear rates, preferably also having a low viscosity at high shear rates at the same time, ii) a good pumpability, iii) a suitability for being used in automated processes, iv) a high green strength and/or v) a high sag resistance.

[0062] These properties can be achieved, for example, with the addition of selected fillers, thixotropic additives, and/or partially crystalline polymers. Further below, some suitable formulation approaches are shown in detail.

[0063] The term "sag resistance" refers to the ability of a material, especially a liquid and/or semi-liquid substance, to resist the downward flow or deformation under the influence of gravity.

[0064] A high viscosity at low shear rates, and a low viscosity at high shear rates at the same time can be achieved by including thixotropic additives. Such additives, exemplified further below, ensure a high viscosity and sag resistance after application (absent any shear forces), while under high shear rates, the viscosity decreases, which facilitates application and enables good pumpability.

[0065] Preferably, the adhesive additionally comprises additives such as plasticizers, solvents, inorganic and/or organic fillers, kaolins, aluminium oxides, silicas, fibers, pigments, thickeners, stabilizers, adhesion promoters, drying agents, rheology controllers, catalysts and/or thixotropic additives.

[0066] Thixotropic agents particularly include layered silicates such as bentonites, derivatives of castor oil, hydrogenated castor oil, polyamides, polyamide waxes, polyurethanes, urea compounds, fumed silicas, cellulose ethers or hydrophobically modified polyoxyethylenes. Preferably, the thixotropic additives comprise polyureas and/or polyamide waxes.

[0067] Suitable fillers include silicic acid derivatives, talc, metallic powder, calcium carbonate, clay, carbon black among others.

[0068] Further auxiliary agents or additives may be included, selected from: adhesion promoters, especially silane-containing compounds, which may additionally contain at least one reactive group, such as epoxy-, isocyanate-, amine

groups or double bonds, dyes or pigments, polyurethane catalysts, such as lead and/or tin and/or other metal compounds, occasionally combined with the use of further catalysts, especially of tertiary amine-containing catalysts, UV-absorbing agents or stabilizers, such as phenolic antioxidants and screening agents.

[0069] In a highly preferred embodiment, the adhesive comprises carbon black and/or calcium carbonate.

[0070] In particular, the calcium carbonate is a surface-coated, especially a stearate-coated, calcium carbonate.

[0071] Carbon black and/or calcium carbonate lead to good stability, also against sagging, and good viscosity properties of the adhesive. Especially added in combination, carbon black and calcium carbonate exhibit synergistic effects and improve the stability and the viscosity of the adhesive.

[0072] Especially, the adhesive comprises 10 - 50 wt. %, preferably 15 - 45 wt. %, especially preferred 20 - 40 wt. %, calcium carbonate and/ or carbon black, related to the total weight of the adhesive.

[0073] Preferably, the adhesive comprises a thixotropic additive, especially a polyurea and/or a polyamide wax.

[0074] In certain embodiments, the thixotropic additive comprises a paste formed by dispersing the thixotropic additive based on urea in a plasticizer. In certain embodiments, the urea-based thixotropic additive may comprise a paste comprising about 15 to 35 wt. % of a thixotropic urea and about 65 to 85 wt. % of a plasticizing phthalate. Preferably, the thixotropic urea is prepared by reacting a monoamine, for example butylamine, with a diisocyanate, for example diphenylmethane diisocyanate.

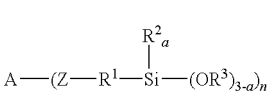
[0075] Especially, the adhesive comprises 1-50 wt. %, preferably 15 - 45 wt. %, especially preferred 20 - 40 wt. %, thixotropic agent, related to the total weight of the adhesive.

[0076] Especially, the adhesive comprises polyester additives comprising polyester groups. The polyester additives can be reactive and/or non-reactive. Especially, the polyester additive is a silane-functional polyester additive, e.g. as described below in the following examples.

[0077] Especially, the adhesive comprises 0.1 - 20 wt. %, preferably 1 - 15 wt. %, especially preferred 5-12 wt. %, polyester additives, related to the total weight of the adhesive.

