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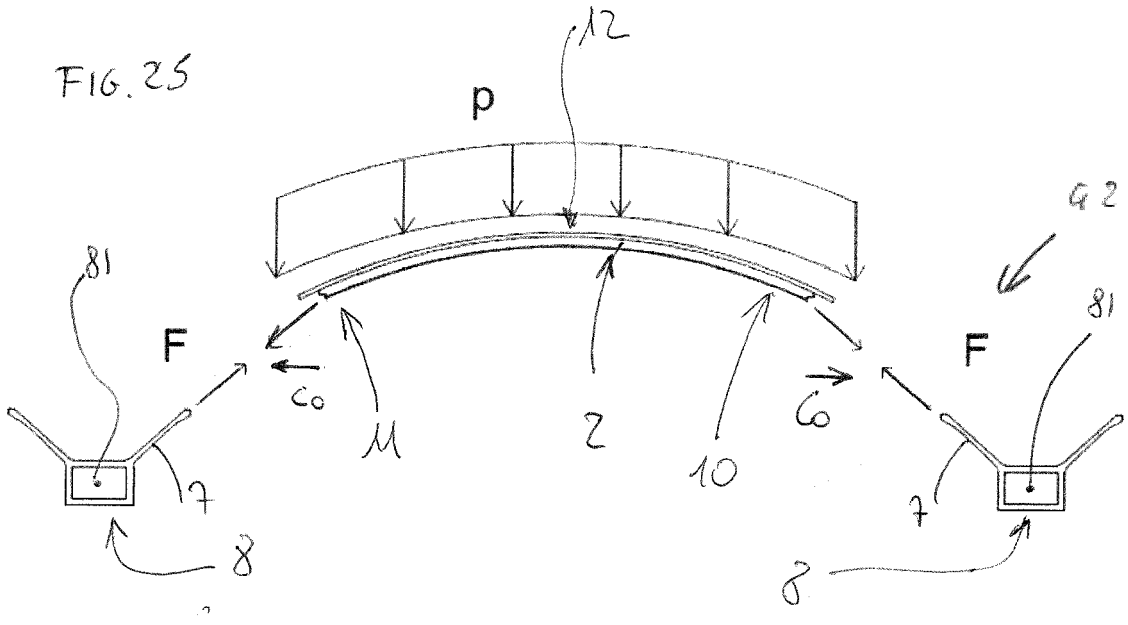
(54) **A BUILDING MATERIALS GROUP FOR REALISING A BUILDING COVERING**

(57) A building materials group is described, comprising two building beams and at least a multi-layer building panel, which has: a first and a second coupling region, in which, when the multi-layer building panel is arranged with the first and the second coupling portion coupled and resting, respectively, on the first and the second building beam, it distributes thereon, respectively, a first and a second horizontal component, opposite one another, of the weight thereof in order to prevent the panel from displacing towards the longitudinal axis, respectively, of the first and the second building beam.



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Description

[0001] The present invention relates to the technical sector of building groups for realising a building covering. These comprise building support elements (8) and multi-layer building panels made of a composite material, also known as "sandwich panels", which are typically used for coverings or industrial roofs. These known multi-layer building panels can be planar (see figures 1-2) or curved (see figures 3-9) and comprise; three layers, solidly constrained to one another, of which: a first layer (3) comprises a first sheet; a second layer (4), which is thermally insulating, which is arranged in contact with the a first layer (3); and a third layer (5), which comprises a second sheet (151) made of a second building material. The third layer (5) is arranged in contact when the second layer (4) on an opposite side to the first layer (3), with respect to the second layer (4). The multi-layer building panel (1) has: a first and a second coupling region (10, 11), also known as connecting regions (enclosed within the dashed terminal areas of figure 1) both terminal and destined to couple, restingly, respectively, with a first and a second support building element (8); and a covering region (12), arranged between the first coupling region and the second coupling region (10, 11), for superiorly closing the space comprised between the building support elements (8). See, for example, as illustrated in figure 1. A terminal structural element (6) is present in the coupling regions (10, 11) which element (6) joins the third layer (5) to the first layer (3) and laterally delimits the second layer (4). Typically, the terminal structural element (6) is in a single body with the second sheet of the third layer (5) (see figure 5), but can also not be in a single body with the sheet of the third layer (5), (see figure 7). Sometimes suitable supports (16) can also be included which are interposed between the coupling portions and the wing element (7) (see figure 6).

[0002] The building support elements (8), commonly used in building groups for realising a building covering, with the aim of supporting the multi-layer building panels, can consist of building beams, winged building beams (8) comprising a wing element (7) (also known as a tile) arranged horizontal (see figure 4), or in a vertical wall which can be, in turn, borne by the wing element (7). As can be observed in figure 4, a known curved multi-layer building panel (2) has the first and the second coupling region (10, 11) resting, respectively, on a first and a second wing element (7) belonging to two horizontal and contiguous winged building beams (8). A multi-layer building panel has a minimum inherent load-bearing capacity which does not depend on the fixing thereof but on the structural and shape characteristics thereof. When the multi-layer building panel is coupled resting on the two building support elements (8) but fixed to neither thereof, it has a load-bearing capacity equal to the minimum inherent load-bearing capacity thereof.

[0003] Once fixed to a pair of building support elements (8), the load-bearing capacity of the fixed multi-layer building panel is greater than the minimum inherent load-bearing capacity and varies, according to the number of fixing points, up to a maximum load-bearing capacity.

[0004] A need has always been recognised to increase the load-bearing capacity of a fixed multi-layer building panel and/or to increase the extension of the covering portion to increase the distance (also known as a gap) between the first and the second support building element. In fact, this would enable lightening the total mass of the coverings and facilitating and accelerating the realising of the coverings.

[0005] As illustrated in figures 5-11, the coupling portions (10, 11) must be fixed to the building support elements (8) by means of fixing elements (13) such as screws, dowels, bolts etc., both for obtaining a load-bearing capacity of the fixed multi-layer building panel greater than the minimum inherent load-bearing capacity of the not-fixed panel, and to prevent the weight of the panel and any loads bearing thereon (for example due to snow) from displacing the panel towards the longitudinal axis of a first winged building beam (8) on which the first coupling portion (10) is rested. In this way, in fact, a horizontal component of the weight of the multi-layer building panel (1) is distributed on the fixing elements (13), as well as any loads bearing upon it, and this prevents the panel from displacing towards the longitudinal axis of the first winged building beam (8). Further, once a curved multi-layer building panel (1) has been fixed to the first and second winged building beam (8), the fixing elements (13) prevent it from deforming by flattening, beneath the action of any bearing loads, causing a displacement of the first and the second coupling portion (or connecting portion) (10, 11) with respect to the longitudinal axis, respectively, of the first and second winged building beam (8).

[0006] The fixing elements (13) require at least the first coupling portion (10) to have through-holes in which to insert the fixing elements. Over time, the horizontal component of the weight of the panel, distributed on the fixing elements (13), tends to widen the holes. Over time this leads to a less effective sealing action and a greater possibility of infiltrations, internally of the room delimited by the multi-layer building panel (2), coming from the widened holes. Note also that curved multi-layer building panels (2) tend to flatten and this contributes to further widening the holes, further increasing the possibility of infiltrations.

[0007] Additionally, once the multi-layer building panel (2) has been rested on the two building support elements (8), it is not stabilised with respect to movements directed towards the longitudinal axis of the winged building beam (8), i.e. having a horizontal component, until the fixing elements are deployed. Therefore, the fixing operations take place while the multi-layer building panel (2) can still displace with the above movements. This can lead to a risk to the safety for the operatives working on the fixing, who are operating on the covering, and, generally speaking, in the worksite. Lastly, it is important to consider that

the fixing of the multi-layer building panel (1) to the first winged building beam (8) or to another support building element requires numerous fixing elements (13), with consequent repercussions on the fixing times and costs due to the necessary labour. There emerges, therefore, the need to reduce the possibility of infiltrations in a room superiorly delimited by a multi-layer building panel, and the risks, times and costs connected to the fixing of the multi-layer building panel.

[0008] The aim of the present invention consists in reducing and/or obviating the above-cited disadvantages with respect to the known building groups for realisation of a building covering comprising multi-layer building panels and building beams and in proposing solutions to the stated needs.

[0009] One of the main aims of the present invention consists in increasing, given same sizes and type of layers and fixing points, the load-bearing capacity of a multi-layer building panel of a building materials group comprising even two building beams, resting thereon. A further main aim of the invention is to be able to increase the distance between two support building elements, i.e. the two building beams of a building materials group for realising a building covering, on which a single multi-layer building panel is to be rested. An additional aim of the invention consists in reducing the possibility of infiltrations in a room superiorly delimited by a building covering comprising a building materials group having two building beams and at least a multi-layer building panel. Another aim of the invention is to reduce the risks connected to the fixing of a multi-layer building panel of the building materials group to the building beams. A further aim of the invention consists in reducing the times and costs for fixing a multi-layer building panel of a building materials group with the realising of a covering and in general the realising of the covering comprising it. An additional aim of the present invention consists in providing a building materials group comprising two building beams and a multi-layer building panel, reliable and having relatively modest costs with respect to the objectives which are set.

[0010] The aims and objectives outlined in the foregoing are according to a building materials group for realising a building covering, comprising two building beams, a multi-layer building panel, and according to independent claim 1.

[0011] By virtue of the presence of the connecting element and of the relative abutting element, the multi-layer building panel comprised in the building materials group for realising a building covering according to the invention, once positioned with the first and the second coupling portion (which can also be defined connecting portions) on the first and second building beam as defined in independent claim 1, or resting on a wing element, respectively, of a first and a second winged building beam, enables distributing on the building beams or on the relative wing elements a first and a second horizontal component, opposite one another, of the weight thereof, and any loads positioned thereon (for example snow, operatives working on the fixing work thereof, etc.). Said loads must not, of course, exceed the load-bearing capacity of the positioned multi-layer building panel. This prevents the panel from displacing including when it is not fixed to the building beams or to the wing elements of the winged building beams, in particular with movements having a horizontal component and directed towards the longitudinal axis of the building beams, the winged building beams, which comprise the wing element. In this way, the multi-layer building panel does not require fixing elements for preventing displacements towards the beams. Therefore, according to the invention, the fixing of the multi-layer building panel requires, given a same surface covered thereby and other factors, an extremely low number of fixing elements which is limited to only the fixing elements necessary only for the purpose of preventing severe atmospheric events (strong wind) from being able to raise the multi-layer building panel from the relative support elements. Consequently, according to the invention, the times and costs relative to the fixing operations of the multi-layer building panel of the building materials group according to the invention are lower than the costs relative to the multi-layer building panel of known type comprised in a building materials group of known type. The applicants estimate that, given an equal surface of the multi-layer building panel, the building materials group according to the invention might require, for the fixing in place of the multi-layer building panel, a number of fixing elements equal to or less than three-fifths of what is required by a known-type multi-layer building panel. According to the invention, the fixing operations of a multi-layer building panel comprised in the building materials group of the invention to the relative beams are more secure with respect to the those of the building materials group of known type and comprising a known-type multi-layer building panel. Given same dimensions and types of layers and fixing points of the multi-layer building panel, the load-bearing capacity of a multi-layer building panel of the building materials group of the invention, once fixed, is greater than that of a multi-layer panel of known type in a building materials group of known type. The building materials group of the invention thus enables increasing the distance between the relative building support elements, i.e. between the building beams, lightening the mass of the covering and facilitating and accelerating the realisation thereof.

