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(54) FLOOR PANEL ASSEMBLY, FLOOR PANEL AND JOINING MEMBERS FOR USE THEREIN

(57) A floor panel assembly comprises sheet-shaped floor panels, provided with a plurality of edges, wherein an edge of a first panel and another edge of a second panel are equipped with joining members which allow a joining of the first and second edges of the two panels by bringing these into engagement with each other, so as to bring the upper sides of both panels substantially in alignment with each other and have them meet at a vertical plane VP, the first edge being provided with a male joining member and the second edge with a female joining member adapted to receive the male joining member therein so as to lock the panels at the adjacent edges at least in a direction perpendicular to the upper side and in a direction parallel to the upper side but perpendicular to the adjacent first and second edges in their joined position, wherein the male and female joining members are so adapted to each other that a surface of the male joining member is urged against a surface of the female joining member in a contact area, said contact area has a horizontal component and is the first of this kind that water meets when it enters between the joining members from the vertical plane VP.

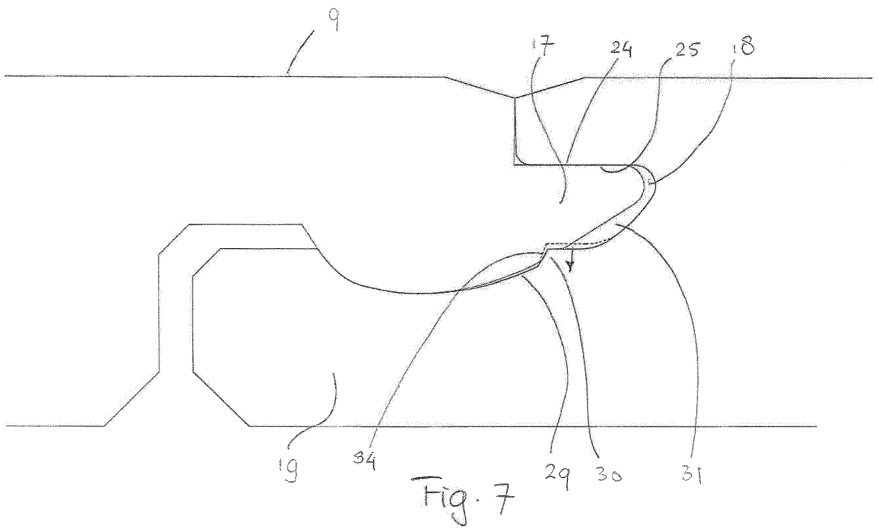

Fig. 7

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Description

[0001] The invention relates to floor panel assembly comprising sheet-shaped floor panels preferably made of relatively resilient material such as LVT (Luxury Vinyl Tile) type material, which floor panels are provided with a plurality of edges, wherein a first edge of a first panel and a second edge of a second panel are equipped with joining members which allow a joining of the first and second edges of the two panels by bringing these into engagement with each other, preferably in a relatively inclined position of the panels and then rotating said panels with respect to each other, so as to bring the upper sides of both panels substantially in alignment with each other and have them meet at a vertical plane VP. The joining member of the first edge may be provided with a tongue and the joining member of the second edge with a groove adapted to receive the tongue therein so as to lock the panels at the adjacent edges at least in a direction perpendicular to the upper side and in a direction parallel to the upper side but perpendicular to the adjacent first and second edges in their joined position.

[0002] Such floor panel assembly is known in the art.

[0003] According to a first aspect, it is an object of the invention to improve the prior art floor panel assembly, especially with respect to the water tightness of the joining members.

[0004] To obtain this object, the tongue and groove are so adapted to each other that an upper surface of the tongue is urged against an upper wall of the groove.

[0005] This creates a tight fit between the tongue and groove in vertical direction, improving water tightness between the joining members, even if the panel edges of adjacent panels would have a small gap in horizontal direction.

[0006] One way of obtaining this is that the vertical size of the tongue is larger than the vertical size of the groove, in non-joined condition.

[0007] This means that the tongue must be compressed or bent in vertical direction in order to enable the tongue to be engaged in the groove. In one embodiment, in the joined position of the panels, the upper surface of the tongue is in contact with the upper wall of the groove in a contact area, the contact area having a small inclination with respect to a corresponding area of the upper wall of the groove in the non-joined condition, and being substantially parallel thereto in the joined condition.

[0008] This inclination, which may vary for example between 1^0 and 6^0, is preferably downwardly in the direction towards the vertical plane VP. Downward bending of the tongue will then result in rotation of the upper surface of the tongue towards horizontal and thereby lowering the height of the tongue to adapt to the size of the groove.

[0009] If a clearance is present between the lower surface of the tongue and the lower wall of the groove in the area substantially below the contact area at the upper surface of the tongue, there is created sufficient room for downward displacement of the tongue if it is bent downwards.

[0010] In a particular embodiment, the contact area between the upper surface of the tongue and the upper wall of the groove is at a distance from the vertical plane VP.

[0011] Due to this feature, the force exerted by the tongue on the panel portion above the groove is concentrated in the area near the bottom of the groove where resistance against deformation is much higher than at the opening of the groove. Thus, this features assist in minimizing upward deformation of the panel edge adjacent the seam between the panels, so that the panels fit smoothly with minimal or no height difference.

[0012] In a further development, the upper surface of the tongue adjacent the vertical plane VP is lowered with respect to the upper surface at a distance from the vertical plane, for example by providing the upper surface of the tongue, adjacent to the vertical plane VP, with a notch parallel to the adjacent edge.

[0013] This notch in the upper surface of the tongue not only creates the contact area spaced from the vertical plane VP, but also reduces the bending resistance of the tongue. This bending resistance can be regulated by dimensioning this notch in dependence of the tongue dimensions and the rigidity of the material of the tongue. The tongue should bend but should also have sufficient bending resistance so as to exert and maintain pressure on the groove under all conditions of use.

[0014] In another embodiment, the tongue and groove are so adapted to each other that in the joined position there is a pressure line between a lower surface of the tongue and a lower wall of the groove at a distance from the vertical plane VP, substantially below the start of the contact area at the upper surface of the tongue, and wherein the lower wall of the groove may have a stepped surface.

[0015] This pressure line or area may provide an alternative or additional way of creating pressure between the upper surface of the tongue and the upper wall of the groove.

[0016] One possibility to obtain this is that the lower wall of the groove is provided with a ridge extending parallel to the adjacent edge of the panel, and the lower surface of the tongue may be provided with an indentation extending parallel to the adjacent edge of the panel and being adapted to receive the ridge of the groove at least partly.

[0017] In a specific embodiment, the floor panels are substantially rectangular and has opposite third and fourth edges adjacent to the opposite first and second edges, each floor panel being provided on at least the third edge with a third joining member and, on the opposite fourth edge, with a fourth joining member, the third and fourth joining members of two panels being vertical joining members and being joined to each other by a mainly vertical movement of the respective panel edges towards each other, the third and fourth joining members locking the panels at the adjacent edges at least in a direction perpendicular to the upper side and in a direc-

tion parallel to the upper side but perpendicular to the adjacent third and fourth edges in their joined position, the third and fourth joining members being provided with at least one locking element locking the third and fourth joining members to each other in the joined position, at least in said direction perpendicular to the upper side.

[0018] The joining members of the first and second edges of each panel may allow a joining of the first and second edges of two panels by bringing the first and second edges into engagement with each other in a relatively inclined position of the panels and then rotating said panels with respect to each other so as to bring the upper sides of both panels substantially in alignment with each other, thereby also bringing the vertical joining members of the third and fourth edges of the tilted panel and an adjacent panel into engagement.

[0019] The locking element may be a horizontal protrusion on the third or fourth edge protruding towards the fourth or third edge and engaging in a recess on the other of the third or fourth edge.

[0020] In a further development, the vertical joining members include a male and a female joining member, at least one of which is deformable, such as bendable for cooperation with the other of the male and female vertical joining members to create tension between them in the joined position. This create an additional locking force and/or water tightness of the connection. The female joining member may have a shape to force the lip(s) into a locking position. In case of two downward lips separated by a vertical notch, the female joining member may have an upward ridge or the like adapted to engage into the notch but being wider than the notch to force the lips away from each other into engagement with walls of the female member. This can also be obtained in case of a single lip, or if in the final joined position, the deformable male or female vertical joining member is deformed away from its resting position thereby creating pressure between the joining members.

[0021] Preferably, the contact area providing water tightness of the joint is as close as possible to the position where the upper surfaces of the panels meet and thus where water can enter the j oint. If the contact area has a horizontal component, i.e. is between substantially horizontal surfaces, or surfaces having a horizontal component, this horizontal component contact area should be the first one of this type that any water entering the joint meets. This applies both to the horizontal and vertical joints.

[0022] The invention also includes a floor panel for use in the floor panel assembly as described above, and joining members for use on this floor panel.

[0023] Further details and advantages of the invention will follow from the below description with reference to the drawings showing an embodiment of the panel assembly according to the invention by way of example.

Fig. 1 is a perspective view of a plurality of panels of a panel assembly according to the invention in a stage of laying the panels.

Fig. 2 is an enlarged schematic perspective cross sectional view according to the line II-II in Fig. 1 showing partly two panels with their first and second edges on the long sides of the panels.

Fig. 3 is an enlarged view according to arrow III in Fig. 2, showing more details of the first and second joining members on two opposite long sides of a single panel.

Fig. 4 is an enlarged view according to arrow IV in Fig. 2, showing the joining members of two panels joined to each other.

Fig. 5 is an enlarged cross sectional view according to the line V-V in Fig. 1, showing more details of the first and second vertical joining members on two opposite short sides of a single panel.

Fig. 6 is an enlarged view according to arrow VI in Fig. 1, showing the vertical joining members of two panels joined to each other.

Fig. 7 is a view corresponding to that of Fig. 4, but showing an alternative embodiment of the first and second joining members.

Fig. 8 is a view corresponding to that of Fig. 5 but showing an alternative embodiment of the vertical joining members.

Fig. 9A - 9E are views corresponding to that of Fig. 6, but showing the embodiment of Fig. 8 in five different positions during joining of the vertical joining members.