[0078] According to a first example, a silane-functional polymer adhesive comprises at least one silane-crosslinking polymer, optionally fine-particle coated calcium carbonate, and optionally soot More specifically, the silane-functional polymer adhesive comprises following constituent(s):

a) silane-crosslinking polyurethane polymer constructed in accordance with the following formula (I):



(I)

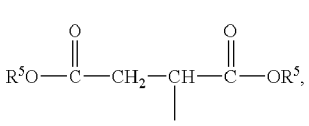
where R^1 stands for an alkyl group having 2 to 8 carbon atoms, linear or branched,

R^2 stands for an alkyl radical having 1 to 8 carbon atoms,

R^3 stands for an alkyl radical having 1 to 5 carbon atoms,

a stands for 0 or 1,

Z stands for a sulfur or an NR^4, where R^4 stands for a hydrogen atom or an organic radical, for example, an alkyl group or an aryl group having 1 to 20 carbon atoms, or a compound having ester groups such as, for example, a moiety of the formula (II)



(II)

where R^5 stands for an alkyl group having 1 to 8 carbon atoms,

n denotes a number from 2 to 4,

and A stands for a radical of a polyurethane prepolymer with the functionality n,

b) optionally, fine-particle coated calcium carbonate, by which is meant fatty acid-treated calcium carbonates having a

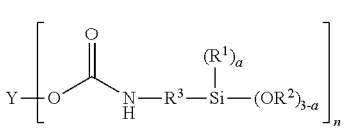
particle size of from 0.05 to 1 micron, with a density of approximately 2.6-2.7 g/ml, and

c) optionally, soot, preference being given to grades having a large surface area, with a density of approximately 1.8 g/ml, there being from 20 to 50 ml of fillers b)+c) per 100 g polymer a), and the volume ratio of b) to c) being between 70/30 and 30/70.

[0079] Such kind of adhesive compositions are described in WO 2002/090411 A1, which is incorporated by reference, especially p. 7, l. 24 - p. 16, l. 14 and p. 16, l. 15 - p. 19. Especially, the adhesive compositions are compositions according to examples 3 - 7 as described in tables 1-3 on pages 18-19 of WO 2002/090411 A1.

[0080] According to a second preferred example, a silane-functional polymer adhesive comprises

a) a silane-functional polyester of formula (I):



(I)

wherein

Y is an n-valent residue of a polyester P which is solid at room temperature and terminated by hydroxy groups, after removal of n hydroxy groups;

R^1 is a linear or branched, monovalent carbon residue having 1 to 12 carbon atoms, optionally having one or more C-C multiple bonds and/or having optionally cycloaliphatic and/or aromatic portions;

R^2 is an acyl residue or a linear or branched, monovalent hydrocarbon residue having 1 to 12 carbon atoms, optionally having one or more C-C multiple bonds and/or having optionally cycloaliphatic and/or aromatic portions;

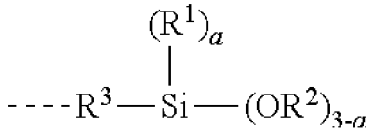
R^3 is a linear or branched, divalent hydrocarbon residue having 1 to 12 carbon atoms, optionally having cyclic and/or aromatic portions, and optionally having one or more heteroatoms;

the variable a has a value of 0, 1 or 2; and

the variable n has a value of 1 to 3.

b) at least one silane-functional polymer STP, for example, having end groups of formula (III).

(III)



with R^1, R^2, R^3 and a have already been described above.

[0081] Such kind of adhesive compositions are described in WO 2010/136511 A1, which is incorporated by reference, especially p. 3, l. 5-p. 25, l. 30 and p. 26 - 32. Especially, the adhesive compositions are compositions according to p. 30, l. 25 - p. 31 as described in WO 2010/136511 A1.

[0082] According to a third example, a polyurethane adhesive comprises the following composition:

- at least one polyether urethane polymer P1 containing isocyanate groups with a monomeric diisocyanate content of at most 0.5 % by weight obtained from the reaction of at least one monomeric diisocyanate with at least one polyether polyol with an average molecular weight Mn of more than 2,500 g / mol an NCO/OH ratio of at least 3/1 and subsequent removal of a majority of the monomeric diisocyanates using a suitable separation process, and

- more than 20 % by weight of carbon black, based on the entire composition, and

- optionally a maximum of 2 % by weight of a polyurethane polymer P2, which is solid at room temperature, based on the entire composition, obtained from the reaction of at least one monomeric diisocyanate with at least one at least partially crystalline polyester or polycarbonate polyol in an NCO / OH ratio of at least 1.3 /1 , and