[0012] In the following part of the present description, specific forms of actuation and embodiments of the invention will be described, according to what is set down in the claims and with the aid of the accompanying tables of drawings, in which figures 1-9 relate to the prior art and in particular:

figure 1 is a perspective view of a multi-layer building panel of known type;

figure 2 is a section view along a relative main plane of a further multi-layer building panel of known type;

figure 3 schematically illustrates the load of a multi-

layer building panel of known type resting on two support elements;
figure 4 is a section view along a main plane of a further multi-layer building panel of known type resting on two wing elements of two distinct horizontal winged building beams; and
figure 5 is an enlarged view and not in scale of detail X of figure 4:
figures 6-9 are larger-scale views, not in scale, of a first coupling portion (or connecting portion) of various multi-layer building panels of known type resting on respective wing elements of winged building beams;
figure 12 is a section view along a main plane of a known building materials group comprising a known-type multi-layer building panel which is not a part of the invention resting on two wing elements of two distinctive horizontal winged building beams;
figure 13 is an enlarged view and not in scale of detail Y of figure 12; and figure 24 illustrates a multi-layer building panel which is not a part of the invention.
Figures 10-11 and 14-26 and 25-26 are, instead, relative to the invention, in which: figure 10 is a section view along a main plane of a first embodiment of the building materials group according to the invention comprising a known-type multi-layer building panel resting on two wing elements of two distinct horizontal winged building beams which are a part of the building materials group;
figure 11 is an enlarged view and not in scale of detail W of figure 10:
figures 14-18 are larger-scale views, not in scale, of details of the building groups according to the invention illustrating a first coupling portion (or connecting portion) of the multi-layer building panels comprised in the building groups and resting on respective wing elements of winged building beams, also comprised in the building groups;
figures 19-23 are larger-scale views, not in scale, of various components of various embodiments of the multi-layer building panel comprised in the building materials group of the invention; and
figures 25-26 are schematic views which illustrate respective embodiments of the building materials group according to the invention.

[0013] Note that the sections of the multi-layer building panels comprised in the building materials group (42) of the invention have been taken along a plane passing through a fret of the relative first sheet. To improve the intelligibility of the figures, the sections include no indication of the shadings and the thicknesses of the first and second layer are not in scale.

[0014] With reference to figures 10-26, numerical reference (42) denotes the building materials group of the invention (see figures 10, 25 and 26), and reference number (2) denotes a multi-layer building panel made of a composite material comprised in the building materials group (42). This comprises:

A) at least a multi-layer building panel (2) made of a composite material in turn comprising:

- a first layer (3) which in turn comprises a first sheet (160) made of a first building material selected from a first building materials group constituted by: metal sheet; metal sheet coated with a rust-proof metal alloy; galvanised metal sheet; painted and galvanised metal sheet; steel sheet coated with a rust-proof metal alloy; galvanised steel sheet; painted and galvanised steel sheet; stainless steel sheet; fibre-cement; plastic reinforced by fiber glass; carbon fibre impregnated with polymerised resin; and carbon fibre textiles impregnated with polymerised resin;
- a second layer (4), which is thermally insulating, which is arranged in contact with the first layer (3) and is solidly constrained to the first layer (3);
- a third layer (5), which in turn comprises a second sheet (151) made of a second building material selected from the first building materials group, wherein the third layer (5) is arranged in contact with the second layer (4) on an opposite side to the first layer (3), with respect to the second layer (4), and wherein the third layer (5) is solidly constrained to the second layer (4);
- a first coupling region (10) and a second coupling region (11), both terminal and destined to couple, restingly, respectively, with a first support building element (8) and a second support building element (8, 90);
- a covering region (12) arranged between the first coupling region (10) and the second coupling region (11) and solidly constrained thereto;
- a section which is transversal, with respect to the first coupling region (10), which is arc-shaped, and which has a convex external edge,

wherein the first layer (3) is arranged at the convex external edge; and wherein the first and the second coupling region (10, 11) each comprise a relative connecting element (14), each of which extends from the first sheet (160) to the second sheet (151) and is solidly constrained thereto, and comprises: a third sheet, which is made of a third building material, selected from the first building materials group, and comprises, in turn, at least a first abutting element (15, 16), which is selected from: a first groove (15), which is accessible from outside the at least a multi-layer building panel (2); and a protuberance (16);
B) a first and a second building beam (8) (which obviously constitute two support building elements), each of which comprising: a respective longitudinal axis (81); and a second abutting element (17, 18) selected, respectively, between an abutment portion (17), which is at least partially receivable in the first

groove (15); and a second groove (18), in which the protuberance (16) is at least partially receivable;
in which the first abutting element (15, 16) of the first and the second coupling region (10, 11) is configured and arranged for, when the at least a multi-layer building panel (2) is arranged with the first layer (3) facing upwards and resting on the first and the second building beam (8) with the first and the second coupling portion (10, 11) coupled, resting, respectively, on the first and the second building beam (8) (obviously with the first and the second coupling portion (10, 11) parallel to the axes of the building beams), abutting, restingly, the second abutting element (17, 18), respectively of the first and the second building beam (8), distributing on the first and the second building beam (8), respectively, a first and a second horizontal component (Co), opposite one another, of the weight of the at least a multi-layer building panel (2) so as to prevent the at least a multi-layer building panel (2) from displacing towards the longitudinal axis (81), respectively, of the first and the second building beam (8).

[0015] Obviously, when the first abutting element is the first groove (15), the second abutting element (17, 18) is the abutment portion (17), while when the first abutting element is the protuberance (16), the second abutting element (17, 18) is the second groove (18).

[0016] A building materials group according to the invention is preferred in which the at least a multi-layer building panel (2) has the second coupling region (11) identical to the first coupling region (10).

[0017] In this case, but also when the coupling regions are different, it is preferable for the first and second building beam (8) to be winged and respectively comprise a first and a second wing element (7); wherein the first and second wing elements (7) comprise the second abutting element (17, 18), respectively, of the first and the second building beam (8). When the at least a multi-layer building panel (2) is arranged with the first layer (3) facing upwards, the connecting element (14) of the first coupling region (10) and the connecting element (14) of the second coupling region (11) are couplable, restingly, respectively, with the first and second wing element (7).

[0018] In this further embodiment of the building materials group of the invention the multi-layer building panel (2) comprises:

- a first layer (3) which in turn comprises (and preferably is constituted by) a first sheet (160) made of a first building material selected from a first building materials group constituted by: metal sheet; metal sheet coated with a rust-proof metal alloy; galvanised metal sheet; painted and galvanised metal sheet; steel sheet coated with a rust-proof metal alloy; galvanised steel sheet; painted and galvanised steel sheet; stainless steel sheet; fibre-cement; plastic reinforced by fiber glass; carbon fibre impregnated with polymerised resin; and carbon fibre textiles impregnated with polymerised resin;
- a second layer (4), which is thermally insulating, which is arranged in contact with the first layer (3) and is solidly constrained to the first layer (3); and
- a third layer (5), which in turn comprises (and is preferably constituted by) a second sheet (151) made of a second building material selected from the first building materials group, wherein the third layer (5) is arranged in contact with the second layer (4) on an opposite side to the first layer (3), with respect to the second layer (4), and wherein the third layer (5) is solidly constrained to the second layer (4);

wherein the multi-layer building panel (2) has: a first coupling region (10); a second coupling region (11), identical to the first coupling region (10), both terminal and destined to couple, restingly, respectively, with a first support building element (8) and a second support building element (8, 90); a covering region (12) arranged between the first coupling region (10) and the second coupling region (11) and solidly constrained thereto, a section which is transversal, with respect to the first coupling region (10), which is arc-shaped, and which has a convex external edge, wherein the first layer (3) is arranged at the convex external edge; wherein the first and the second coupling region (10, 11) comprise a relative connecting element (14), each of which extends from the first sheet (160) to the second sheet (151) and is solidly constrained thereto, and wherein each connecting element (14), when the multi-layer building panel (2) is arranged with the first layer (3) facing upwards, is destined to couple, restingly, with a wing element (7) of a winged building beam (8), which comprises a longitudinal axis (81). The connecting elements (14) each comprise: a third sheet, which is made of a third building material, selected from the first building materials group and comprises, in turn, at least a first abutting element (15, 16), which is selected from: a first groove (15), which is accessible from outside the multi-layer building panel (2); and a protuberance (16). The first abutting element (15, 16) is configured and arranged in such a way that, when the second coupling portion (11) is coupled restingly on the second support building element (8, 90); and the connecting element (14) of the first coupling region (10) is arranged resting on a wing element (7) of a first horizontal winged building beam (8) having a relative longitudinal axis (81), wherein the wing element (7), in turn, comprises a second abutting element (17, 18) (preferably terminal) selected from, respectively, an abutment portion (17), (preferably terminal) of the wing element (7), which is at least partially receivable in the first groove (15); and a second groove (18) (see figure 18), in which the protuberance (16) is at least partially receivable, abuts the second abutting element (17, 18) distributing, on the wing element (7), a horizontal component (Co) of the weight of the multi-layer building panel (2) (see figures 24-25) (as well as any gravitational loads arranged on the panel and smaller

than the load-bearing capacity of the panel). This is in order to prevent the multi-layer building panel (2) from being able to move towards the longitudinal axis (81) of the first winged building beam (8). In practice, this abutment prevents a horizontal sliding of the first coupling portion (10) towards the longitudinal axis, and therefore constrains, on a relative first side, the multi-layer building panel (2) to be resting on the wing element (7) and on the second support building element (8, 90). According to a first embodiment, when the second support building element is a second winged beam (8) (which is obviously identical to the first winged beam, see figure 25) which has a longitudinal axis (81), the multi-layer building panel (2) is arranged resting on the first and a second wing element (7), respectively, of the first winged building beam (8) and of the second winged building beam (8) distributing on the first and on the second wing element (7), two horizontal components (Co) and opposite of the weight of the multi-layer building panel (2) also to prevent the multi-layer building panel (2) from being able to move towards the longitudinal axis (81) of the second winged building beam (8). In this case, the multi-layer building panel (2) according to the invention is stabilised with respect to horizontal movements thereof directed towards one of the two winged building beams (8) and has, though not fixed, a load-bearing capacity that is greater than the minimum inherent load-bearing capacity that it would have if arranged resting on a support plane.