Fig. 10 and 11 are views corresponding to that of Fig. 6 but showing other alternative embodiments.

[0024] The drawings and in first instance Figs. 1 and 2 thereof, show a number of panels of an embodiment of the panel assembly according to the invention. In particular, Fig. 1 shows a first panel 1, a second panel 2, a third panel 3 and a fourth panel 4. These panels are substantially rectangular and may both be square or elongated. The four panels 1 - 4 shown are elongated having a first edge 7 and an opposite second edge 8 that form the long edges and a third edge 5 and an opposite fourth edge 6 that are the short edges.

[0025] In principle the panel assembly is intended to form a floor covering, but the panels may also be used as wall panels, ceiling panels or panels for covering other surfaces. These surfaces may be indoor or outdoor surfaces. The panels may be constructed as flexible/bendable/resilient LVT-like panels for forming a laminate flooring which is known in the art. These panels are normally used to imitate planks or tiles of natural material, such as wood, stone or any other material. Generally these panels comprise a core of relatively resilient and/or bendable material, in particular material including a soft plastics material. The plastics material may be polyvinylchloride, polyvinyl chloride/polyvinyl acetate copolymer, polythene, polypropylene or any other suitable polymer, copolymer or mixture thereof. The material would normally incorporate one or more additives such as are conven-

tionally used in the formulation of PVC floor coverings including: plasticizers, extending oils, stabilizers (e.g. metal salts), pigments, and fillers (e.g. ground limestone, or other finely divided inorganic materials such as mica, slate, china clay. The plastics could be engineered with other materials, such as natural or synthetic fibers or flour to obtain composite material such as WPC (Wood Plastic Composite) or plastic material mixed with carpet waste.

[0026] The core of these panels may be covered by a decorative layer formed for example from transfer foil. The décor may also be formed in a different way, for example by printing directly and/or digitally on the core, and/or by finishing the core by embossing, chafing or the like. An upper surface 9 is formed thereby. A lower surface 10 of the panels may be formed by another layer, for example a water-proof coating or sheet. However, the invention is also applicable for panels made of plastic or other material with or without separate upper and/or lower layers. The thickness of the panels may for example vary between 3 mm and 6 mm, the panel shown in the drawings is 4 mm.

[0027] The edges 5 - 8 of each panel 1 - 4 are provided with joining members to join the panels to each other to obtain a floor covering in which the panels are coupled to each other substantially without the formation of a gap. For this purpose, the third edge 5 of each panel is provided with a third or male vertical joining member 11, the fourth edge 6 with a fourth or female vertical joining member 12 (see Fig. 5 and 6), whereas the first edge 7 is provided with a first or male horizontal joining member 13 and the second edge 8 with a second or female horizontal joining member 14.

[0028] The first and second edges 7, 8 with first and second joining members 13, 14 are shown schematically in Fig. 2. These joining members 13, 14 are such that they allow a joining of the first and second edges 7, 8 of two panels 2, 3 by bringing male joining member 13 in contact with female joining member 14 of a panel or of two panels which are already installed on the surface. In Fig. 1, panel 1 is brought into engagement with panels 3 en 4. The first male joining member 13 is brought in engagement with the second female joining member 14 while the panel 1 is held in a relatively inclined position, whereafter panel 1 with the male joining member 13 is rotated with respect to the other panels 3 and 4 so as to bring the upper surfaces 9 of the panels substantially in alignment with each other. This method is also known as the "angling in" joining method. In principle, it would also be possible to angle in a female joining member onto a male joining member of a panel already installed. Other methods of bringing the joining members into engagement with each other, such as horizontal shifting, are conceivable as well.

[0029] In the embodiment shown in Fig. 2, the joining members 13, 14 comprise locking means which prevent the panels 2, 3 from drifting apart in a direction parallel to their surfaces 9, 10 and perpendicularly to their edges 7, 8. These locking means are configured such that they exert a force urging the panels towards each other (i.e. perpendicular to their edges) while the panels are in their joined condition. This force counteracts the formation of gaps between the panels, in particular at the position near the upper surface 9 where the panels meet each other. This position may be exactly at the upper surface in the situation of Fig. 4, but in case the upper edges of the panels are machined for example to form a V-groove (see Figs. 1, 2), U-groove or other lowered area between the panels, the panel edges will meet at a distance from the upper surface 9. The panels 2, 3 will contact each other in a plane, here a substantially vertical plane VP through surfaces 15 and 16 which here extend substantially vertical.

[0030] Fig. 2 also shows that the first male joining member 13 includes a tongue 17, while the second female joining member 14 includes a groove 18 which is able to receive at least a portion of tongue 17 therein so as to lock the panels with respect to each other in a direction perpendicularly to surfaces 9, 10, i.e. in vertical direction. The shape of the tongue and groove 17, 18 may have all kinds of configurations and orientations as long as they include surfaces that restrict movements in a direction perpendicularly to surfaces 9, 10.

[0031] The horizontal lock of the panels away from each other is accomplished by means of a lip 19 below groove 18 projecting from panel 2 beyond vertical plane VP and carrying near its free edge an upper protrusion 20 engaging into a downwardly open groove or recess 21 positioned behind tongue 17 of panel 3.

[0032] Fig. 3 and 4 show the first and second joining members 13, 14 in more detail. It is shown that the lower surface of tongue 17, especially in an area before vertical plane VP is rounded, and has a heel 22 ending into the front wall of downwardly open groove 21. This heel 22 cooperates with an upward wall 23 of upper protrusion 20 to accomplish the horizontal lock at these edges 7, 8 and also might urge panels 2, 3 toward each other so as to be pressed against each other at the position of substantially vertical surfaces 15 and 16 forming a seam which is closed, also when forces are exerted on panels 2, 3 trying to separate the panels at their first and second edges 7, 8. Above protrusion 20 and beyond lip 19 there is a gap or clearance towards the other panel so that contact between the panel edges is limited to designated areas.

[0033] One of the designated surfaces is an upper surface 24 of tongue 17 engaging in the joined position with an upper wall 25 of groove 18. As is shown in Fig. 4 contact between these surfaces is only in a limited contact area 26 at a distance from vertical plane VP. In this embodiment, this is accomplished by lowering upper surface 24 of the tongue adjacent the vertical surface 15 or vertical plane VP, in this case by providing a notch 27 in the upper surface 26 extending parallel to the adjacent edge. This notch 27 may be one tenth to a few tenths of a millimetre deep and the width may be approximately between a quarter and half of the length of tongue 17,

thus leaving a contact area 24 of approximately half of the upper surface of the tongue remote from vertical plane VP. This means that any pressure exerted by tongue 17 onto upper wall 25 of groove 18 is exerted near the bottom, i.e. deepest part, of groove 18 only. This reduces any deformation of the panel portion above groove 18 to a minimum as the moment of inertia on this panel portion is minimum, due to the shorter distance to the bottom of groove 18, i.e. near the solid portion of the panel.

[0034] A pressure is exerted by tongue 17 on upper wall 25 of groove 18 by urging tongue 17 upwardly due to the engagement of heel 22 of the tongue with upward wall 23 of protrusion 20 and also with a recess 29 in the upper surface of lip 19. The upper surface 24 of tongue 17 at the position of contact area 26 is slightly inclined downwardly in a direction towards vertical plane VP in the non-joined position, see Fig. 3 at angle α. This inclination α may for example be 1^0 - 6^0, preferably 1^0 - 4^0, most preferably approximately 2^0 with respect to the upper wall 25 of the groove 18 or in this case with respect to the horizontal. The vertical distance between the highest part of the upper surface 26 and the lowest point of the heel 22 of the tongue is greater than the vertical distance between the upper wall 25 of groove 18 and the bottom of the recess 29 in the lip 19. Thus, when tongue 17 is inserted into groove 18, tongue 17 should be deformed slightly, for example by compression or bending, in order to allow the joining members 13, 14 to engage. In this case, when joining members 13, 14 are joined, the tongue is bent and as a result the contact area 26 of tongue 17 is rotated to an orientation in which it extends substantially parallel to upper wall 25 of groove 18, in this case substantially horizontal. Due to this rotation of a part of the tongue, the height of the tongue is reduced (the highest part of the tongue 17 is remote from vertical plane VP beyond which the deformation starts) whereby the joining members 13, 14 are allowed to fully engage.

[0035] Alternatively, it is conceivable to shape upper wall 25 of groove 18 such that there is only pressing contact between upper surface 26 of tongue 17 and upper wall 25 of groove 18, for example by creating a notch in upper wall 25 at the open end of groove 18, or by incline upper wall 25, such that wall 25 is higher at its open end than at its closed end. The other way around, upper surface 26 of tongue 17 can be configured at an inclination of e.g. 5^0 - 10^0, such that when the tongue is slightly deformed and/or rotated, the free end of tongue 17 is still higher than its base, so that there is contact only at a distance from vertical plane VP.

[0036] In order to create freedom of movement for tip 32 of tongue 17 within groove 18, there is a distance between tip 32 of tongue 17 and bottom 33 of groove 18 in the joined position of joining members 13, 14, and there is also a clearance 31 between a lower surface 28 of tongue 17 and the recess 29 or upper wall of lip 19, lower wall of groove 18. One could also say that in the non-joined condition the vertical distance between the upper surface 9 of the panel and the highest part of the upper surface 24 of the tongue is smaller that the vertical distance between the upper surface 9 of the panel and the upper wall 25 of groove 18, and the deformation of the joining members will be such that these vertical distances will be equal, so that the upper surfaces of adjacent panels will be on equal levels.

[0037] Thus, in the joined position of the joining members, the designated contact areas are between

- the substantially vertical surfaces 15, 16 at the seam between the panels 2, 3,
- the contact area 26 at the upper surface 24 of the tongue 17 and the upper wall 25 of the groove 18 at a distance from the vertical plane VP
- the heel 22 of the tongue 17 and upward wall 23 of protrusion 20 extending up to recess 29 of lip 19.

[0038] Of course, it would be possible to split up or reduce these contact areas by providing lowered portions within these contact areas. For example, the substantially vertical surfaces 15, 16 could be made such that the contact is concentrated in the upper part thereof, ensuring that the seam is closed also in critical tolerance situations.