- optionally up to 5 % by weight of a polyetherurethane polymer P3, based on the entire composition, obtained from the reaction of at least one monomeric diisocyanate with at least one polyetherdiol with an average molecular weight M_n of at most 2,500 g / mol in an NCO /OH ratio of at least 1.3/1, with the proviso that at least one of the polymers P2 and P3 is contained in the composition

[0083] A "monomeric diisocyanate" is an organic compound with two isocyanate groups that are separated from each other by a divalent hydrocarbon radical with 4 to 15 carbon atoms.

[0084] A "polyetherurethane polymer" is a polymer that has ether groups as repeating units and additionally contains urethane groups.

[0085] A "polyesterurethane polymer" is a polymer that has ester groups as repeating units and additionally contains urethane groups.

[0086] The "NCO content" refers to the content of isocyanate groups in percent by weight based on the entire polymer.

[0087] "Molecular weight" is the molar mass (in grams per mole) of a molecule or a residue of a molecule. The "average molecular weight" is the number-average molecular weight (Mn) of a polydisperse mixture of oligomeric or polymeric molecules or molecular residues. It is determined using gel permeation chromatography (GPC) against polystyrene as a standard.

[0088] Such kind of adhesive compositions are described in WO 2023/180217 A1, which is incorporated by reference, especially p. 5, 1. 10 - p. 39 and p. 40 - 49. Especially, the adhesive compositions are compositions Z1, Z2 or Z11 - Z15 as described in tables 1 and 2 on p. 39 and 40 of WO 2023/180217 A1.

[0089] According to a fourth example, a polyurethane adhesive comprises at least one urethane prepolymer formed from a reaction product comprising:

i) one or more polyisocyanates;

ii) one or more liquid polyetherpolyols; and

iii) one or more thermoplastic polyesterpolyols;
wherein the urethane prepolymer has a free isocyanate content of from about 0.6 to about 3.5 % by weight, based on the weight of the polyurethane

[0090] Thereby, preferably, one or more of the following conditions are fulfilled:

- said one or more polyisocyanates comprises one or more diisocyanates;

- said one or more liquid polyetherpolyols comprises an ethylene oxide end capped triol and/or a propylene oxide end capped triol;

- said one or more liquid polyetherpolyols comprises an ethylene oxide end capped triol having a weight average molecular weight of about 4500 to about 5000.

- said one or more liquid polyetherpolyols comprises a propylene oxide end capped triol having a weight average molecular weight of from about 150 to about 250;

- said one or more liquid polyetherpolyols comprises polypropylene glycol.

- said one or more liquid polyetherpolyols comprises polypropylene glycol having a weight average molecular weight of about 3500 to about 4500

[0091] Such kind of adhesive compositions are described in WO 02/092714 A1, which is incorporated by reference, especially p. 5,- p. 15, l. 5. Especially, the adhesive compositions are compositions I - VI as described in tables 1 and 2 on p. 15,1. 10 - p. 30 of WO 02/092714 A1.

[0092] A second aspect of the invention concerns a dry wall and/or a dry ceiling obtainable or obtained by the method

according to the embodiments in the previous description.

[0093] A dry wall and/or a dry ceiling comprises a supporting framework, an adhesive and at least one board, whereby the board and the supporting framework are connected to each other by the adhesive and whereby the adhesive is an adhesive as described above.

[0094] An inventive dry wall and/or an inventive dry ceiling facilitates the installation of such a dry wall and/or a dry ceiling greatly. During transportation of the dry wall and/or the dry ceiling, the board and the supporting framework only move minimal distances against each other, obtaining essentially the original structure of the bonded composite right after joining the board and the supporting framework by the adhesive. Thus, a high stability of the dry wall and/or the dry ceiling can be achieved, especially during transportation.

[0095] In a third aspect, the dry wall and/or the dry ceiling comprise a supporting framework, an adhesive and at least one board, whereby the board and the supporting framework are connected to each other by the adhesive and whereby the adhesive is an adhesive according to the embodiments mentioned in the previous description.