[0019] In the building materials group (42) according to the invention, the multi-layer building panel (2) is curved and, as it has the two coupling regions (10, 11) as previously defined (and optionally the second coupling region is identical to the first coupling region - see figures 10 and 26), the multi-layer building panel (2) is also prevented from deforming and flattening following loads bearing thereon. The first abutting element is preferably the first groove (15), in particular as defined in the present description.

[0020] Further, given the same characteristics, with the exclusion of the first abutting element, the load-bearing capacity of the multi-layer building panel comprised in the building materials group (42) of the invention not fixed to the wing element (7), is greater than the load of the multi-layer building panel of known type and not fixed to the wing element (7).

[0021] Like in the prior art, the covering portion (12) is destined to superiorly close the space comprised between the building support elements, being the building beams (8).

[0022] Obviously, and as illustrated in figures 10-11 and 14-23 and 25-26, the wing element (7) is the one arranged proximal to the multi-layer building panel (2) and not the one arranged distally thereto. The abutment portion (17) of the wing element (7) is preferably the terminal portion of the wing element (7) as illustrated in figures 10-11 an 14-17, alternatively the abutment portion (17) of the building beam of the winged building beam (8) can also be a further protuberance (not illustrated) comprised in the building beam or the wing element of the winged building beam which extends parallel to the longitudinal axis (81) of the building beam or the winged building beam (8). The first, second and third structural building material are preferably selected, independently of one another, from a second group of building materials consisting of: metal sheet; metal sheet coated with a rust-proof metal alloy; galvanised metal sheet; painted and galvanised metal sheet; steel sheet coated with a rust-proof metal alloy; galvanised steel sheet; painted and galvanised steel sheet; stainless steel sheet.

[0023] In general, the preferred building material is a metal sheet coated with a rust-proof metal alloy or a painted and galvanised metal sheet. The rust-proof metal alloy can be of various types and has protective characteristics for the metal sheet it covers. It can preferably comprise aluminium, zinc and silicon. For the purposes of the invention it is preferable to use "Aluzinc" sheets.

[0024] According to a preferred embodiment of the invention, the first abutting element (15, 16) is the first groove (15), which, when the multi-layer building panel (2) is arranged with the first layer (3) facing upwards, faces downwards. The first groove(15) can be defined by a first abutting wall (19), preferably planar, and a second abutting wall (20), preferably planar, which are inclined with respect to one another (see figure 11). These abutting walls (19, 20) can advantageously be arranged inclined by an angle comprised between 80° and 100°, preferably 85° and 95°, more preferably an angle of 90°.

[0025] It is preferable for the building materials group (42) according to the invention to comprise a multi-layer building panel (2), in which when it is resting with relative connecting portions on a support plane (not illustrated), the first abutting wall (19) of the first groove (15) is arranged parallel to the plane and, more preferably, the second abutting wall (20) is arranged perpendicularly to the plane and facing outwardly.

[0026] In a further embodiment of the invention, the first abutting element (15, 16) is the protuberance (16) (see figure 18). It can be advantageously defined by three abutting walls, preferably planar, which are preferably: a third abutting wall; a fourth abutting wall, which originates from the third abutting wall and is inclined, with respect to the third wall, by an obtuse angle; and a fifth abutting wall, which originates from the fourth abutting wall, and is inclined, with respect to the fourth wall, by an obtuse angle, in order to facilitate the receiving of the protuberance (16) in the second groove (18) of the wing element (7) of the winged building beam (8), acting in this way as a guide for the coupling between the first portion and the wing element (7).

[0027] The second groove (18) can advantageously be complementarily profiled to the protuberance (16). The second groove can be constituted by a continuous rib which extends along a side of the multi-layer building panel (2) but can also be constituted by a plurality of projections, discontinuous from one another. In this case, the first or the second coupling portion (or connecting

portion) (10,11) might advantageously couple with a building beam or a wing element (7) of a winged building beam (8) having a plurality of grooves, discontinuous with one another, complementarily profiled to the projections so as to prevent movements of the multi-layer building panel (2) in a parallel direction to the building beam or to the winged building beam (8).

[0028] When the abutting element is the first groove (15), in the covering region (12) the second layer (4) has a first minimum thickness which is constant. In this case, at least the first coupling region (10) has: a first portion, which extends from the covering region (12) to the first groove (15), and which has a second minimum thickness which is greater than the first minimum thickness; and a second portion, which is arranged at the groove, which has a third minimum thickness which is lower than the second minimum thickness and which, optionally, is identical to the first minimum thickness. A third portion can advantageously be provided which originates from the first groove (15), on the opposite side to the second portion, and which has a fourth minimum thickness which is greater than the third minimum thickness. This is with the purpose of preventing, at the first coupling portion (or connecting portion), impacting on the insulating capacity of the multi-layer building panel (2) and then, of guaranteeing the continuity of heat insulation. This is required by the existing standards in the sector.

[0029] When the first sheet (160) is fretted or corrugated, the minimum thicknesses of the second layer (4), are those relative to the areas without frets or the areas arranged at the concavities of the corrugation. When, instead, the first sheet (160) is not fretted, corrugated or profiled in another way, the minimum thicknesses are constant. The thickness of the second layer (4) preferably has a progressively increasing thickness in a direction which extends from the covering region (12) to the first groove (15); more preferably it has an increase in thickness that is constant along that direction, but it can also have a first value of increase in thickness along the direction proximally to the covering region (12), and a second value of increase in thickness along the direction that is smaller than the first, proximally to the first groove (15). Therefore the inclination of the external wall of the connecting element (14) will have portions with a different inclination in proximity of the first groove (15).

[0030] According to an aspect of the invention, when the first abutting element is the protuberance (16), the second layer (4), with the exception of at the protuberance (16), a first minimum thickness which is constant.

[0031] As illustrated in figures 10-11 and 14-19 and 25, the first layer (3) can project from the first coupling region (10) and/or from the second coupling region (11) in order to protect them from atmospheric agents, in particular from the rain and snow. For this purpose it can form a flap (21) (see figure 11).

[0032] Considering a known building materials group and a building materials group (42) of the invention, in which the second coupling region (11) is identical to the first coupling region (10), with the relative panels not fixed to the relative building support elements (8), i.e. the building beams, at which the following are supported (figures 3 and 26), the multi-layer building panel of the building materials group (42) according to the invention, owing to the connecting element (14), has horizontal constraints, which in figure 26 are denoted by numerical reference (24). The horizontal constraints (24) not only prevent horizontal displacements thereof but also lead to an increase in the relative load-bearing capacity from (P) to (aP) where α is greater than 1. This enables increasing the covering gap, i.e. the distance between the first and second building beam or between the first and second building beam (8), consequently lightening the total mass of the covering with respect to the known art.

[0033] The third sheet of the connecting element (14) can advantageously not be realised in a single body with the second sheet (151) (see figures 21-23), or with the first sheet (160). In a preferred aspect of the invention, the third sheet of the connecting element (14) is not realised in a single body with the second sheet (15) i.e. it is separate, from the second sheet (151) (see figures 19-20) and/or from the first sheet (160). In both cases, optionally and preferably, the first building material and/or the second building material and/or the third building material are selected, independently of one another, from a second group of building materials consisting of: metal sheet; metal sheet coated with a rust-proof metal alloy; galvanised metal sheet; painted and galvanised metal sheet; steel sheet coated with a rust-proof metal alloy; galvanised steel sheet; painted and galvanised steel sheet; stainless steel sheet, wherein the second layer (4) comprises a thermally insulating material selected from among: expanded polyurethane; expanded polystyrene; glass wool; cellulose; rock wool and polyester fibre. In this case the first sheet can preferably be fretted or corrugated.

[0034] Independently of the conformation of the multi-layer building panel (2) comprised in the building materials group (42) according to the invention, it is preferable for the first sheet (160), the second sheet (151) and the third sheet to be metal sheets and for the second layer (4) to be made of an expanded polyurethane. In this way, it is possible to manufacture the multi-layer building panel (2), comprised in the building materials group (42) of the invention, using a lower mould and a corresponding upper mould in which the following are arranged, in contact with the internal walls of the moulds: the first sheet (160), the second sheet (15); the third sheet for the first coupling portion (10); and, the coupling (10) of a further third sheet for the second coupling portion (11). Note that the third sheet and the further third sheet can be, or may not be, realised in a single body with the first sheet (160), or with the second sheet (151) and can be appropriately profiled with a groove (15) or a protuberance (16). In a case in which the second coupling portion (10) is different to the first coupling portion (10), the first sheet (160) or the second sheet (151) can be shaped so as to laterally close

the multi-layer building panel (2) at the second coupling portion (10). Alternatively, a terminal structural element can also be arranged, separately (not illustrated), which will join the third layer (5) to the first layer (3) and will laterally delimit the second layer (4). The two moulds, once coupled to one another, will have shapes and dimensions such as to define between them a space for the injection of a suitable quantity of a precursor material of the expanded polyurethane. Once the expanded polyurethane has been formed, it will function as a glue for making the following mutually solid to one another: the first sheet (160), the second sheet (15); the third sheet; and, in a case in which the second coupling portion is identical to the first coupling portion (10), the further third sheet.

[0035] It is however possible to manufacture the multi-layer building panel (2) comprised in the building materials group (42) according to the invention making mutually solidly constrained (for example using glues and pressing): the first sheet (160), the pre-constituted second layer (4), the second sheet (15), the third sheet, a possible further third sheet or the terminal structural element. In this case, it is preferable for the pre-constituted layer to be made of expanded polystyrene, glass wool, rock wool, cellulose and polyester fibre but might also be made of expanded polyurethane.