[0039] In Fig. 4 it is shown that in the recess 29 in lip 19, i.e. in the lower wall of groove 18 there is formed a ridge 30, which has no function here as it does not have contact with the lower surface 28 of tongue 17. Here it is the result of machining the joining member 14 with different tools under different angles.

[0040] In the alternative embodiment of Fig. 7 it is shown that the pressure between the upper surface 24 of tongue 17 and the upper wall 25 of groove 18 can additionally or alternatively be accomplished by creating a pressure line or area between the lower surface of tongue 17 and the lower wall of groove 18 extending parallel to the respective edge, for example by the ridge 30 or otherwise raised area on lower wall 29 of groove 18 urging tongue 17 upwards when it is inserted into groove 18. Due to the elasticity of the material of ridge 30, it can be deformed downwardly to enable entry of the tongue (see dotted line and arrow in Fig. 7). However, additionally or alternatively, tongue 17 can be bent downwardly by upper wall 25 of groove 18 at a position slightly beyond the pressure line enabled by the gap or clearance 31 between lower surface 28 of tongue 17 and lower wall 29 of groove 18. Ridge 30 is positioned substantially below the start of contact area 26 between upper surface 24 of tongue 17 and upper wall 25 of groove 18.

[0041] Ridge 30 may have a substantially triangular cross-section so as to create the pressure line between tongue 17 and groove 18. Other cross-sections are conceivable, for example having a rounded or flat top. The ridge 30 may be more or less pronounced. The ridge 30 could also be created on lower surface 28 of tongue 17. The same is true for contact area 26 between upper surface 24 of tongue 17 and upper wall 25 of groove 18. This may be defined by a notch or the like in the upper

wall of the groove adjacent to the vertical plane VP, such that contact is only created where this notch or inclined area ends. In Fig. 7 the contact area 26 of the tongue extends substantially the whole length thereof.

[0042] As is shown in Fig. 7, lower surface 28 of tongue 17 could be provided with a recess or indentation 34 extending parallel to respective panel edge 7, 8 and being adapted to at least partly receive ridge 30 when joining members 13, 14 are in their joined condition. Upper surface 24 of tongue 17 is here uninterrupted so that contact with upper wall 25 of groove 18 is substantially over the entire area of the upper surface of the tongue, but also here notch 27 may be provided to concentrate the contact at the bottom of groove 18.

[0043] A close contact between the tongue and the groove can also be accomplished by dimensioning the vertical size of the tongue and groove, such that the vertical size of the tongue in a vertical cross section is larger than the vertical size of the groove in the corresponding cross section, i.e. in the joined position. To obtain this joined position, at least one of the tongue and groove must deform to adapt the vertical sizes to correspond, so that the tongue fits into the groove. If the tongue deforms, this can be accomplished by compression or bending. Bending can be promoted by shaping the tongue, for example by providing the tongue with a horizontal notch. Compression can be accomplished by proper material selection.

[0044] Figs. 5 and 6 show third and fourth vertical joining members 11, 12 at short edges 5, 6 of panels 1, 2. The panels meet each other near their upper surface 9 in a vertical plane VP. The fourth or female joining member 12 comprises a recess 35 extending at a distance below the upper surface 9 of panel 2 and parallel to respective panel edge 6 to limit a contact area between vertical wall surfaces 42, 43. A lower panel portion is extended beyond vertical plane VP into a protruding lip 36 including in its upper surface a depression 37 adjacent to the vertical plane VP. In the embodiment shown, depression 37 has a flat bottom parallel to edge 6. On its free end lip 36 is provided with an upward projection 38 having an upright wall 39 bordering depression 37 and an upper surface 40. On the free end of lip 36 remains a free space 41 to first edge 5 of the other panel in order to ensure that the seam between vertical wall surfaces 42, 43 near upper surface 9 of panels 1, 2 can be closed.

[0045] The third or male vertical joining member 11 comprises a downward protrusion 44 having in this case a substantially flat lower surface extending parallel to first edge 5. The shape and dimension of this downward protrusion 44 is such that it will fit into depression 37 of female joining member 12 when first and second joining members 11 and 12 are in their joined condition. The lower surface of protrusion 44 forms the lowest point of first joining member 11 where the distance from upper surface 9 of the panel is at a maximum. The lower surface of the protrusion 44 might or might not contact the bottom of depression 37 in its joined position, at least it is not necessary to have contact. Inclined wall 39 together with the engagement of vertical wall surfaces 42 and 43 provide vertical support to panel 1. On the lower side of first edge 5 is a downwardly open recess 45 which is sufficiently large to take up upward projection 38 on lip 36 of female joining member 12 with either a clearance (as shown) or with contact between surface 40 and the upper wall of recess 45.

[0046] In this embodiment, female joining member 12 is provided with a vertical locking element 46 in the form of a protrusion extending horizontally parallel to the adjacent panel edge and protruding towards the other panel 1, in this case towards a wall 47 defining one side of protrusion 44. In this vertical wall 47, there is created an undercut 48 to take up locking element 46. The inclined lower surface 49 of protrusion 46 and inclined lower wall 50 of undercut 48 engage with each other and lock panel edges 5, 6 with respect to each other in vertical direction, in cooperation with the engagement of the downward protrusion 44 and upward surface 39 of protrusion 38 bordering the depression 37. The downward protrusion 44 and the depression 37 are formed such that protrusion 44 can enter depression 37 by a downward displacement in combination with a slightly sideways displacement and/or by deformation of the locking element 46, downward protrusion 44 and/or lip 36. To further improve the water tightness of the connection one can vary the angles of the engaging surfaces of protrusion 44 and/or of depression 37 (also different angles of engaging surfaces) to create increased pressure there between. Creating increased pressure due to other measures such as different sizes is also conceivable.

[0047] Locking element 46 and undercut 48 could also be positioned in other places where upright or substantially vertical surfaces of third and fourth joining members 11, 12 are adjacent to each other, such as on one of the upright walls of the upward protrusion 38 on lip 36. In the embodiment shown, one could also say the depression 44 with wall 50 forms a locking element engaging in a recess or undercut formed below locking element 46 by wall 49.

[0048] Locking element 46 as shown is integrated in the joining member, i.e. made in one piece with the panel from the same material. It may however also be made separately and be attached or connected to the panel. It may extend along the whole length of first edge 5, but especially if it is made separately, it is possible to provide a plurality of short locking elements distributed along the length of edge 5, or even only one short locking element substantially in the middle of second edge 6. The length and placement of the locking element depends on various factors, in particular the length of edges 5, 6, the material of the panels and the particular use of the panel assembly. The use of one or more narrow locking elements 46 facilitate a connection between two panel edges when the edges are moved towards each other in a non-parallel orientation, for example, if one panel is folded down as is disclosed here. Also the locking effect is

better when there is a high local load because if one locking element is disengaged due to the high local load, the other locking elements will remain locked and keep the edges together. Of course, if locking element is interrupted along the length, it cannot provide water tightness to the joint. In that case, water tightness should be effected between other surfaces.

[0049] Figs. 8 and 9A - 9E show a variation of the vertical joining members 11, 12. In this case, the downward protrusion 44 of joining member 11 is split at the bottom by a substantially vertical notch 51 extending parallel to the adjacent edge and creating two resilient lips 52, 53 which can slightly bend towards and away from each other. For example when the protrusion 44 enters the depression 37 to join the vertical joining members 11, 12, one or both lips 52, 53 might be urged to bend inwardly. When protrusion 44 has fully entered depression 37, the lip(s) is or are allowed to bend at least partly back to form a vertical lock together with the walls 39, 49 of the depression 44. These lips 52, 53 of the protrusion 44 and walls 39, 49 of the depression 44 can be shaped to form a strong or weaker vertical lock, and also additional water tightness of the connection.

[0050] As is shown in Fig. 8 and 9, at the bottom of the depression 37 there may be formed an upwardly converging ridge 54 which is forced to enter notch 51 when the protrusion 44 is almost in its lowest position (from Fig. 9B on), thereby forcing at least lip 52 adjacent wall 49 away from the other lip (from Fig. 9C on) as ridge 54 becomes wider than notch 51. In this way, it is not necessary to first bend the lips 52, 53 towards each other to create the lock and/or water tightness when in the final position.

[0051] Fig. 10 shows a variation of Fig. 9, in which there is no ridge 54 provided in depression 37, but lip 52 adjacent wall 49 of locking element 46 (the lip furthest away from the centre of panel 1) is pre-shaped such that in the final joined position lip 52 is bent away (see arrow) from its resting position (shown in dashed lines) so that it is positioned against wall 49 with tension to strengthen the vertical lock and (water) tightness of the joint. Thus, the width of protrusion 44 is larger than that of depression 37, at least at one corresponding level, so that the width of the protrusion 44 must be reduced elastically by bending a part (i.e. lip 52) to enter its joined position in the depression 37. In the embodiment of Fig. 10 lip 52 is more slender than lip 53 which is more massive, especially at its upper end, thereby increasing the resistance to bending.

[0052] Surface 50 of lip 52 preferably does not extend beyond surface 42 in horizontal direction, i.e. remains behind this surface 42, so that during a downward movement of this panel the lip will not engage with upper surface 9 of the other panel already laid. If there is a small horizontal distance between surface 42 and extreme part of surface 50, it will not engage upper surface 9 even if the adjacent sides of panel 1 rae not exactly square.

[0053] Fig. 11 shows another variation in which the downward protrusion 44 of the male joining member 11 as a whole is formed as a bendable lip 52 which is tensioned in its final joined position against wall 49 of locking element. This is the result of the fact that the distance between the front face of lip 52 and vertical plane VP is smaller than the distance between wall 49 and VP at the corresponding level, so that lip 52 must be deformed to equal the distance. Depression 37 is large enough to take of the bending deformation of lip 52, but horizontally supports the upper side of lip 52 to urge the panels in engagement with each other near their upper sides at vertical plane VP.

[0054] Of course, it would in principle be possible that the walls 39 and/or 49 of the female joining member 12 are deformable, i.e. bendable to provide the same kind of tension between the male and female joining members 11, 12.