[0096] In another preferred embodiment it is also possible that the dry wall and/or the dry ceiling additionally comprises at least one paneling element. Especially, the paneling element is attached to the at least one board.

[0097] Preferably, the paneling element is attached to the board by a second adhesive. Most preferably, the second adhesive is the same as the adhesive used to connect the supporting framework and the board.

[0098] However, it is also conceivable that the second adhesive differs from the adhesive used to connect the supporting framework and the board. Especially, the second adhesive can for example be a wood glue. The wood glue may for example be selected from animal glue, urea-formaldehyde resin adhesives, phenol formaldehyde resin adhesives, lignin-phenol-formaldehyde resin adhesives, polyurethane adhesives, epoxy resin adhesives, cyanoacrylate adhesives, casein glue, polyvinyl acetate adhesives and/or aliphatic resin adhesives. Especially preferred are polyvinyl acetate adhesives.

[0099] In another preferred embodiment, the at least one paneling element is attached offset to the at least one board, such that the paneling element covers possible joints created by the at least one board.

[0100] In an especially preferred embodiment, the second adhesive is SikaBond®-530.

[0101] The second adhesive allows for a more rigid and/or stable structure of the dry wall and/or the dry ceiling.

[0102] A fourth aspect of the invention concerns the use of an adhesive as described above for the production of a dry wall and/or a dry ceiling, whereby the adhesive is used for bonding one or more boards to a supporting framework. Especially, the bonding is performed without penetrating the board(s).

[0103] The board(s) and supporting framework are as defined above in connection with the other aspects of the invention.

[0104] Further advantageous configurations of the invention are evident from the exemplary embodiments.

Brief description of the figures

[0105] The drawings used to explain the embodiments show:

Fig. 1 A perspective view of an inventive supporting framework

Fig. 2 A cross-sectional view of an inventive dry wall

Fig. 3 A cross-sectional view of a cutout of an adhesive layer connecting part of a supporting framework and part of a board after step d) according to the invention.

Fig. 4a A cross-sectional view of a test arrangement comprising a supporting framework, a board, a paneling element, and nails.

Fig. 4b A cross-sectional view of a test arrangement comprising a supporting framework, an inventive adhesive, a board, a second adhesive, a paneling element, and nails.

Fig. 4c A cross-sectional view of a test arrangement comprising a supporting framework, an inventive adhesive, a board, a second adhesive and a paneling element.

[0106] In the figures, the same components are given the same reference symbols.

Exemplary embodiments

[0107] Fig. 1 shows a perspective view of an inventive supporting framework 1. The supporting framework 1 comprises a top plate 11, two bottom plates 12, vertically placed studs 3 and horizontally placed blockings 2. Between the top plate 11,

the bottom plates 12, the studs 3 and/or the blockings 2, intermediate spaces 4 are formed. Boards 6 can be connected to either side of the supporting framework 1, as indicated by the arrows pointing away from the boards.

[0108] Fig. 2 illustrates a cross-sectional view of an inventive dry wall 5. The supporting framework 1 is partially coated with an inventive adhesive 7 and connected to several boards 6.

[0109] Fig. 3 shows a cross-sectional view of a cutout of an adhesive layer 7 connecting part of a supporting framework 1 and part of a board 6 after step d) according to the invention. The double arrow indicates the thickness of the inventive adhesive.

[0110] Fig. 4a shows a cross-sectional view of a test arrangement comprising a supporting framework 1, a board 6, a paneling element 9 and nails 8. The framework 1, the board 6 and the paneling element 9 are attached to each other by nails 8. The nails 8 penetrate the board 6 as well as the paneling element 9 and they partially enter the supporting framework 1.

[0111] Fig. 4b shows a cross-sectional view of a test arrangement comprising a supporting framework 1, an inventive adhesive 7, a board 6, a second adhesive 10, a paneling element 9 and nails 8. The framework 1 and the board 6 are attached by an inventive adhesive 7. The board 6 and the paneling element 9 are attached to each other by a second adhesive 10. Additionally, all five layers, i.e. the supporting framework 1, the inventive adhesive 7, the board 6, the second adhesive 10 and the paneling element 9 are connected to each other by nails 8. The nails 8 penetrate the inventive adhesive 7, the board 6, the second adhesive 10 as well as the paneling element 9 and they partially enter the supporting framework 1.