[0036] Advantageously, in all the embodiments of the building materials group (42) according to the invention and illustrated in the foregoing, the first sheet (160) of the multi-layer building panel (2) can be fretted (as illustrated in figures 10-26), corrugated or profiled in another way with the aim of increasing the minimum inherent load-bearing capacity of the multi-layer building panel (2), with the frets or the corrugations perpendicular to the first and second coupling portion (11, 10). The invention also relates to a building covering comprising a building materials group (42) according to the invention, in which the at least a multi-layer building panel (2) is arranged with the first layer (3) facing upwards and is resting on the first and the second building beam (8) with the first and the second coupling portion (10, 11) coupled and resting, respectively, on the first and the second building beam (8) (obviously with the first and the second coupling portion (10, 11) parallel to the axes of the building beams), and abut the second abutting element (17.18), respectively of the first and the second building beam (8), distributing on the first and the second building beam (8), respectively, the first and second horizontal component (Co), opposite one another, of the weight of the at least a multi-layer building panel (2) preventing the at least a multi-layer building panel (2) from displacing towards the longitudinal axis (81), respectively, of the first and the second building beam (8).

[0037] In the building covering, the first and second building beam (8) are preferably winged and respectively comprise a first and a second wing element (7); in which each of the first and second wing element (7) comprise the second abutting element (17, 18), respectively, of the first and the second building beam (8); and wherein the connecting element (14) of the first coupling region (10) and the connecting element (14) of the second coupling region (11) are couplable, restingly, respectively, with the first and second wing element (7).

Claims

1. A building materials group for realising a building covering, the building materials group (42) comprising:

   A) at least a multi-layer building panel (2) made of a composite material in turn comprising:

   - a first layer (3) which in turn comprises a first sheet (160) made of a first building material selected from a first building materials group constituted by: metal sheet; metal sheet coated with a rust-proof metal alloy; galvanised metal sheet; painted and galvanised metal sheet; steel sheet coated with a rust-proof metal alloy; galvanised steel sheet; painted and galvanised steel sheet; stainless steel sheet; fibre-cement; plastic reinforced by fiber glass; carbon fibre impregnated with polymerised resin; and carbon fibre textiles impregnated with polymerised resin;
   - a second layer (4), which is thermally insulating, which is arranged in contact with the first layer (3) and is solidly constrained to the first layer (3);
   - a third layer (5) which in turn comprises a second sheet (151) made of a second building material selected from the first building materials group, wherein the third layer (5) is arranged in contact with the second layer (4) on an opposite side to the first layer (3), with respect to the second layer (4), and wherein the third layer (5) is solidly constrained to the second layer (4);
   - a first coupling region (10) and a second coupling region (11), both terminal and destined to couple, restingly, respectively, with a first support building element (8) and a second support building element (8, 90);
   - a covering region (12) arranged between the first coupling region (10) and the second coupling region (11) and solidly constrained thereto;
   - a section which is transversal, with respect to the first coupling region (10), which is arc-shaped, and which has a convex external edge,

   wherein the first layer (3) is arranged at the con-

vex external edge; and wherein the first and the second coupling region (10, 11) each comprise a relative connecting element (14), each of which extends from the first sheet (160) to the second sheet (151) and is solidly constrained thereto, and comprises: a third sheet, which is made of a third building material, selected from the first building materials group, and comprises, in turn, at least a first abutting element (15, 16), which is selected from: a first groove (15), which is accessible from outside the at least a multi-layer building panel (2); and a protuberance (16);

B) a first and a second building beam (8), each of which comprising: a respective longitudinal axis (81); and a second abutting element (17, 18) selected, respectively, between an abutment portion (17), which is at least partially receivable in the first groove (15); and a second groove (18), in which the protuberance (16) is at least partially receivable;

in which the first abutting element (15, 16) of the first and the second coupling region (10, 11) is configured and arranged, when the at least a multi-layer building panel (2) is arranged with the first layer (3) facing upwards and resting on the first and the second building beam (8) with the first and the second coupling portion (10, 11) coupling resting, respectively, on the first and the second building beam (8), abutting, restingly, the second abutting element (17, 18), respectively of the first and the second building beam (8), distributing on the first and the second building beam (8), respectively, a first and a second horizontal component (Co), opposite one another, of the weight of the at least a multi-layer building panel (2) to prevent the at least a multi-layer building panel (2) from displacing towards the longitudinal axis (81), respectively, of the first and the second building beam (8).

2. The building materials group of the preceding claim, wherein the at least a multi-layer building panel (2) has the second coupling region (11) identical to the first coupling region (10).

3. The building materials group of claim 1 or 2, wherein the first and second building beam (8) are winged and comprise, respectively, a first and a second wing element (7); wherein the first and second wing elements (7) comprise the second abutting element (17, 18), respectively, of the first and the second building beam (8); wherein, when the at least a multi-layer building panel (2) is arranged with the first layer (3) facing upwards, the connecting element (14) of the first coupling region (10) and the connecting element (14) of the second coupling region (11) are couplable, restingly, respectively, with the first and second wing element (7).

4. The building materials group of any one of the preceding claims, wherein the first abutting element (15, 16) is the first groove (15), which, when the at least a multi-layer building panel (2) is arranged with the first layer (3) facing upwards, faces downwards, and wherein the first groove (15) is defined by a first planar abutting wall (19) and a second planar abutting wall (20) which are inclined with respect to one another by an angle comprised between 85° and 95°, preferably by an angle of 90°.

5. The building materials group of the preceding claim, wherein, when the at least a multi-layer building panel (2) is resting with the first and the second coupling portion on a support plane, the first planar wall of the first groove (15) is arranged parallel to the rest plane and the second wall is arranged perpendicularly to the rest plane.

6. The building materials group of any one preceding claim, wherein the first abutting element (15, 16) is the first groove (15), in which in the covering region (12) the second layer (4) has a first minimum thickness which is constant; and wherein at least the first coupling region (10) has: a first portion which extends from the covering region (12) to the first groove (15) and which has a second minimum thickness which is greater than the first minimum thickness; and a second portion, which is arranged at the groove, which has a third minimum thickness which is lower than the second minimum thickness and which, optionally, is identical to the first minimum thickness to guarantee the continuity of heat insulation of the at least a multi-layer building panel (2).

7. The building materials group of any one preceding claim, wherein the abutment portion (17) is a further protuberance comprised in the building beam or in the wing element of the winged building beam which extends parallel to the longitudinal axis (81), respectively, of the first and/or the second building beam or of the first and the second winged building beam (8).

8. The building materials group of claim 1, wherein the first abutting element (15, 16) is the protuberance (16), which is defined by: a third planar abutting wall, a fourth planar abutting wall which originates from the third abutting wall and is inclined, with respect to the third planar wall, by an obtuse angle; and a fifth planar abutting wall, which originates from the fourth abutting wall, and is inclined, with respect to the fourth planar wall, by an obtuse angle, in order to facilitate the receiving of the protuberance (16) in the second groove (18) of the wing element (7) of the winged building beam (8).

9. The building materials group of any one preceding claim, wherein the third sheet of the connecting element (14) is not realised in a single body with the second sheet (151) or with the first sheet (160), and wherein, optionally the first sheet (160), the second sheet (151) and the third sheet, are, respectively, a first metal sheet, a second metal sheet and a third metal sheet.

10. The building materials group of any one preceding claim, wherein the first building material and/or the second building material and/or the third building material are selected, independently of one another, from a second group of building materials consisting of: metal sheet; metal sheet coated with a rust-proof metal alloy; galvanised metal sheet; painted and galvanised metal sheet; steel sheet coated with a rust-proof metal alloy; galvanised steel sheet; painted and galvanised steel sheet; stainless steel sheet, wherein the second layer (4) comprises a thermally insulating material selected from among: expanded polyurethane; expanded polystyrene; glass wool; cellulose; rock wool and polyester fibre, and wherein, optionally, the first sheet is fretted or corrugated.

11. The building materials group of any one preceding claim, wherein, in the at least a multi-layer building panel (2), the first layer (3) projects from the first coupling region (10) and/or from the second coupling region (11) in order to protect the regions (10, 11) from atmospheric agents.

12. The building materials group of any one preceding claim, wherein, in the at least a multi-layer building panel (2), the first sheet (160) is fretted or corrugated with the aim of increasing the minimum inherent load-bearing capacity of the at least a multi-layer building panel (2), with the frets or the corrugations perpendicular to the first and second coupling portion (11, 10).

13. A building covering comprising a building materials group according to any one of preceding claims 1 to 11 wherein the at least a multi-layer building panel (2) is arranged with the first layer (3) facing upwards and is resting on the first and the second building beam (8) with the first and the second coupling portion (10, 11) being coupled and resting, respectively, on the first and the second building beam (8), and abutting the second abutting element (17, 18), respectively of the first and the second building beam (8), distributing on the first and the second building beam (8), respectively, the first and second horizontal component (Co), opposite one another, of the weight of the at least a multi-layer building panel (2) preventing the at least a multi-layer building panel (2) from displacing towards the longitudinal axis (81), respectively, of the first and the second building beam (8).

14. The building covering of the preceding claim, wherein the first and second building beam (8) are winged and comprise respectively, a first and a second wing element (7); in which each of the first and second wing element (7) comprises the second abutting element (17, 18), respectively, of the first and the second building beam (8); and wherein the connecting element (14) of the first coupling region (10) and the connecting element (14) of the second coupling region (11) are couplable, restingly, respectively, with the first and second wing element (7).