[0055] It is noted that aspects of the various embodiments as shown and described may be used in different combinations. For example, the vertical joining members can be used independently of the other joining members. The principle of the invention with a deformed part of a male or female joining member in the joined position to obtain (water) tightness of the joint is applicable to all kinds of joining members between panels. The invention is not limited to the embodiments shown in the drawing and described above, which may be varied in different ways within the scope of the invention. For example, it would be possible to use the invention with panels that have the first and second joining members on all four sides and that can thus be laid according to the so-called angling-angling method. It is also possible that each of the third and fourth vertical joining members has its own locking element co-operating with the other one. Both locking elements could be deformable or only one. It is also conceivable that the single locking element only locks the panels in cooperation with other locking means, such as ridges, tongues and grooves, hooks and undercuts and the like. The panels may have a different configuration than substantially rectangular, in particular triangular or hexagonal. The panel edges should be configured such that adjacent panel edges have matching joining members.

The invention also relates the following list of numbered items:

Item 1. Floor panel assembly comprising sheet-shaped floor panels, preferably made of relatively resilient material, which floor panels are provided with a plurality of edges, wherein a first edge of a first panel and a second edge of a second panel are equipped with joining members which allow a joining of the first and second edges of the two panels by bringing these into engagement with each other, preferably in a relatively inclined position of the panels and then rotating said panels with respect to each other, so as to bring the upper sides of both panels substantially in alignment with each other and have

them meet at a vertical plane VP, the first edge being provided with a tongue and the second edge with a groove adapted to receive the tongue therein so as to lock the panels at the adjacent edges at least in a direction perpendicular to the upper side and in a direction parallel to the upper side but perpendicular to the adj acent first and second edges in their joined position, wherein the tongue and groove are so adapted to each other that an upper surface of the tongue is urged against an upper wall of the groove.

Item 2. Floor panel assembly of item 1, wherein the vertical size of the tongue is larger than the vertical size of the groove, in non-joined condition.

Item 3. Floor panel assembly of item 1 or 2, wherein in the joined position of the panels, the upper surface of the tongue is in contact with the upper wall of the groove in a contact area, the contact area having a small inclination with respect to a corresponding area of the upper wall of the groove in the non-joined condition, and being substantially parallel thereto in the joined condition.

Item 4. Floor panel assembly of any of items 1-3, wherein a clearance is present between the lower surface of the tongue and the lower wall of the groove in the area substantially below the contact area at the upper surface of the tongue.

Item 5. Floor panel assembly of any of the preceding items, wherein a contact area between the upper surface of the tongue and the upper wall of the groove is at a distance from the vertical plane VP.

Item 6. Floor panel assembly of item 5, wherein the upper surface of the tongue adjacent the vertical plane VP is lowered with respect to the upper surface at a distance from the vertical plane.

Item 7. Floor panel assembly of item 6, wherein the upper surface of the tongue, adjacent to the vertical plane VP, is provided with a notch parallel to the adjacent edge.

Item 8. Floor panel assembly of any of the preceding items, wherein the tongue and groove are so adapted to each other that in the joined position there is a pressure line between a lower surface of the tongue and a lower wall of the groove at a distance from the vertical plane VP, substantially below the start of the contact area at the upper surface of the tongue, and wherein the lower wall of the groove may have a stepped surface.

Item 9. Floor panel assembly of any of the preceding items, wherein the tongue and groove are so adapted to each other that in the joined position there is a pressure line or area between a lower surface of the tongue and a lower wall of the groove at a distance from the vertical plane VP.

Item 10. Floor panel assembly of item 9, wherein the lower wall of the groove is provided with a ridge extending parallel to the adjacent edge of the panel.

Item 11. Floor panel assembly of item 10, wherein the lower surface of the tongue is provided with an indentation extending parallel to the adjacent edge of the panel and being adapted to receive the ridge of the groove at least partly.

Item 12. Floor panel assembly preferably according to any of the preceding items, wherein the floor panels are substantially rectangular and has opposite third and fourth edges adjacent to the opposite first and second edges, each floor panel being provided on at least the third edge with a third joining member and, on the opposite fourth edge, with a fourth joining member, the third and fourth joining members of two panels being vertical joining members and being joined to each other by a mainly vertical movement of the respective panel edges towards each other, the third and fourth joining members locking the panels at the adjacent edges at least in a direction perpendicular to the upper side and in a direction parallel to the upper side but perpendicular to the adj acent third and fourth edges in their joined position, the third and fourth joining members being provided with at least one locking element locking the third and fourth joining members to each other in the joined position, at least in said direction perpendicular to the upper side.

Item 13. Floor panel assembly of item 12, wherein the joining members of the first and second edges of each panel allow a joining of the first and second edges of two panels by bringing the first and second edges into engagement with each other in a relatively inclined position of the panels and then rotating said panels with respect to each other so as to bring the upper sides of both panels substantially in alignment with each other, thereby also bringing the vertical joining members of the third and fourth edges of the tilted panel and an adjacent panel into engagement.

Item 14. Floor panel assembly of item 11 or 12, wherein the locking element is a horizontal protrusion on the third or fourth edge protruding towards the fourth or third edge and engaging in a recess on the other of the third or fourth edge.

Item 15. Floor panel assembly, preferably according to any of items 12 - 14, wherein the vertical joining members include a male and female joining member, at least one of which is deformable, such as bendable, for cooperation with the other of the male and female vertical joining members and is deformed when in the joined position to create tension.

Item 16. Floor panel assembly of item 15, wherein the male vertical joining member includes a substantially downwardly oriented protrusion and the female vertical joining member includes an upwardly oriented depression, said protrusion includes at least one bendable lip.

Item 17. Floor panel assembly of item 16, wherein the protrusion of the male vertical joining member includes two lips separated by a notch, at least one of said lips being bendable.

Item 18. Floor panel assembly of item 17, wherein

the lip furthest away from the panel centre is bendable.

Item 19. Floor panel assembly of any of items 14 - 18, wherein the protrusion and depression of the vertical joining members are adjacent a vertical plane VP where the panels meet each other near their upper sides.

Item 20. Floor panel assembly of any of the preceding items, wherein the joining member of the second edge includes a lip below the groove having an upper protrusion and the joining member of the first edge includes a downwardly open recess behind the tongue, the upper protrusion being adapted to engage the recess to provide a horizontal lock.

Item 21. Floor panel and joining members for use in the floor panel assembly of any of the preceding items.

Item 22. Floor panel assembly comprising sheet-shaped floor panels, preferably made of relatively resilient material, which floor panels are provided with a plurality of edges, wherein a an edge of a first panel and another edge of a second panel are equipped with joining members which allow a joining of the first and second edges of the two panels by bringing these into engagement with each other, so as to bring the upper sides of both panels substantially in alignment with each other and have them meet at a vertical plane VP, the first edge being provided with a male joining member and the second edge with a female joining member adapted to receive the male joining member therein so as to lock the panels at the adjacent edges at least in a direction perpendicular to the upper side and in a direction parallel to the upper side but perpendicular to the adjacent first and second edges in their joined position, wherein the male and female joining members are so adapted to each other that a surface of the male joining member is urged against a surface of the female joining member in a contact area, said contact area has a horizontal component and is the first of this kind that water meets when it enters between the joining members from the vertical plane VP.

Claims

1. Floor panel assembly comprising sheet-shaped floor panels (1-4), which floor panels are provided with a plurality of edges (5-8), wherein a first edge (7) of a first panel (1) and a second edge (8) of a second panel (2) are equipped with joining members (13, 14) which allow a joining of the first and second edges (7, 8) of the two panels (1, 2) by bringing these into engagement with each other, preferably in a relatively inclined position of the panels (1, 2) and then rotating said panels (1, 2) with respect to each other, so as to bring the upper sides of both panels (1, 2) substantially in alignment with each other and have them meet at a vertical plane VP, the first edge (7) being provided with a tongue (17) and the second edge (8) with a groove (18) adapted to receive the tongue (17) therein so as to lock the panels (1, 2) at the adjacent edges at least in a direction perpendicular to the upper side and in a direction parallel to the upper side but perpendicular to the adjacent first and second edges in their joined position, wherein the tongue (17) and groove (18) are so adapted to each other that an upper surface (24) of the tongue (17) is urged against an upper wall (25) of the groove (18) and is in contact with the groove (18) in a contact area (26), **characterized in that** the vertical size of the tongue (17) is larger than the vertical size of the groove (18), in non-joined condition, and wherein a clearance is present between the lower surface of the tongue (17) and the lower wall of the groove (18) in the area substantially below the contact area (26).

2. Floor panel assembly according to claim 1, wherein the contact area (26) between the upper surface (24) of the tongue (17) and the upper wall (25) of the groove (18) is at a distance from the vertical plane VP.

3. Floor panel assembly according to claim 1 or 2, wherein the contact area (26) has an inclination (α) with respect to a corresponding area of the upper wall (25) of the groove (18) in the non-joined condition, and is substantially parallel to the corresponding area of the upper wall (25) of the groove (18) in the joined condition, wherein said inclination (α) is downwardly in the direction towards the vertical plane VP.

4. Floor panel assembly according to any of the preceding claims, wherein the upper surface (24) of the tongue (17) adjacent the vertical plane VP is lowered with respect to the upper surface (24) of the tongue (17) at a distance from the vertical plane VP, for example by providing the upper surface (24) of the tongue (17), adjacent to the vertical plane VP, with a notch parallel to the adjacent edge.

5. Floor panel assembly according to any of the preceding claims, wherein the inclination (α) is between 1° and 6°, more preferably between 1° and 4°.

6. Floor panel assembly according to any of the preceding claims, wherein the tongue (17) and groove (18) are so adapted to each other that in the joined position there is a pressure line between a lower surface (28) of the tongue (17) and a lower wall of the groove (18) at a distance from the vertical plane VP, substantially below the start of the contact area (26) at the upper surface (24) of the tongue (17), wherein the lower wall of the groove (18) is preferably provided with a ridge extending parallel to the adjacent

edge of the panel, and more preferably, wherein the lower surface of the tongue (17) is provided with an indentation extending parallel to the adjacent edge of the panel and being adapted to receive the ridge of the groove (18) at least partly.