[0112] Fig. 4c shows a cross-sectional view of a test arrangement comprising a supporting framework 1, an inventive adhesive 7, a board 6, a second adhesive 10 and a paneling element 9. The framework 1 and the board 6 are attached by an inventive adhesive 7. The board 6 and the paneling element 9 are attached to each other by a second adhesive 10.

Comparative tests

[0113] Experimental tests have shown that a dry wall produced according to the inventive method exhibits a higher stability than conventionally produced dry walls.

[0114] In the test setup, the stability of three differently produced dry walls has been examined by applying a vertical shear force to them. The three test dry walls shown in Fig. 4a - 4c comprised each a supporting framework and a board attached to the supporting framework, whereas the attachment was realized either by nails (Fig. 4a), by nails and an inventive adhesive (Fig. 4b) or only by an inventive adhesive (Fig. 4c). The following table illustrates the different test methods as well as the vertical shear force applied to the dry walls to the point of crack formation in the board.

	Dry wall illustrated in Fig. 4a	Dry wall illustrated in Fig. 4b	Dry wall illustrated in Fig. 4c
Nails	Yes	Yes	-
Inventive adhesive	-	Yes	Yes
Shear force [N]	1’856	3’080	3’150

[0115] The results show that a dry wall produced by an inventive method, i.e., by connecting the supporting framework to the board only by an inventive adhesive (Fig. 4c), is the most stable arrangement, since the force needed to induce cracks is the highest. The shear force applied to the dry wall in Fig. 4c exceeds the shear force applied to the dry wall shown in Fig. 4a (only nails) by approximately 70 %, meaning that a greater force has to be applied to the dry wall in Fig. 4c until cracks form in the board.

[0116] Surprisingly, it has also been discovered by these tests that the inventive method even leads to a more stable dry wall than a dry wall combining nails and an inventive adhesive (see Fig. 4b). The necessary shear force to induce crack formation in an inventive dry wall (Fig. 4c) exceeds the necessary shear force for the dry wall in Fig. 4b by approximately 2 %. It can therefore be concluded that 1) the use of nails as fasteners have a negative impact on the integrity of the board, thus leading to crack formation and 2) the inventive solution using solely an inventive adhesive shows the most stable dry wall.

[0117] It will be appreciated by those skilled in the art that the present invention can be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The presently disclosed embodiments are therefore considered in all respects to be illustrative and not restricted.

List of reference symbols (not submitted)

[0118]

1	Supporting framework
2	Blocking
3	Stud
4	Intermediate space
5	Dry wall (cross section)
6	Board
7	Adhesive
8	Nails
9	Paneling element
10	Second adhesive
11	Top plate
12	Bottom plate

Claims

1. Method for producing a dry wall and/or a dry ceiling (5) comprising a supporting framework (1) and at least one board (6), comprising the steps of:

    a) Providing and/or obtaining a supporting framework (1),
    b) Providing and/or obtaining at least one board (6),
    c) Applying an adhesive (7) to the supporting framework (1) and/or the board (6); and
    d) Placing the board (6) onto the supporting framework (1), such that the board (6) and the supporting framework (1) are connected to each other by the adhesive (7) to obtain a bonded composite,

    whereby a green strength of the adhesive (7) is such that a structure of the bonded composite remains essentially intact when the bonded composite is lifted at the supporting framework (1) and/or at the board (6) immediately after step d).

2. Method according to claim 1, whereby in step d) the board (6) is placed onto the supporting framework (1) in a vertically upright position.

3. Method according to claim 2, whereby the surface weight of the board (6) on the supporting framework (1) is 0.1 - 40 g/cm^2, preferably 0.2 - 20 g/cm^2, most preferred 0.5 - 10 g/cm^2 or 0.6 - 5 g/cm^2.

4. Method according to any of claims 1-3, whereby after step d) the adhesive (7) has a layer thickness of 1 - 5 mm, preferably of 2 - 4 mm, most preferred of 3 mm.

5. Method according to any of claims 1-4, whereby the board (6) is a wall board and/or a ceiling board.

6. Method according to any of claims 1-5, whereby the board (6) is a cement board, composite board, wooden board, a chipboard, a gypsum plasterboard and/or a gypsum fiberboard.