FIG. 1

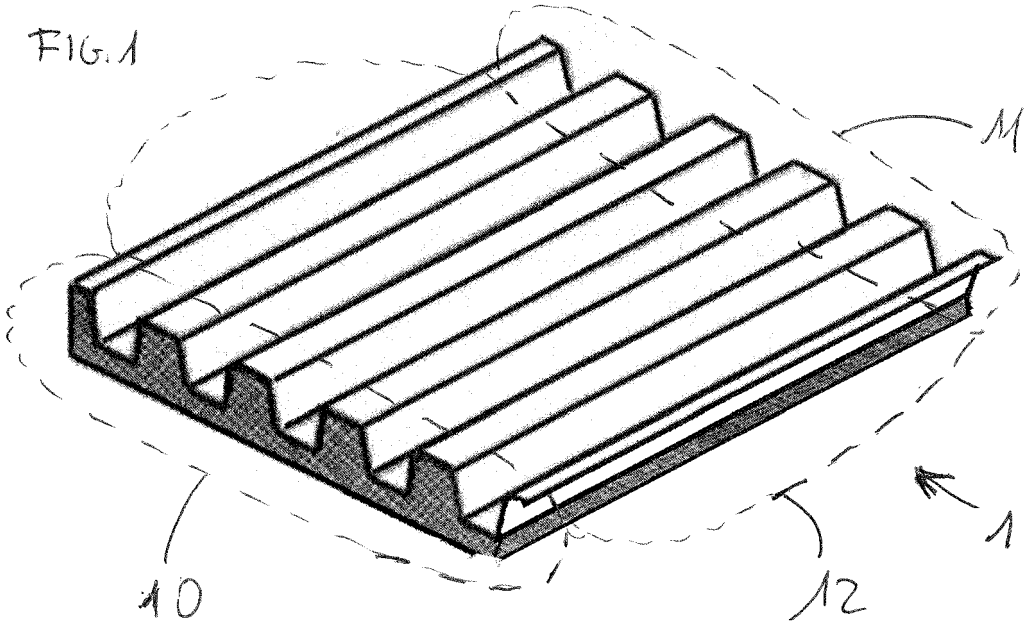


FIG. 2

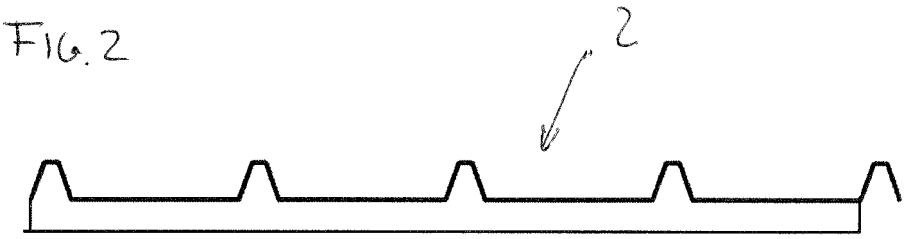


FIG. 3

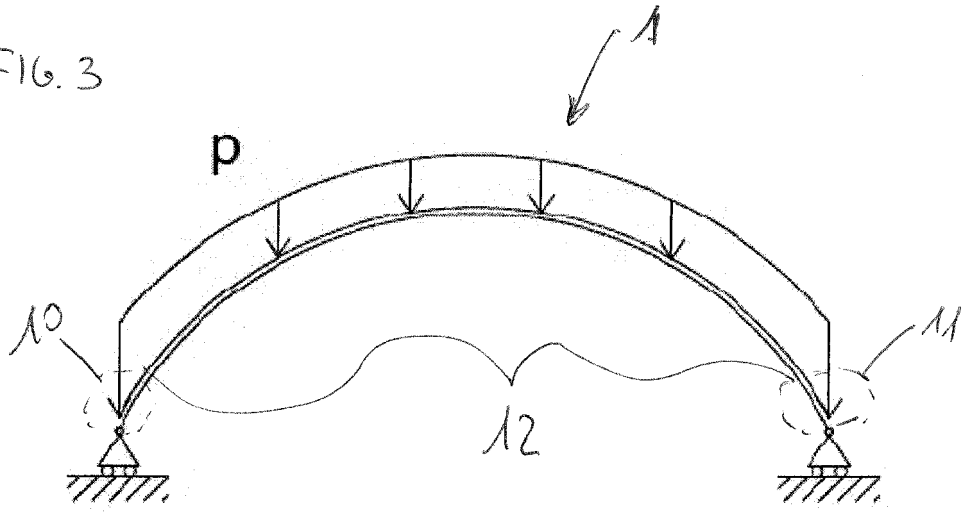


FIG. 4

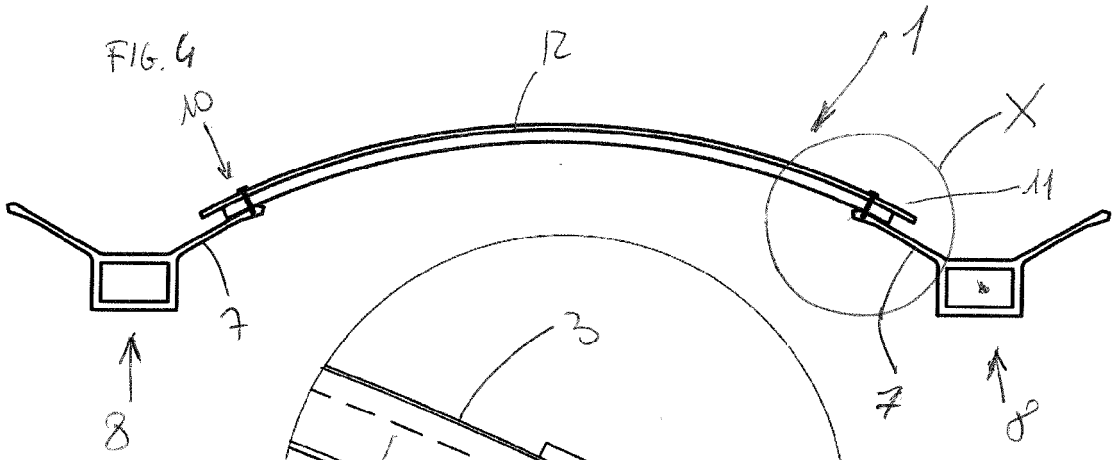


FIG 5

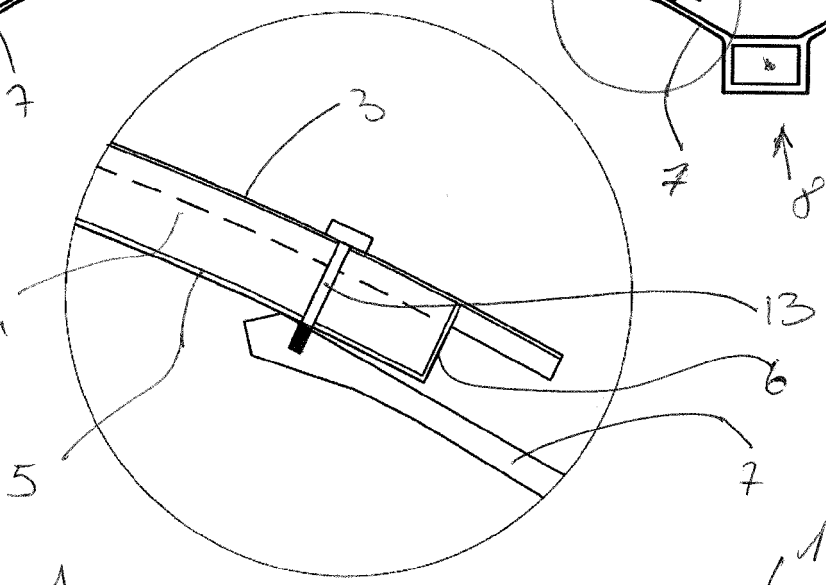


FIG. 6