7. Floor panel assembly according to any of the preceding claims, wherein the horizontal lock of the panels away from each other is accomplished by means of a lip (19) below the groove (18) projecting from the panel (2) beyond the vertical plane VP and carrying near its free edge an upper protrusion (20) engaging into a downwardly open groove or recess (21) positioned behind the tongue (17) of the panel (3).

8. Floor panel assembly according to claim 7, wherein the lower surface of tongue (17) has a heel (22) ending into the front wall of the downwardly open groove (21), wherein this heel (22) cooperates with an upward wall (23) of the upper protrusion (20) to accomplish the horizontal lock at these edges (7, 8).

9. Floor panel assembly according to claim 8, wherein the heel (22) and the upward wall (23) urge the panels (2, 3) toward each other and press the panels (2,3) against each other at the position of substantially vertical surfaces (15, 16).

10. Floor panel assembly according to any of the preceding claims, wherein the sheet-shaped floor panels (1-4) are made of relatively resilient material.

11. Floor panel assembly according to any of the preceding claims, wherein the floor panels are substantially rectangular and has opposite third (5) and fourth edges (6) adjacent to the opposite first (7) and second edges (8), each floor panel being provided on at least the third edge (5) with a third joining member (11) and, on the opposite fourth edge (6), with a fourth joining member (12), the third and fourth joining members (11, 12) of two panels being vertical joining members and being joined to each other by a mainly vertical movement of the respective panel edges towards each other, the third and fourth joining members (11, 12) locking the panels at the adjacent edges (5, 6) at least in a direction perpendicular to the upper side and in a direction parallel to the upper side but perpendicular to the adjacent third and fourth edges (5, 6) in their joined position, the third and fourth joining members (11, 12) being provided with at least one locking element locking the third and fourth joining members (11, 12) to each other in the joined position, at least in said direction perpendicular to the upper side.

12. Floor panel assembly according to claim 11, wherein the joining members (13, 14) of the first and second edges (7, 8) of each panel allow a joining of the first and second edges (7, 8) of two panels by bringing the first and second edges (7, 8) into engagement with each other in a relatively inclined position of the panels and then rotating said panels with respect to each other so as to bring the upper sides of both panels substantially in alignment with each other, thereby also bringing the vertical joining members of the third and fourth edges (5, 6) of the tilted panel and an adjacent panel into engagement.

13. Floor panel assembly according to claim 11 or 12, wherein the locking element is a horizontal protrusion on the third or fourth edge protruding towards the fourth or third edge and engaging in a recess on the other of the third or fourth edge.

14. Floor panel assembly according to any of claims 11 to 13, wherein the vertical joining members include a male and female joining member, at least one of which is deformable, such as bendable, for cooperation with the other of the male and female vertical joining members and is deformed when in the joined position to create tension.

15. Floor panel according to claim 14, wherein the male vertical joining member includes a substantially downwardly oriented protrusion and the female vertical joining member includes an upwardly oriented depression, said protrusion includes at least one bendable lip.