7. Method according to any of claims 1-6, whereby the supporting framework (1) comprises interconnected studs (3), blockings (2), bottom plates (12), top plates (11) and/or intermediate spaces (4).

8. Method according to any of claims 1-7, whereby the intermediate spaces (4) contain insulation material, preferably organic, mineral and/or synthetic insulation material, especially the insulation material comprises mineral wool, wood fiber, cellulose, rockwool, glass wool, calcium silicate, mineral foam, extruded polystyrene, expanded polystyrene, polyurethane and/or aerogel.

9. Method according to any of claims 1-8, whereby the supporting framework (1) is made of wood, metal and/or synthetic

material.

10. Method according to any of claims 1-9, whereby the adhesive (7) is configured such that, directly after application to a vertical surface it can hold a flat planar element with a surface weight of 20 g/cm^2 or more pressed onto the adhesive to form a layer thickness of the adhesive of 3 mm and a full surface bonding between the vertical surface and the flat planar element, whereby the element bonded in this way does not slip more than 10 mm during 1 minute.

11. Method according to any of claims 1 - 10, whereby the adhesive (7) belongs to the group of polyurethane adhesives and/or silane-functional polymer (STP) adhesives.

12. Method according to any of claims 1 - 11, whereby the adhesive (7) comprises 10- 50 wt. %, preferably 15 - 45 wt. %, especially preferred 20 - 40 wt. %, calcium carbonate and/or carbon black, related to the total weight of the adhesive.

13. Method according to any of claims 1 - 12, whereby the adhesive (7) additionally comprises additives such as plasticizers, solvents, inorganic and/or organic fillers, kaolins, aluminium oxides, silicas, fibers, pigments, thickeners, stabilizers, adhesion promoters, drying agents, rheology controllers, catalysts, polyesters and/or thixotropic additives.

14. A dry wall and/or a dry ceiling (5) comprising a supporting framework (1), an adhesive (7) and at least one board (6), whereby the board(6) and the supporting framework (1) are connected to each other by the adhesive (7) and whereby the adhesive (7) is an adhesive (7) as defined in any of claims 1-13.

15. Use of an adhesive (7) as described in any of claims 1 - 13, for the production of a dry wall and/or a dry ceiling, whereby the adhesive (7) is used for bonding one or more boards (6) to a supporting framework (1).