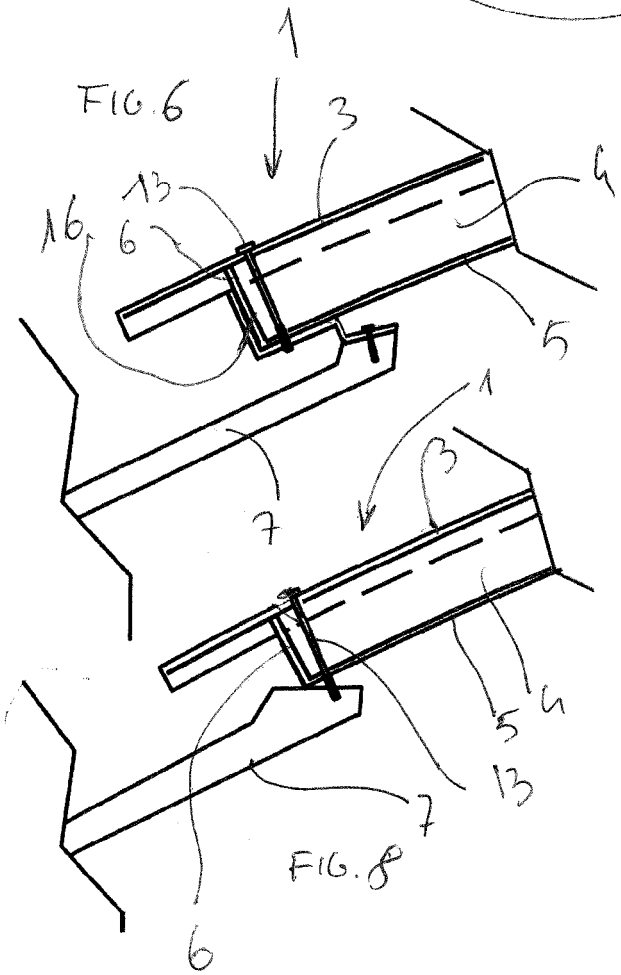


FIG. 8

FIG. 7

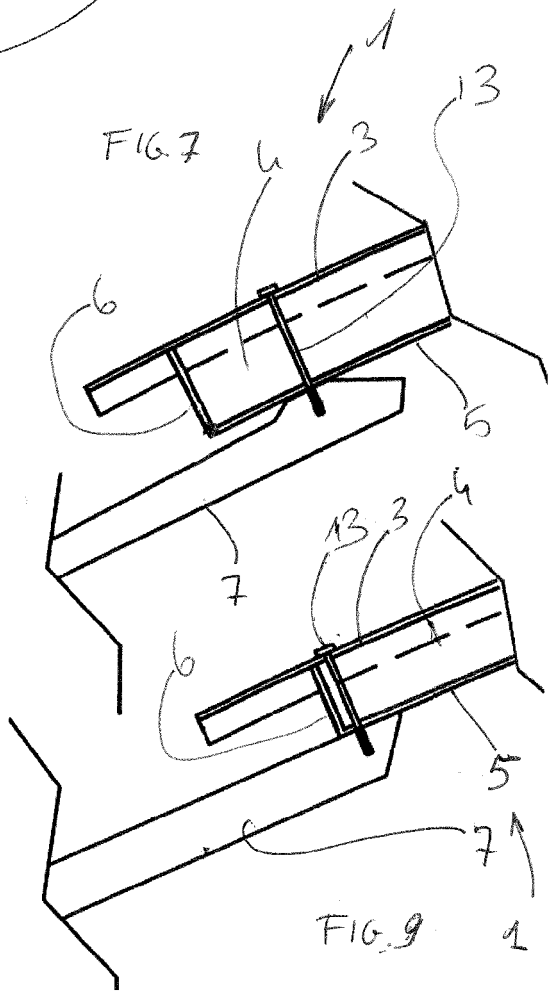


FIG. 9

FIG.10

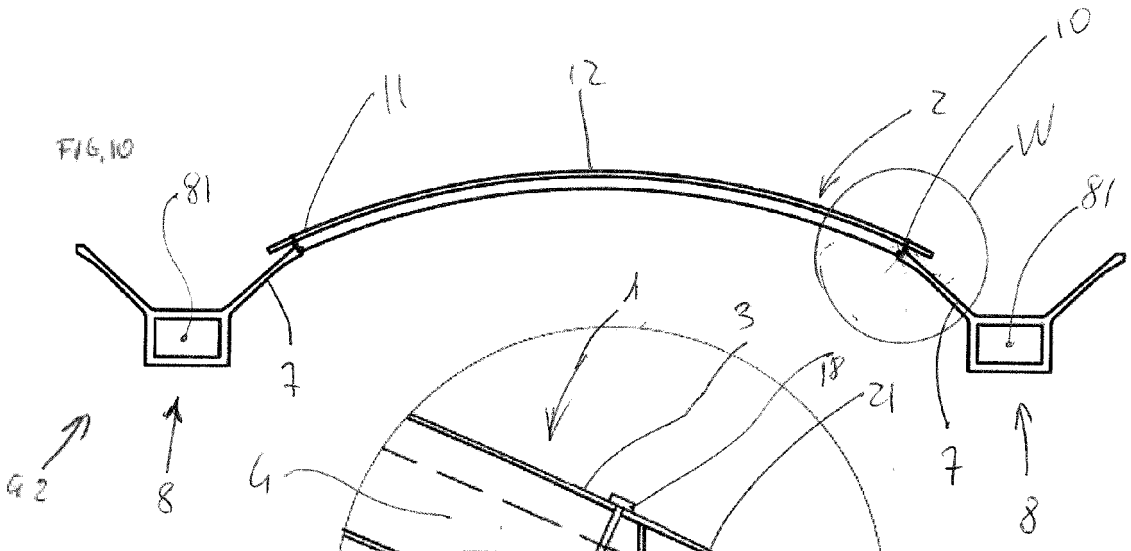


FIG.11

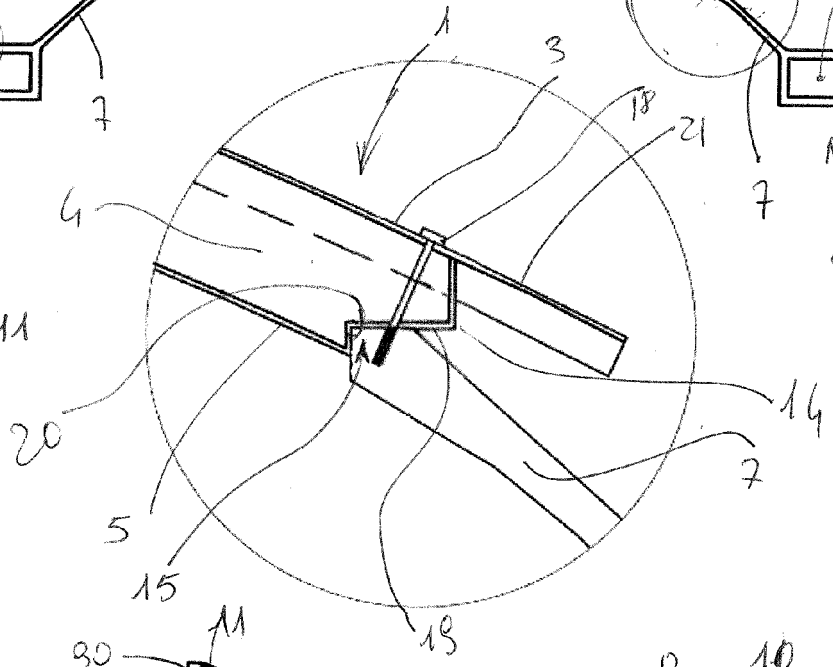


FIG.12

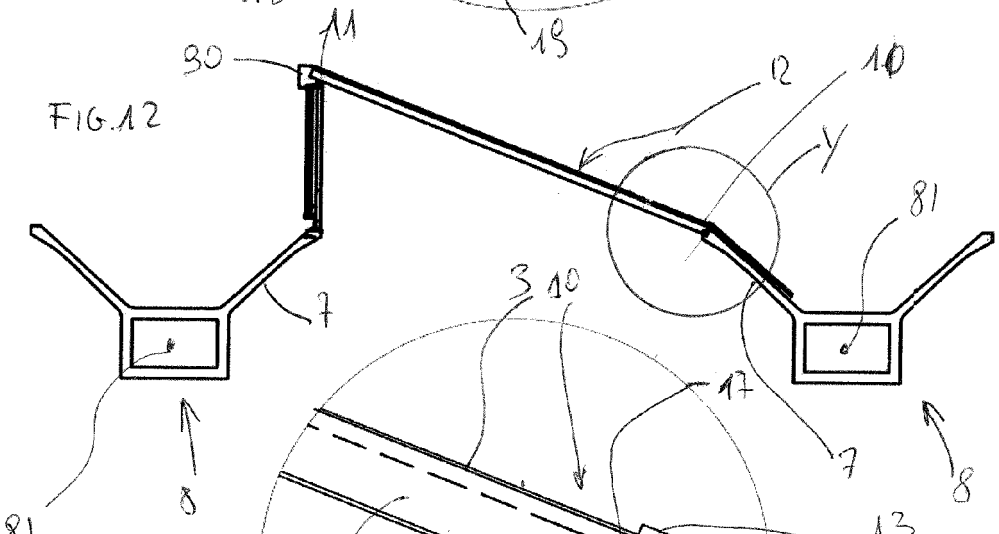
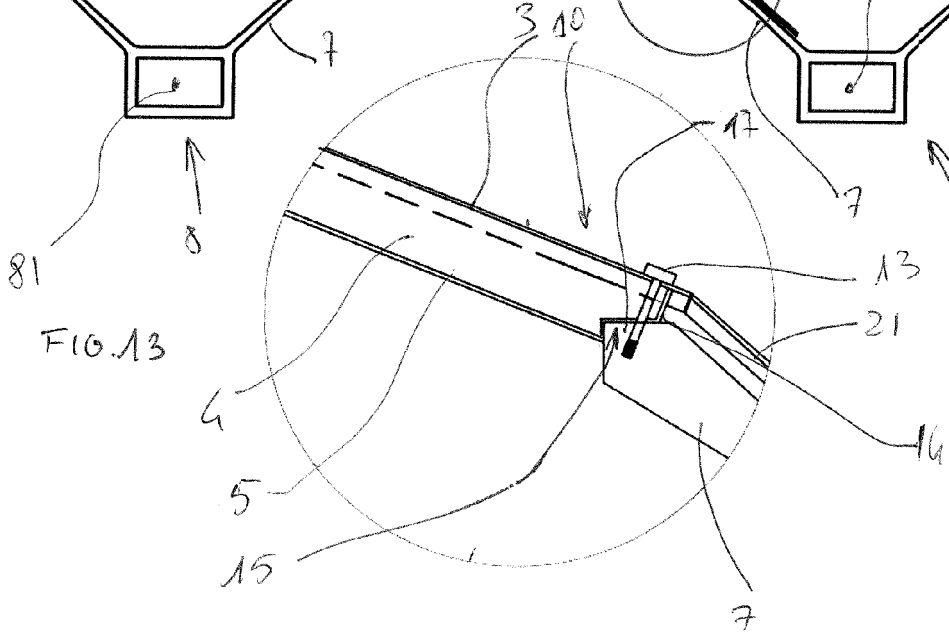