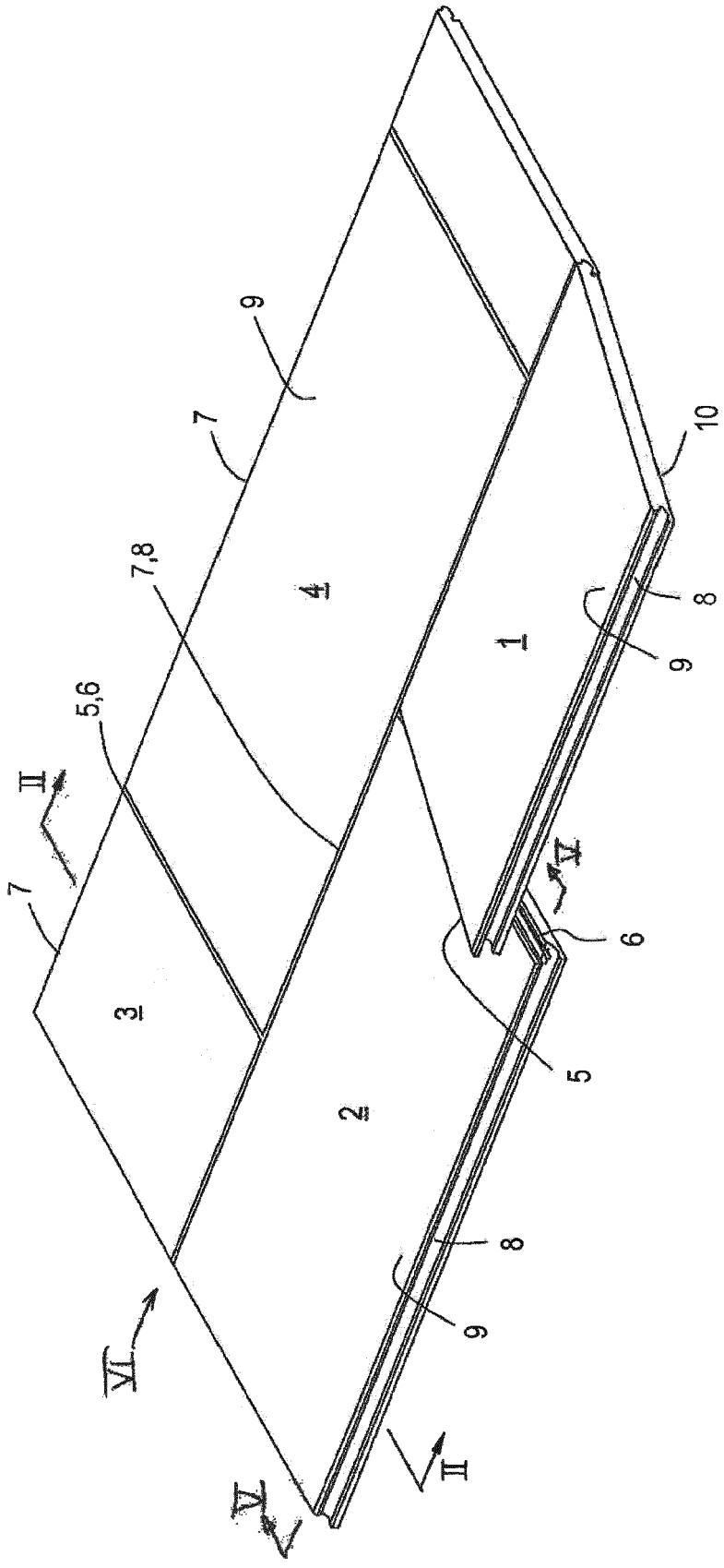

Fig.1

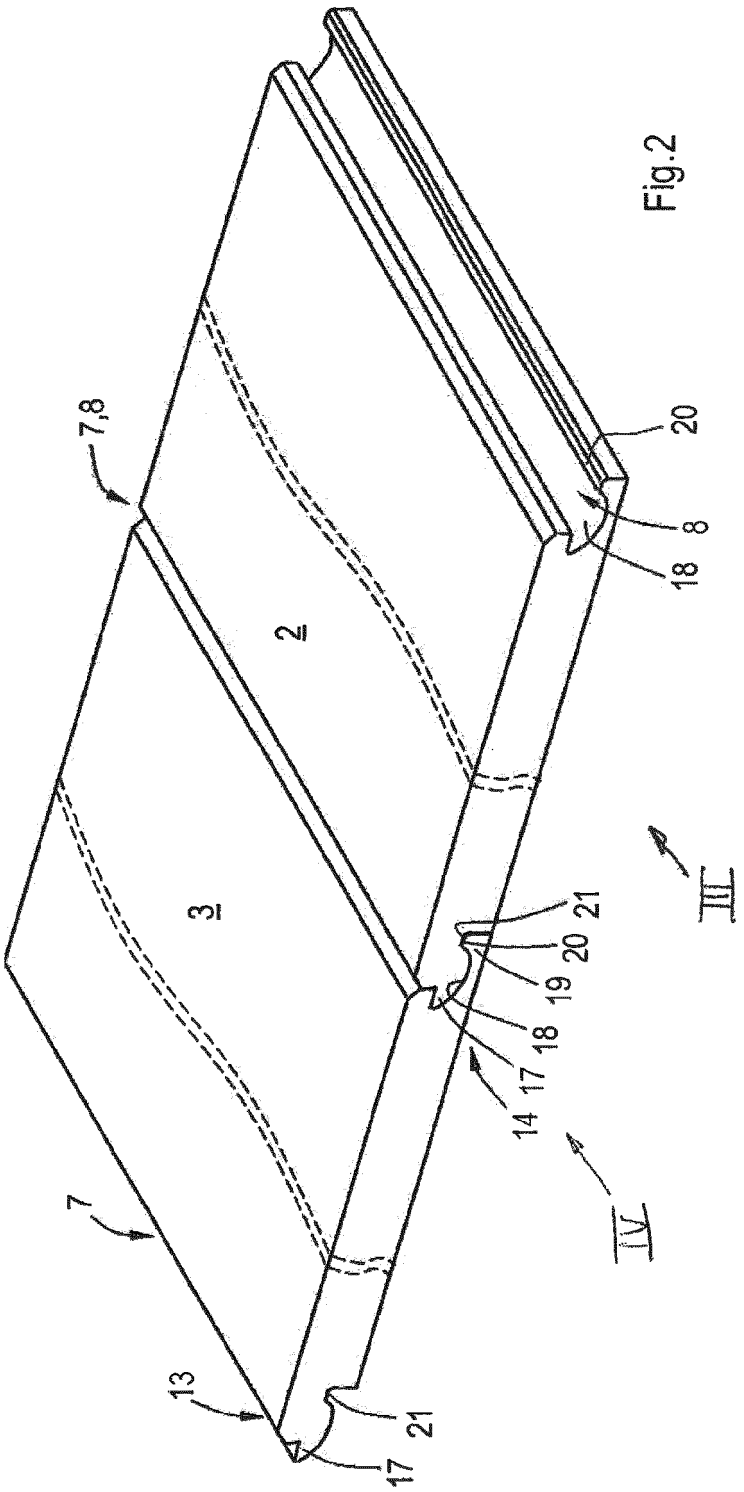

Fig.2

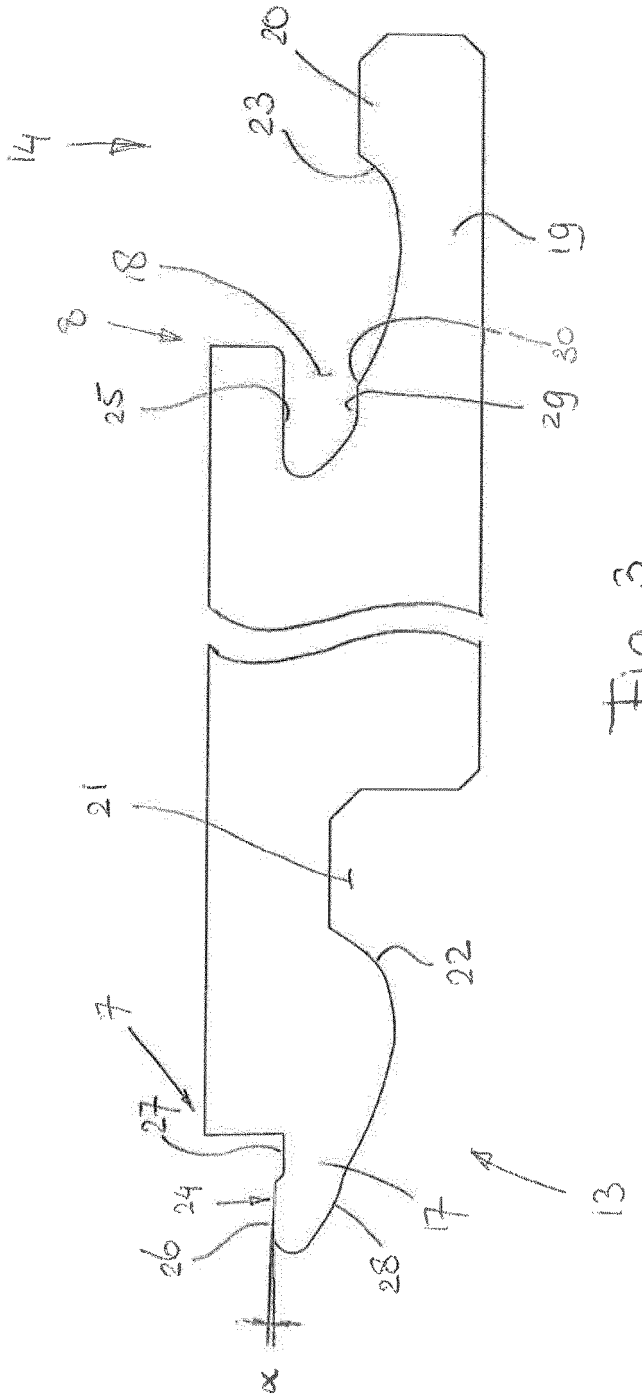

Fig. 3

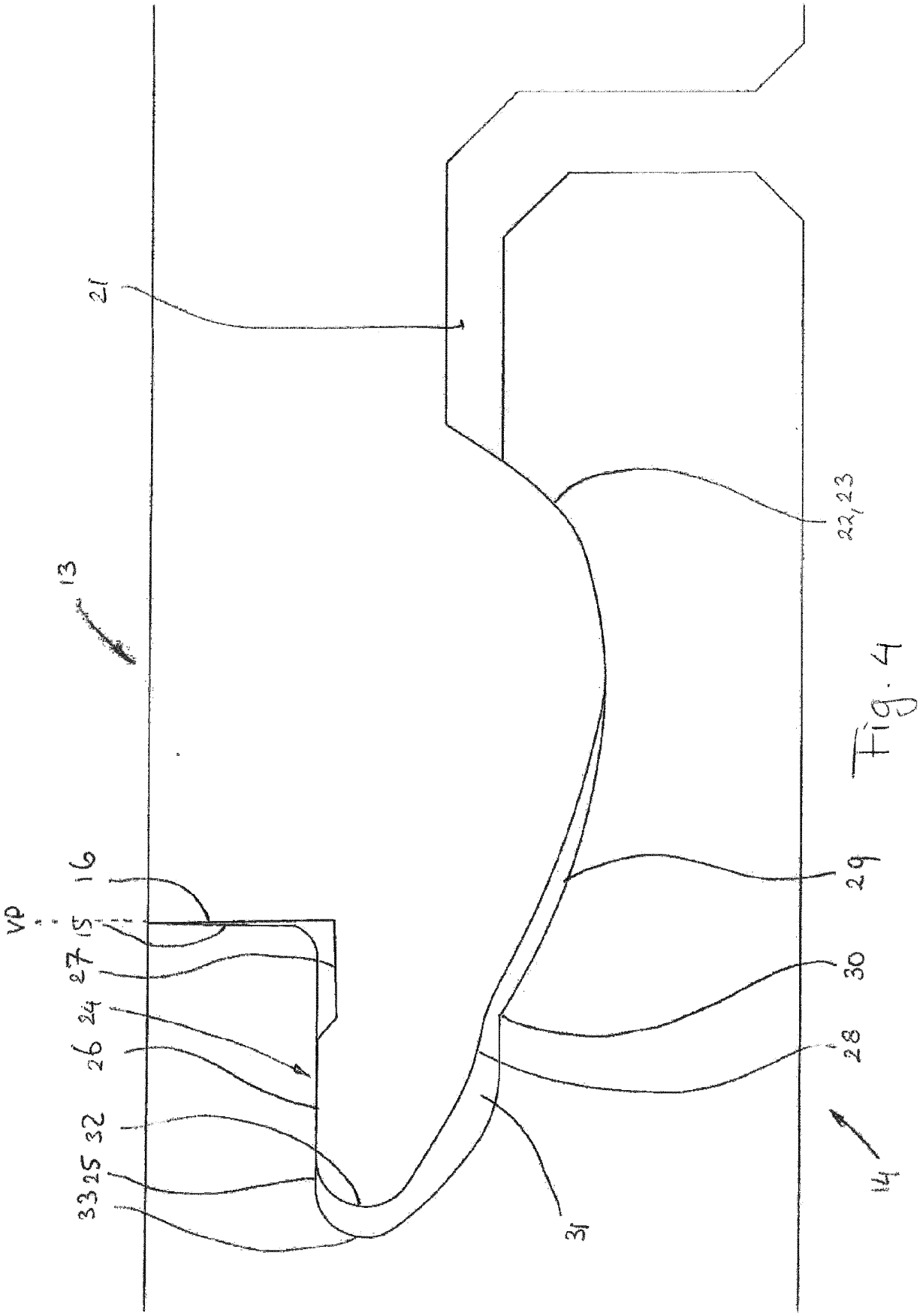

Fig. 4

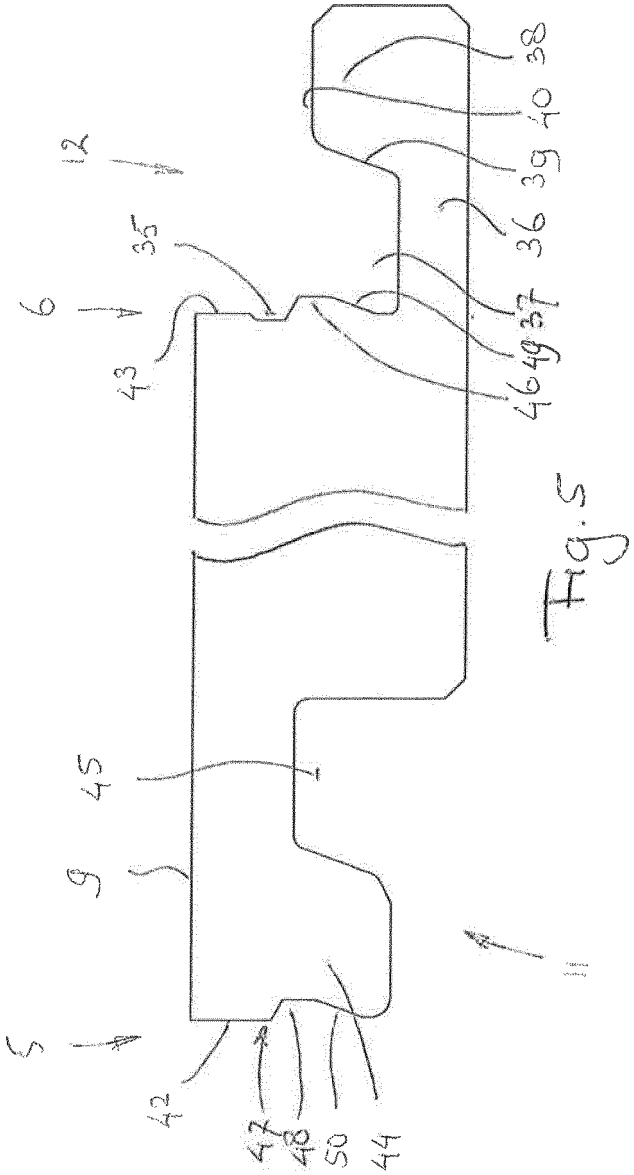

Fig. 5