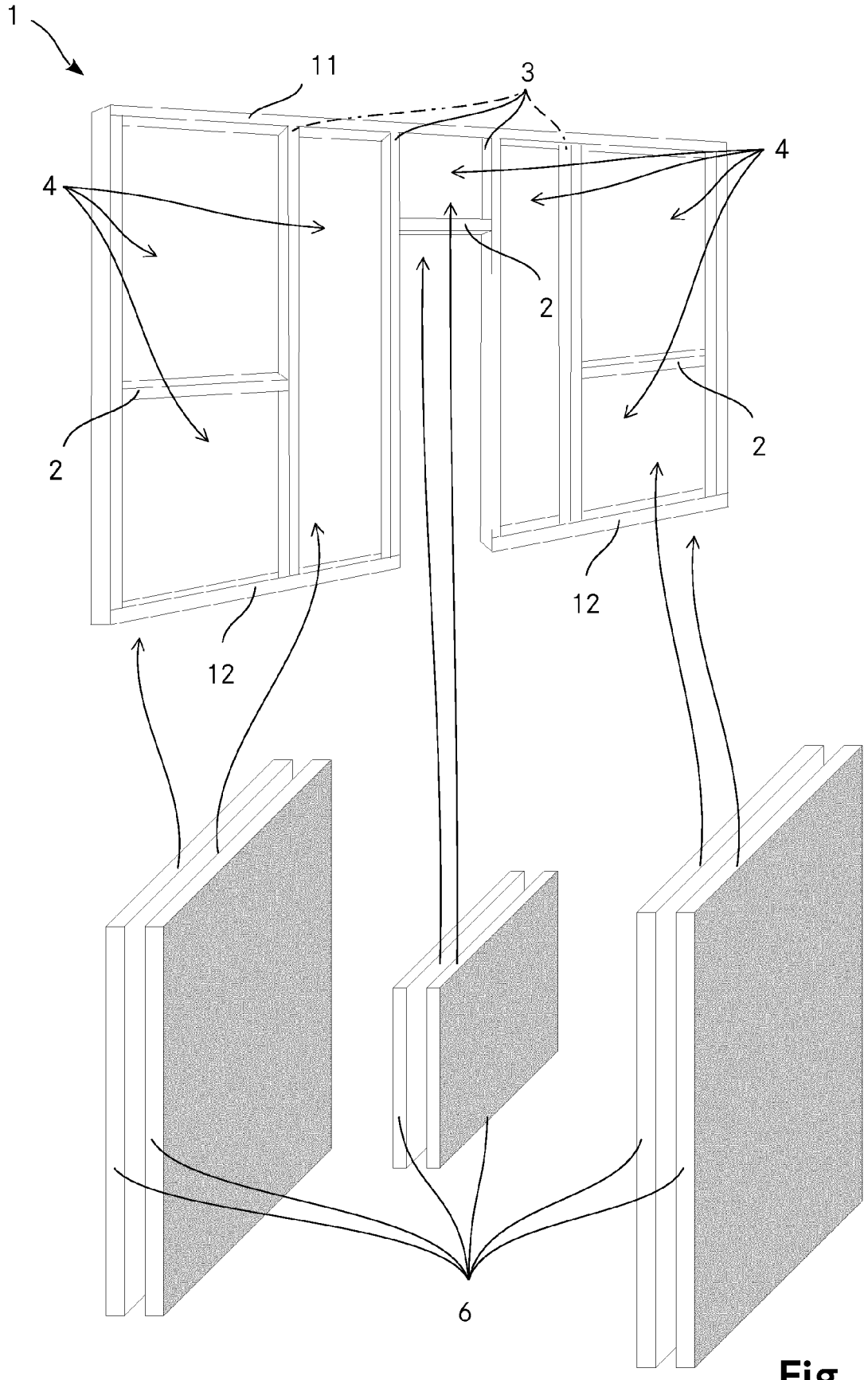


Fig. 1

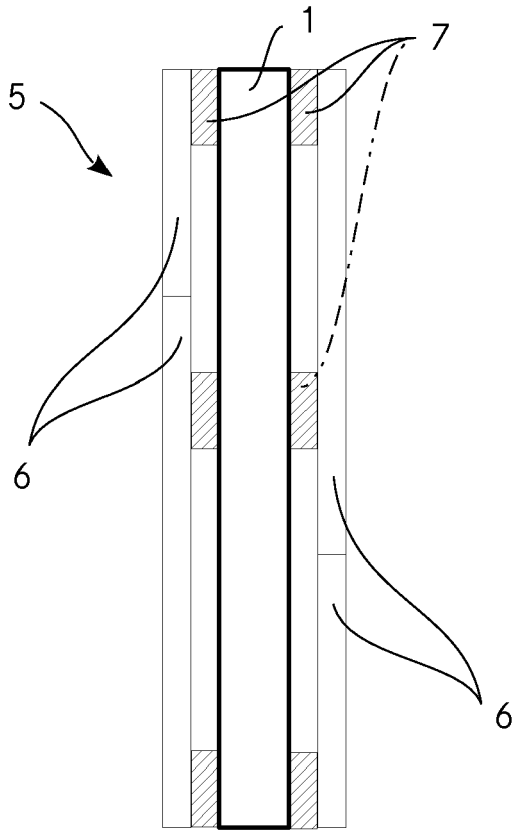


Fig. 2

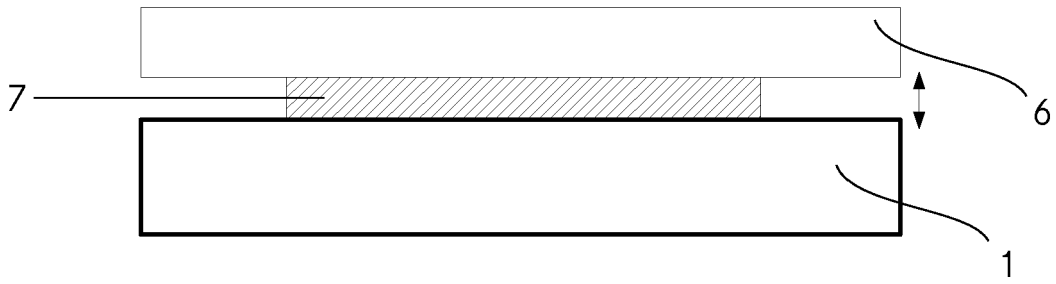


Fig. 3

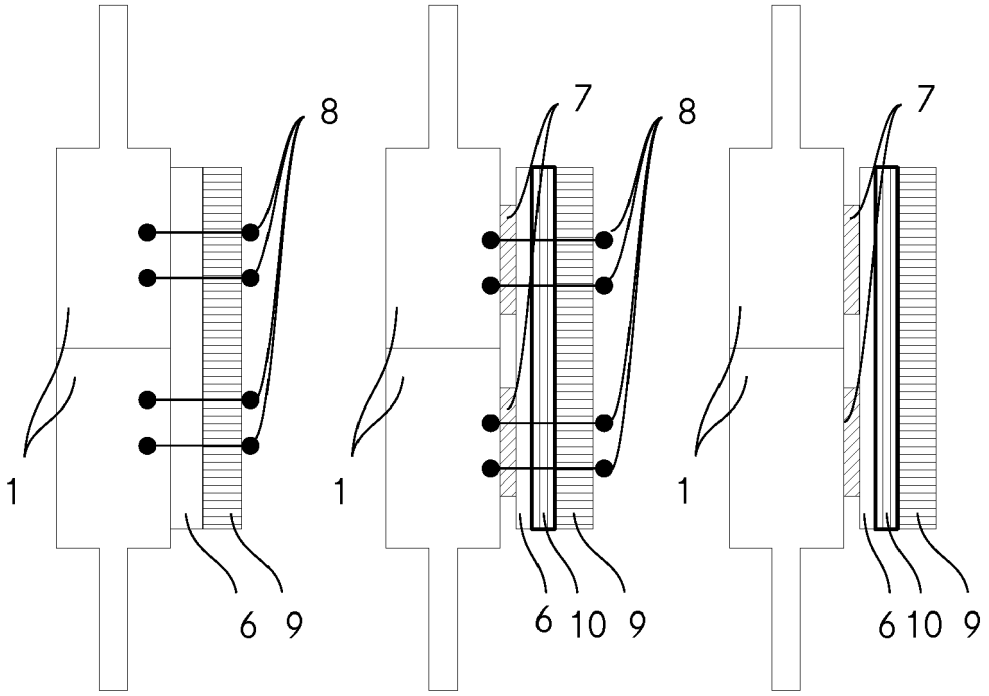


Fig. 4a Fig. 4b Fig. 4c

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EUROPEAN SEARCH REPORT

Application Number
EP 23 21 9965

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 2023/146388 A1 (CHUA TZE NEN [MY]) 3 August 2023 (2023-08-03) * paragraph [0001] - paragraph [0111]; figures 1-30 *	1-15	INV. E04B2/74
X	WO 97/14855 A1 (PEHRSON CLAES GOERAN [SE]) 24 April 1997 (1997-04-24) * page 1, line 1 - page 8, line 25; figure 1 *	1-15	
X	US 4 914 883 A (WENCLEY STANLEY E [US]) 10 April 1990 (1990-04-10) * column 1, line 13 - column 5, line 40; figures 1-10 *	1-15	
A	Sika: "Sikaflex 118 construction adhesive", , 2 April 2020 (2020-04-02), XP093171656, Retrieved from the Internet: URL:https://gcc.sika.com/dam/dms/gcc/x/sikaflex_-118_extremegrab.pdf [retrieved on 2024-06-06] * the whole document *	1-15	

TECHNICAL FIELDS SEARCHED (IPC)
E04B
E04F
E04C
C08G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	6 June 2024	Dieterle, Sibille

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06-06-2024

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2023146388 A1	03-08-2023	NONE	
WO 9714855 A1	24-04-1997	AU 7347996 A	07-05-1997
		CA 2234608 A1	24-04-1997
		EP 0847463 A1	17-06-1998
		NO 311985 B1	25-02-2002
		WO 9714855 A1	24-04-1997
US 4914883 A	10-04-1990	NONE	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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Patent documents cited in the description

- WO 2002090411 A1 **[0079]**
- WO 2010136511 A1 **[0081]**
- WO 2023180217 A1 **[0088]**
- WO 02092714 A1 **[0091]**