FIG.13



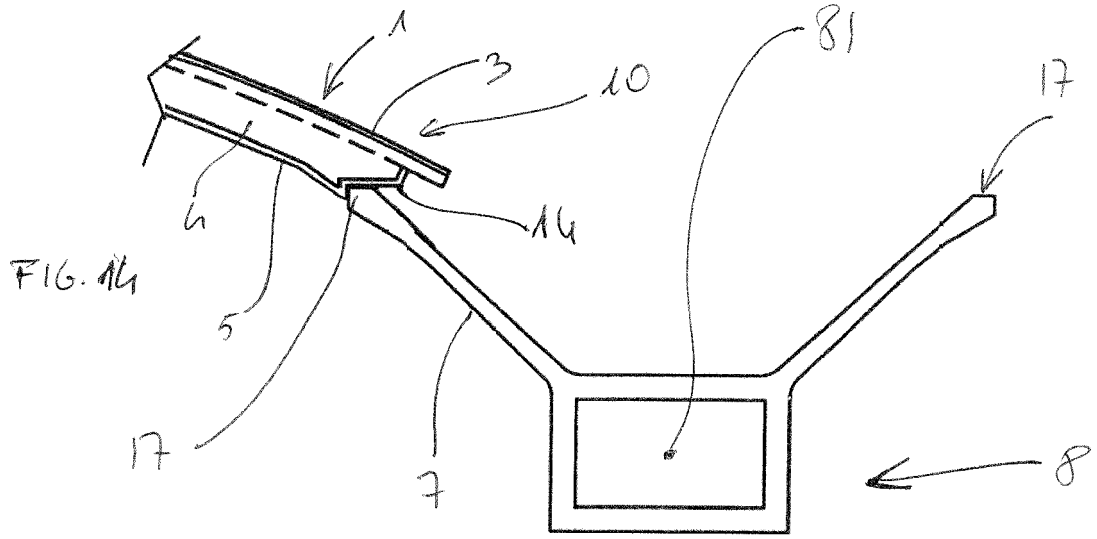


FIG. 14

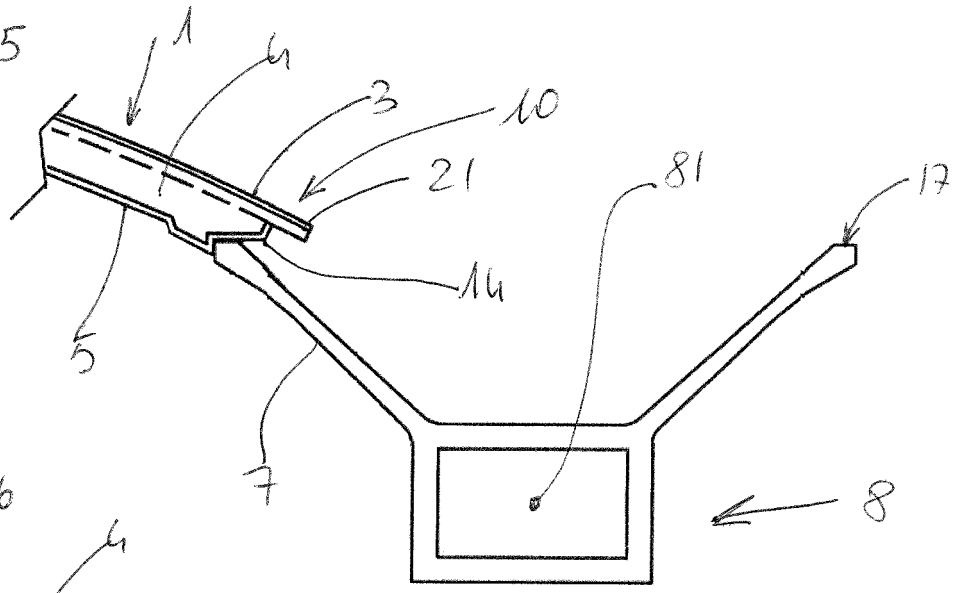


FIG. 15

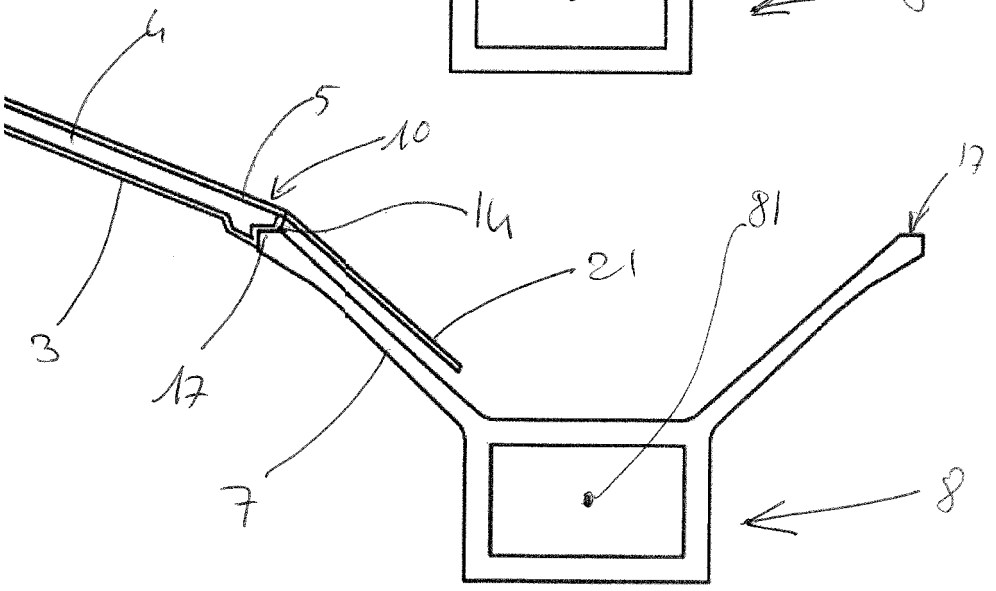


FIG. 16

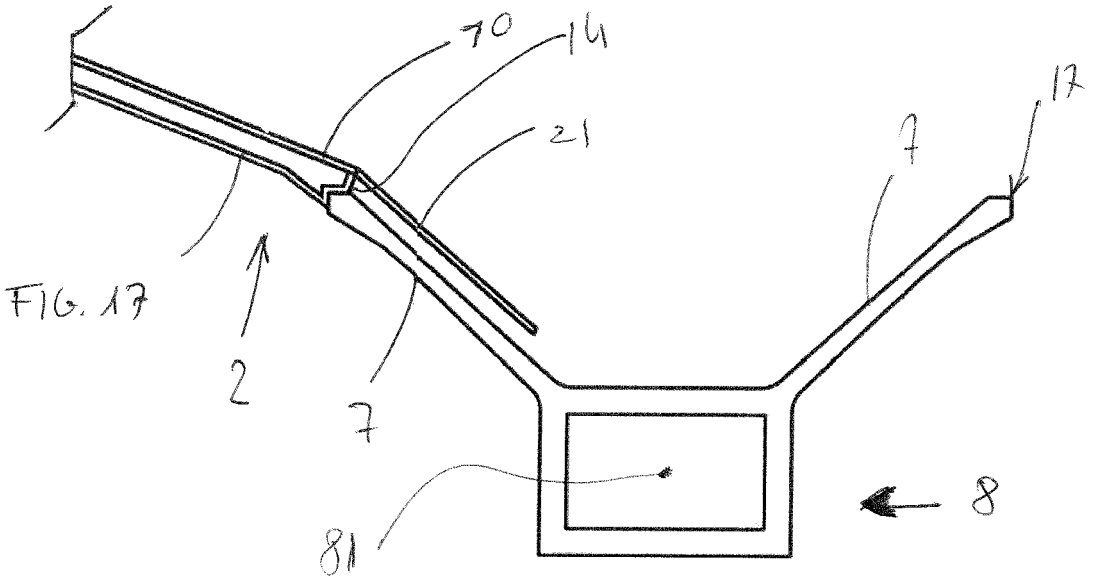


FIG. 17

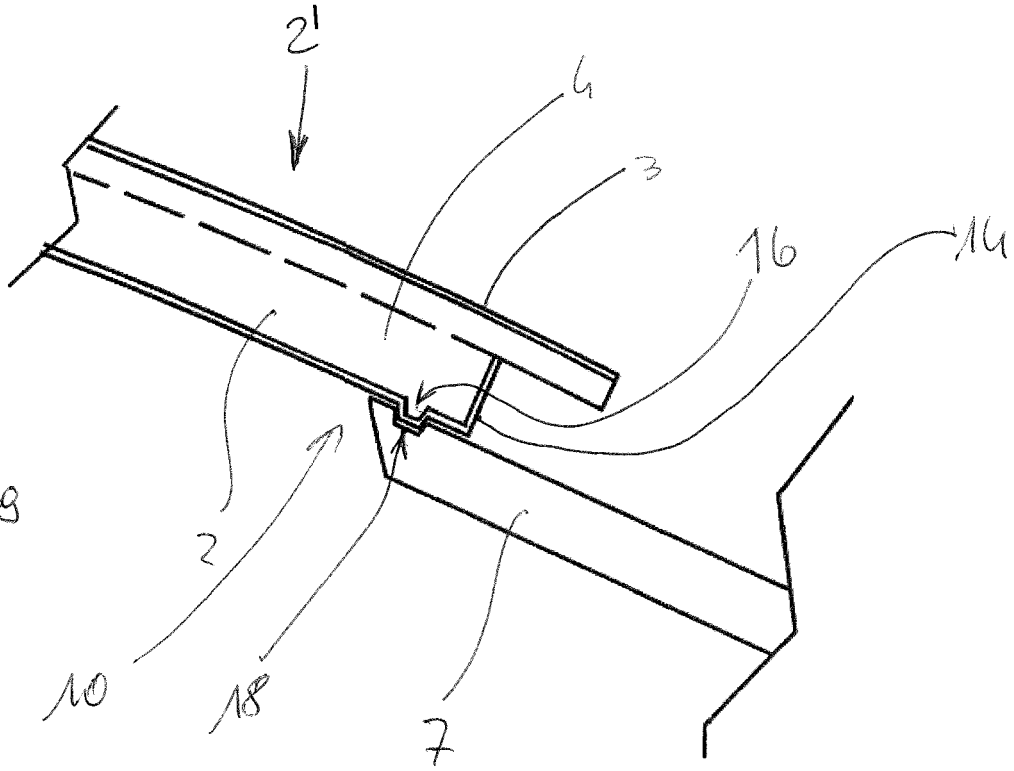


FIG. 18

FIG. 19

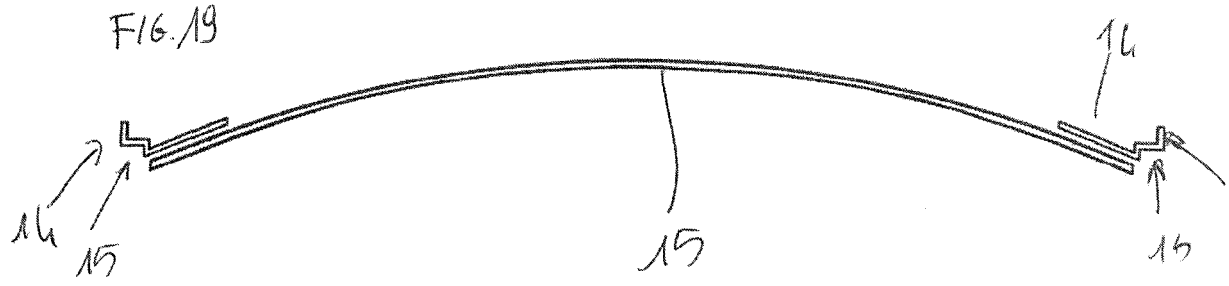


FIG. 20

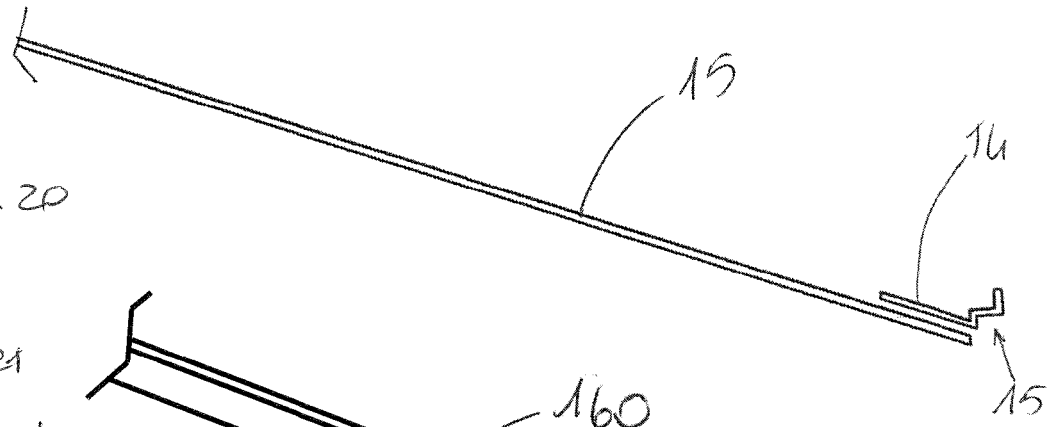


FIG. 21

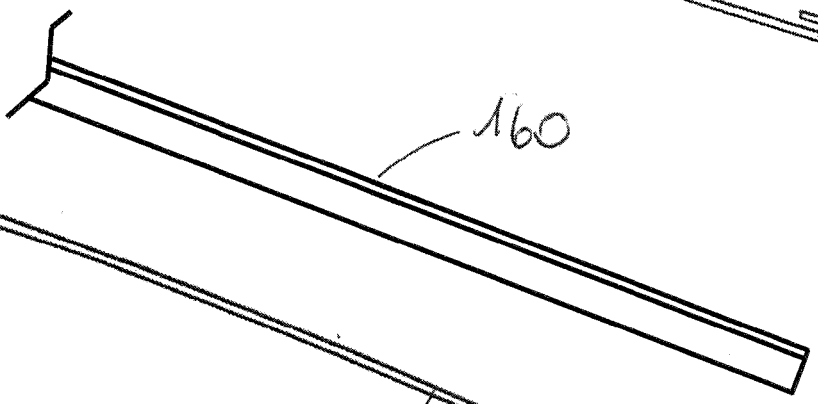
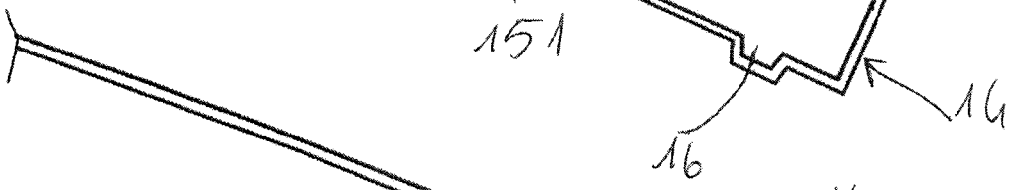


FIG. 22



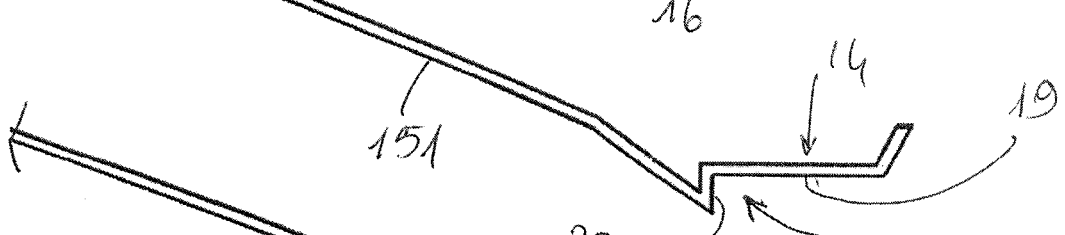


FIG. 23

FIG. 24

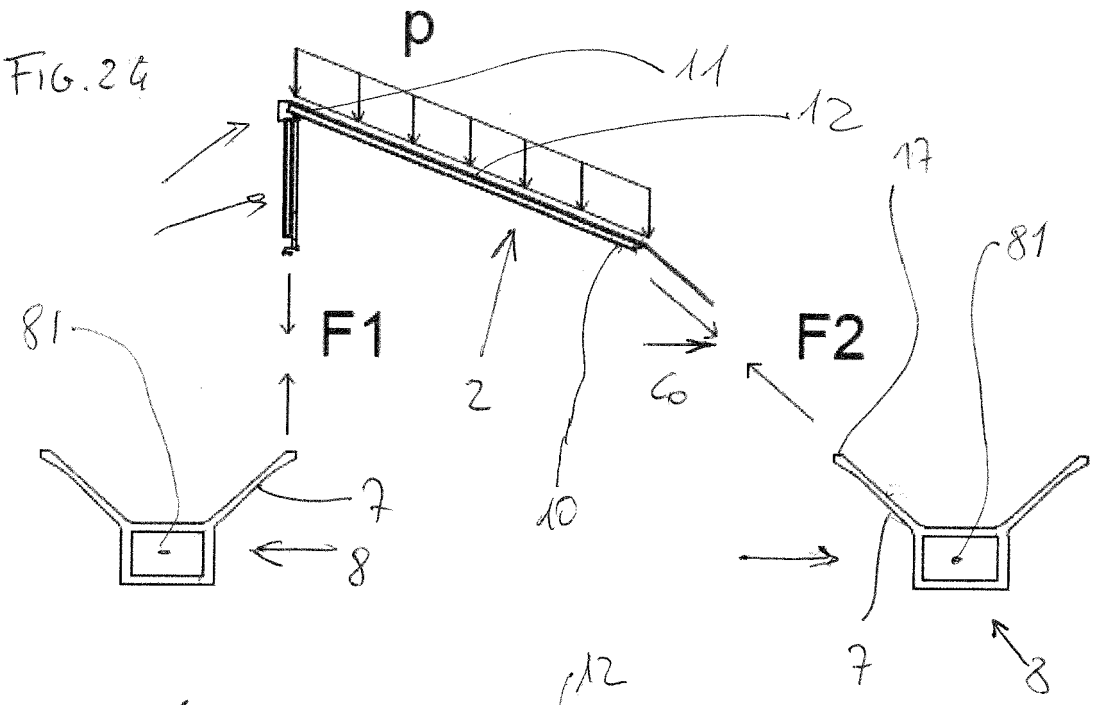


FIG. 25

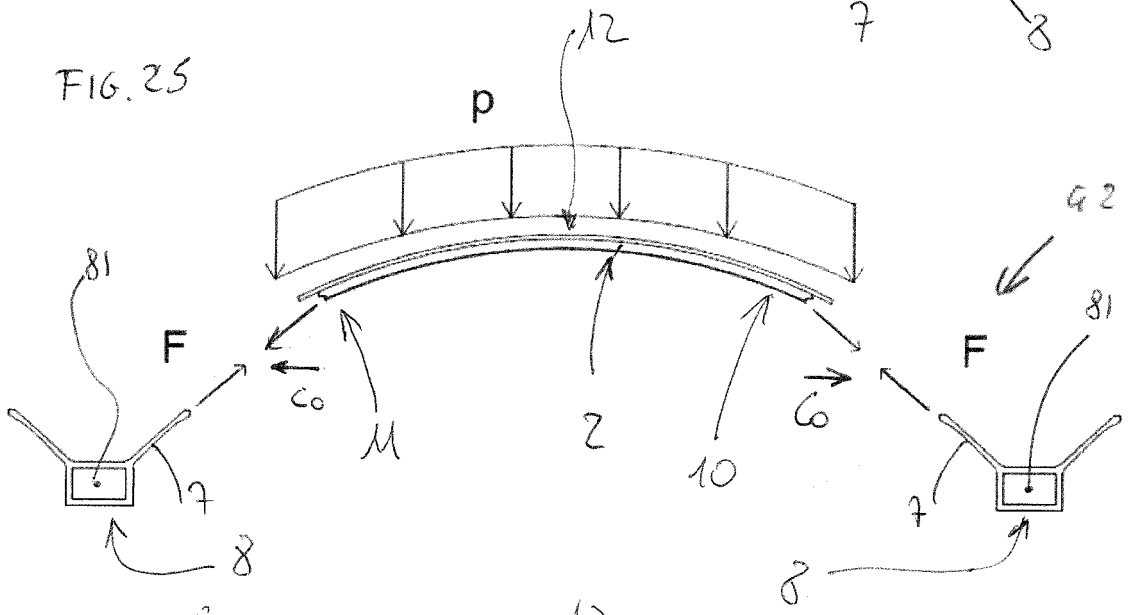
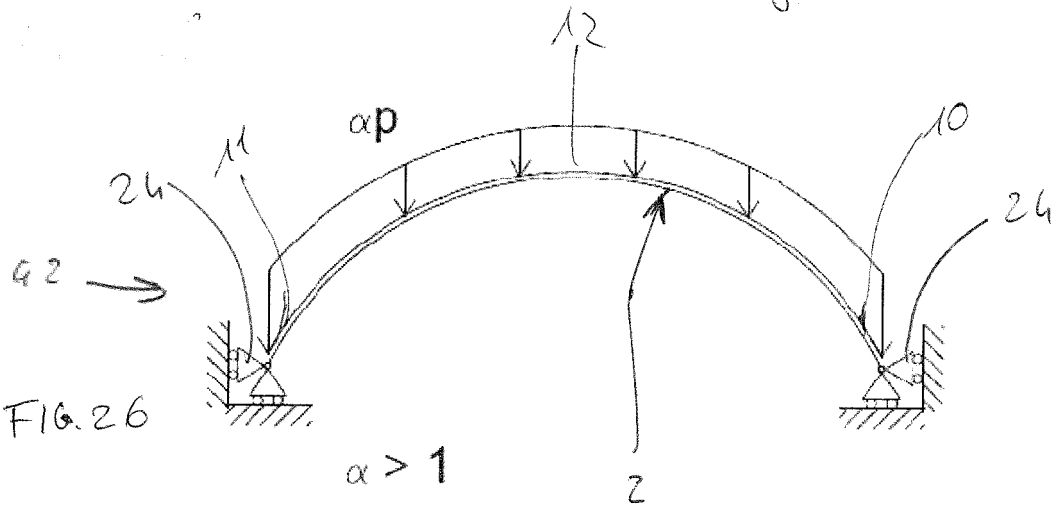


FIG. 26



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EUROPEAN SEARCH REPORT

Application Number
EP 23 15 5508

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 1 111 147 A2 (FLII RE S R L [IT]) 27 June 2001 (2001-06-27) * paragraphs [0001], [0020], [0021]; figure 8 *	1-14	INV. E04C2/292 E04C2/296 E04B7/08 E04B7/12 E04D3/35 ADD. E04C2/00
A	EP 1 022 404 A1 (A L ERRE ENGINEERING S R L [IT]; FRANCHI ANDREA [IT] ET AL.) 26 July 2000 (2000-07-26) * paragraphs [0033] - [0037] *	1-14	
A	GB 1 225 152 A (PAYNE) 17 March 1971 (1971-03-17) * page 2 *	1-14	

TECHNICAL FIELDS SEARCHED (IPC)

E04C
E04D
E04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	31 May 2023	Saretta, Guido

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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 23 15 5508

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31-05-2023

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