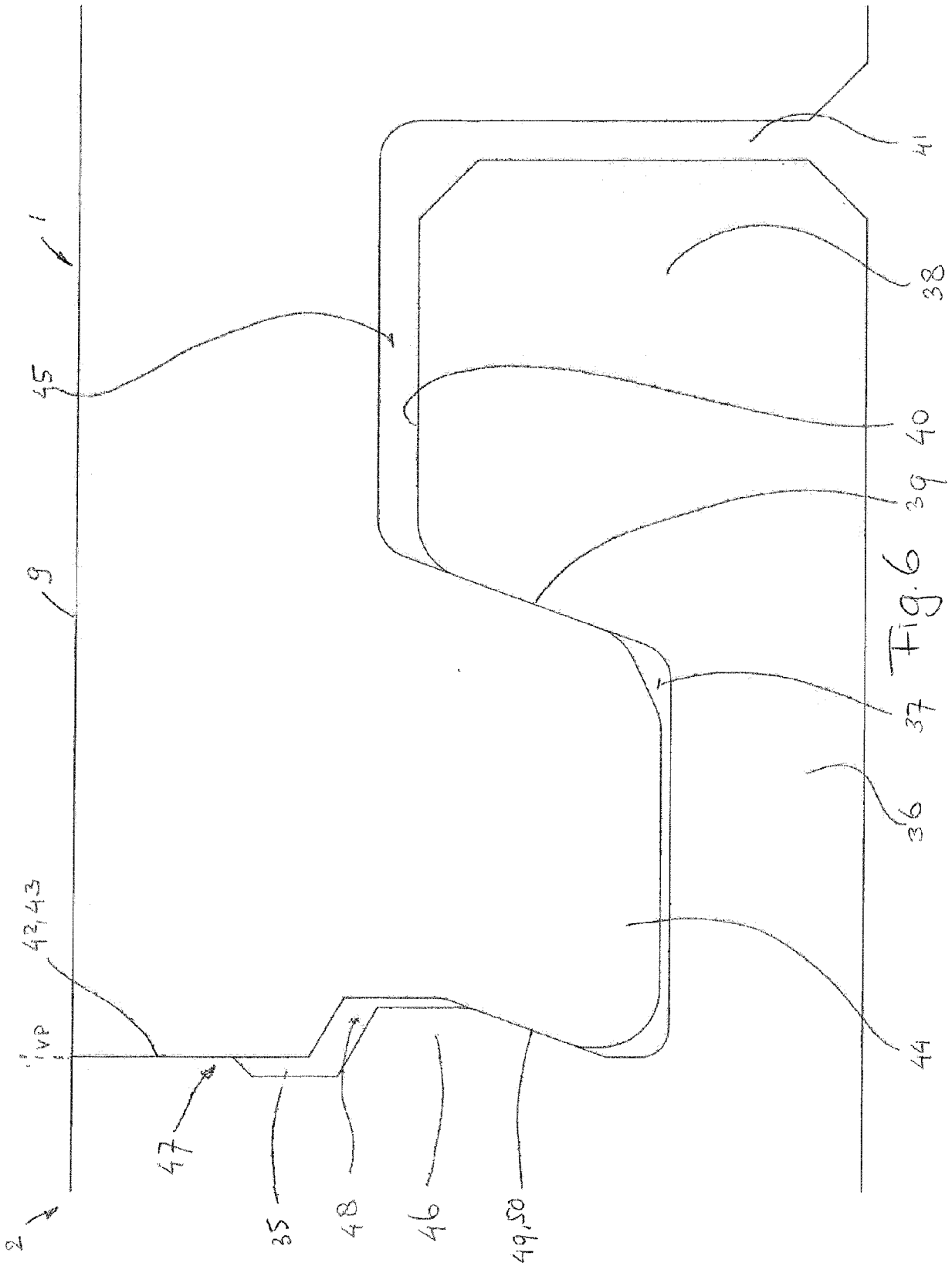

Fig.6

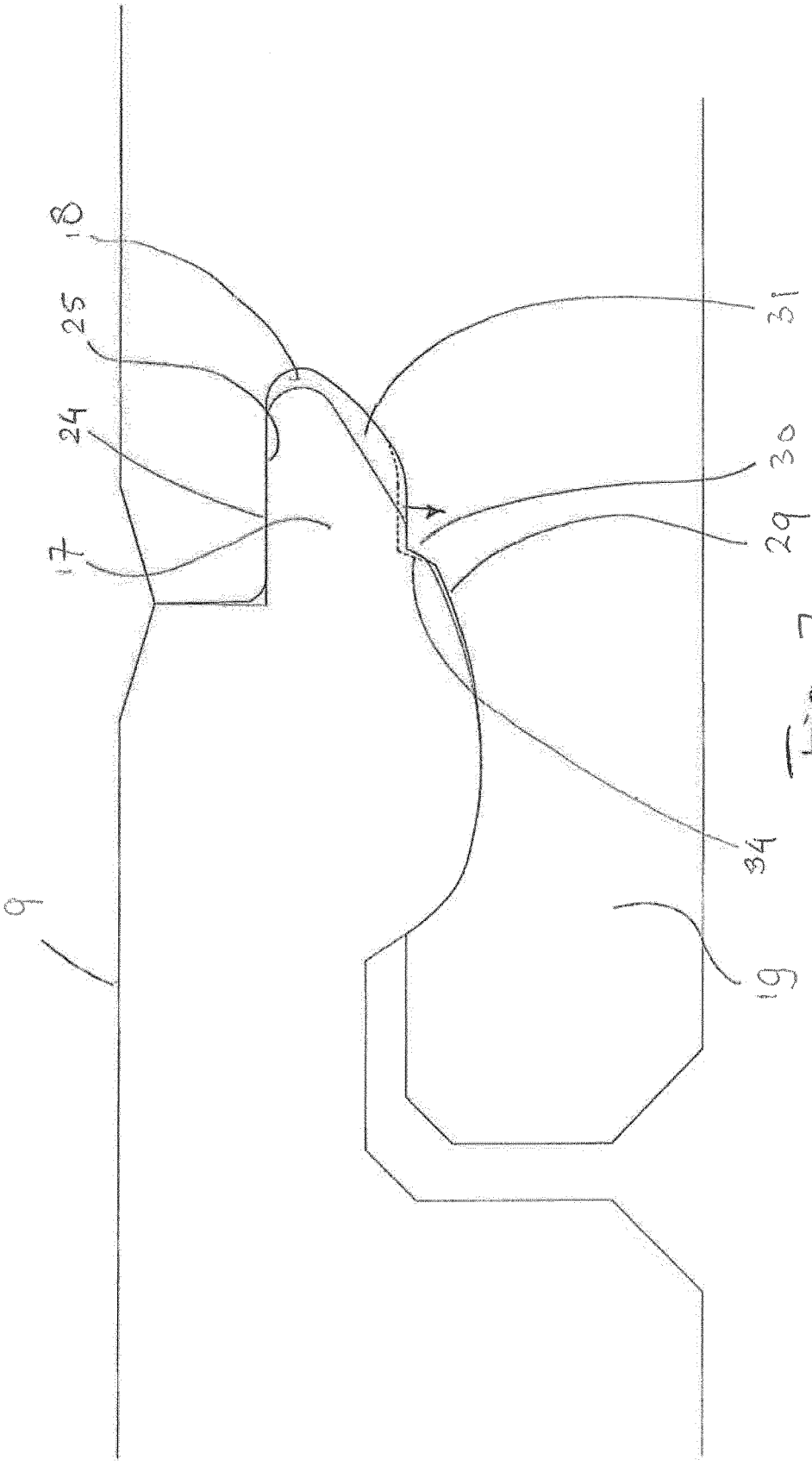

Fig. 7

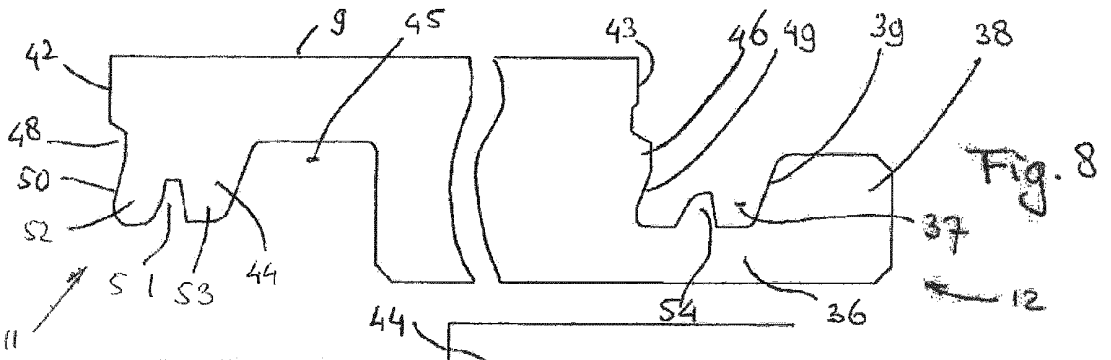

Fig. 8

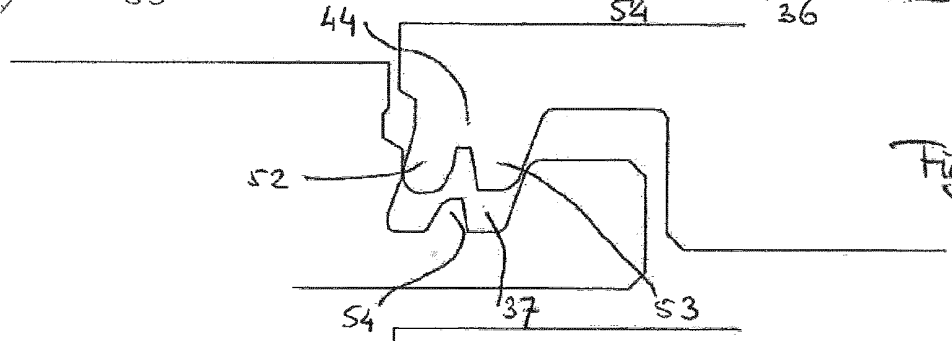

Fig. 9A

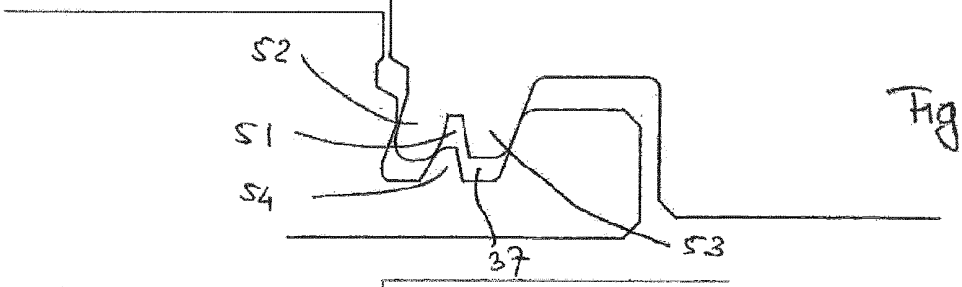

Fig. 9B

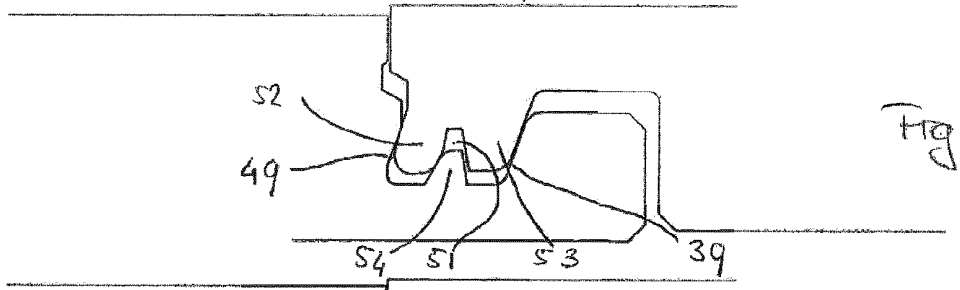

Fig. 9C

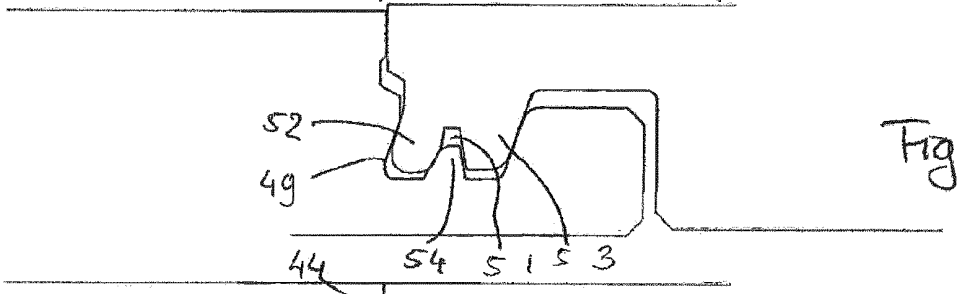

Fig. 9D

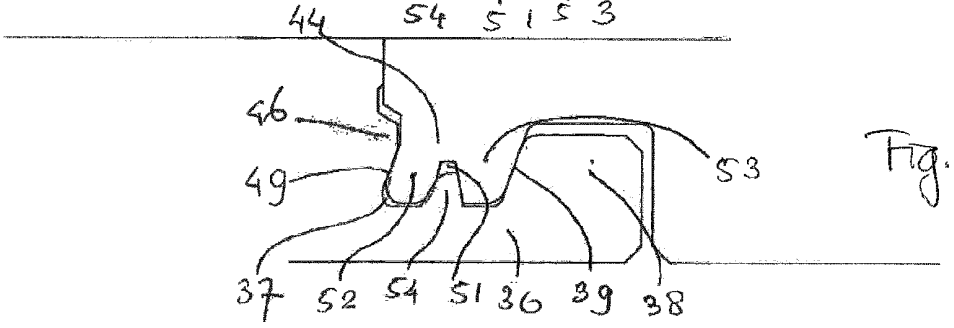

Fig. 9E

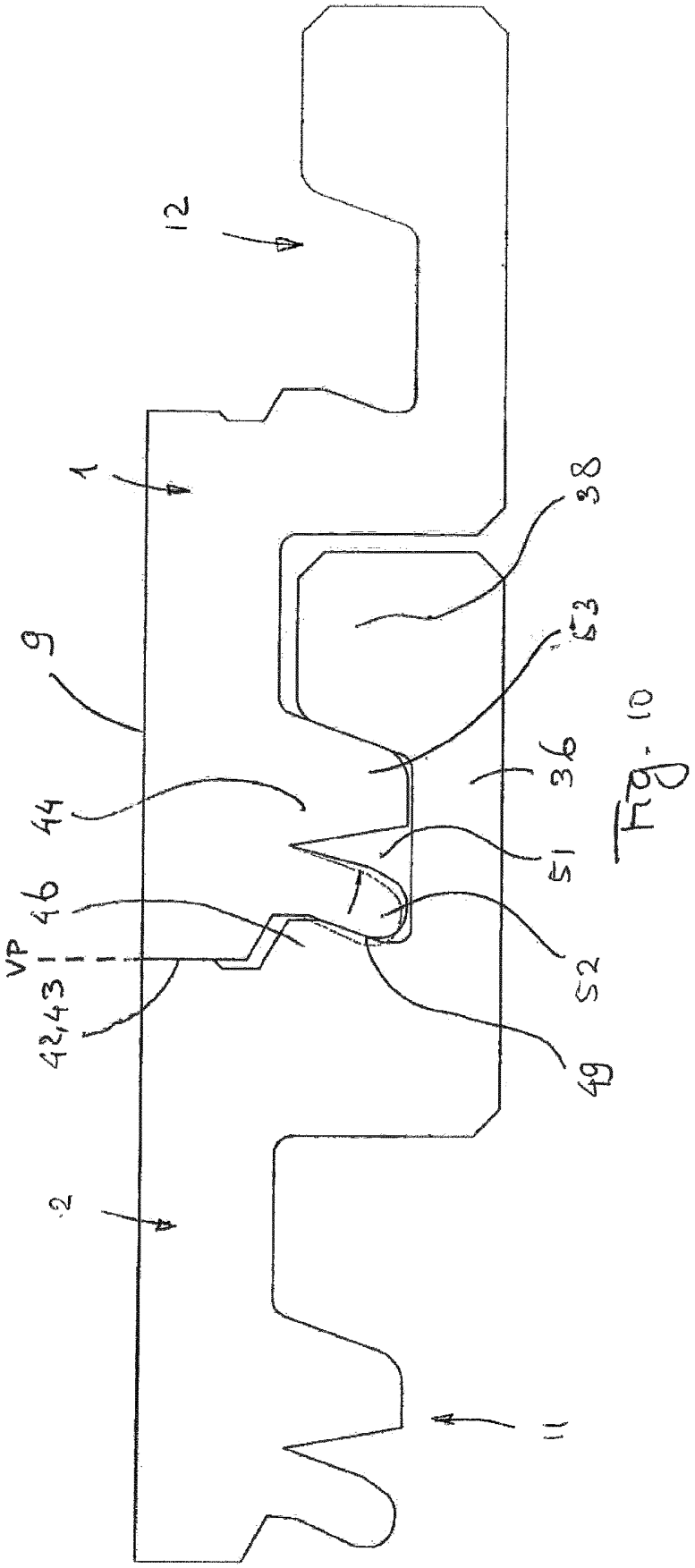

Fig. 10

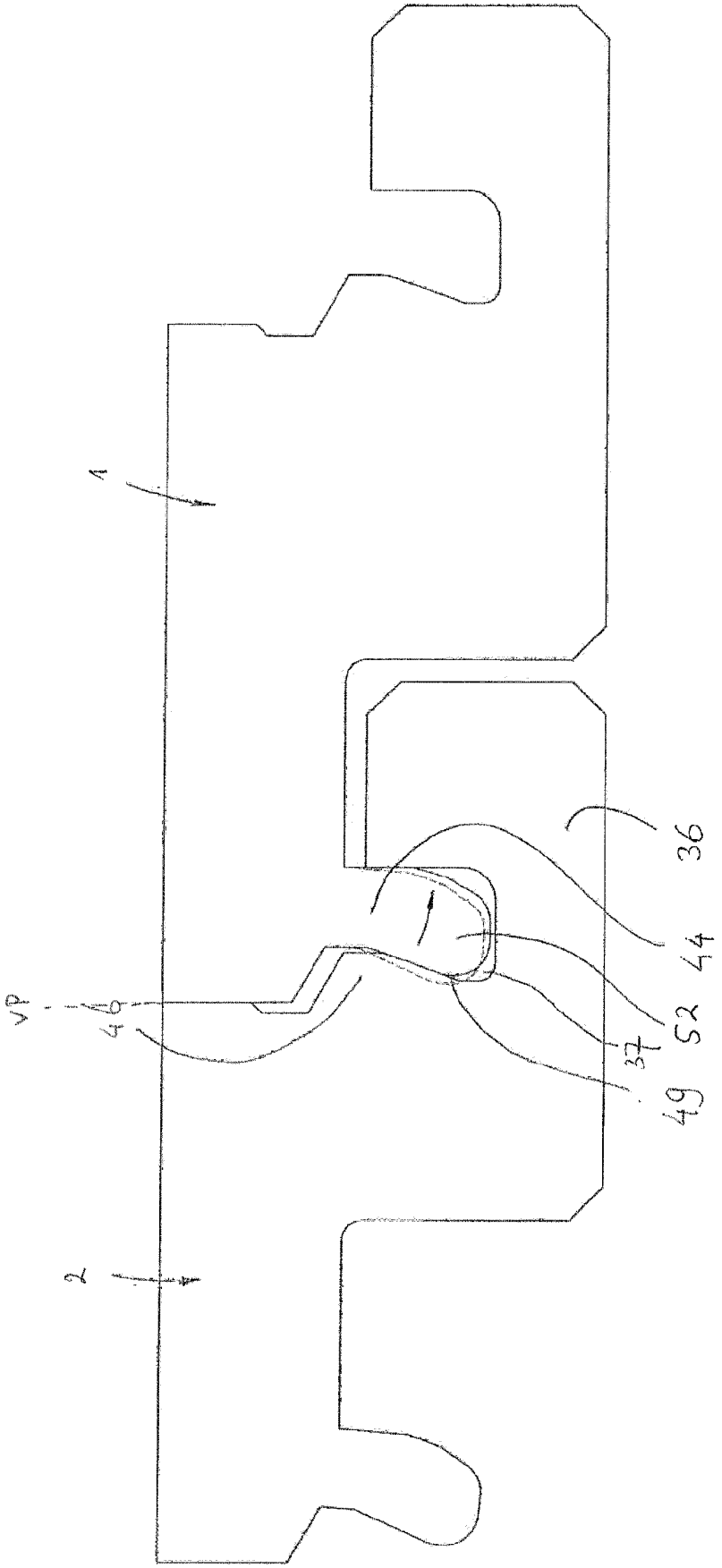

Fig. 11