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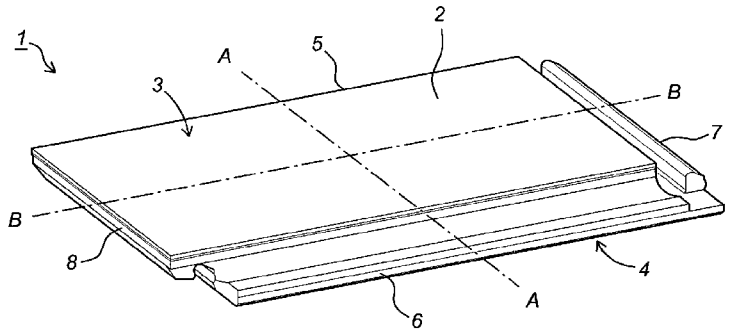

Fig. 1

(57) Abstract: The invention relates to a panel, in particular a floor panel (1), comprising a first complementary locking mechanism on a first pair of opposed edges (5, 6) and a second complementary locking mechanism on the other opposed edges (7, 8), whereby the first locking mechanism is designed to allow vertical and horizontal interlocking by angling down of the panel while the second mechanism is designed for vertical movement and horizontal locking thereby interconnecting similar panels and forming a covering. The invention also relates to a covering consisting of mutually connected floor panels according to the invention. The invention further relates to a method of assembling multiple floor panels for forming a covering.

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Panel interconnectable with similar panels for forming a covering

The invention relates to a panel, in particular a floor panel, interconnectable with similar panels for forming a covering. The invention also relates to a covering consisting of mutually connected floor panels according to the invention. The invention further relates to a method of assembling multiple floor panels for forming a covering.

The last ten years has seen enormous advance in the market for laminate for hard floor covering. It is known to install floor panels on a underlying floor in various ways. It is, for example, known that the floor panels are attached at the underlying floor, either by glueing or by nailing them on. This technique has a disadvantage that is rather complicated and that subsequent changes can only be made by breaking out the floor panels. According to an alternative installation method, the floor panels are installed loosely onto the subflooring, whereby the floor panels mutually match into each other by means of a tongue and groove coupling, whereby mostly they are glued together in the tongue and groove, too. The floor obtained in this manner, also called a floating parquet flooring, has as an advantage that it is easy to install and that the complete floor surface can move which often is convenient in order to receive possible expansion and shrinkage phenomena. A disadvantage with a floor covering of the above-mentioned type, above all, if the floor panels are installed loosely onto the subflooring, consists in that during the expansion of the floor and its subsequent shrinkage, the floor panels themselves can drift apart, as a result of which undesired gaps can be formed, for example, if the glue connection breaks. In order to remedy this disadvantage, techniques have already been through of whereby connection elements made of metal are provided between the single floor panels in order to keep them together. Such connection elements, however, are rather expensive to make and, furthermore, their provision or the installation thereof is a time-consuming occupation. There is a need to improve the coupling profiles of panels, in particular floor panels, which lead to a relatively reliable en durable connection at all edges, and which can be installed relatively easily, preferably without needing additional connection means, such as glue or metal connection elements.

It is an object of the invention to provide an improved floor panel, which can be coupled in an improved manner to other panels, and whereby preferably one or more of the aforementioned disadvantages are excluded.

It is a further object of the invention to provide an improved panel, in particular floor panel, which can be connected to similar panels in a relatively easy manner while leading to a relatively reliable and firm connection between panels.

The invention provides for this purpose a panel, in particular a floor panel, interconnectable with similar panels for forming a covering, comprising:

- a centrally located core provided with an upper side and a lower side, said core being provided with:
  - a first pair of opposite edges, comprising:
    - a first edge comprising a sideward tongue extending in a direction substantially parallel to the upper side of the panel, the bottom front region of said sideward tongue being rounded at least partly, the bottom back region of said tongue being configured as bearing region, wherein the bottom back region is located closer to the level of the upper side of the panel than a lowest part of the bottom front region,
    - an opposite, second edge comprising a recess for accommodating at least a part of the sideward tongue of a further panel, said recess being defined by an upper lip and a lower lip, said lower lip being provided with a upwardly protruding shoulder for supporting the bearing region of the sideward tongue,
    - the sideward tongue being designed such that locking takes place by an introduction movement into the recess of the sideward tongue a further panel and a angling down movement about an axis parallel to the first edge, as a result of which a top side of the sideward tongue will engage the upper lip and the bearing region of the sideward tongue will be supported by the shoulder of the lower lip, leading to locking of adjacent panels at the first and second edges in both horizontal direction and vertical direction; and
  - a second pair of opposite edges, comprising:
    - a third edge comprising a single upward tongue, at least one upward flank lying at a distance from the upward tongue and a single upward groove formed between the upward tongue and the upward flank, wherein a at least a part of a side of the upward tongue facing toward the upward flank extends in the direction of the normal of the upper

side of the core, and wherein at least a part of a side of the upward tongue facing away from the upward flank comprises a substantially rigid first locking element, and

- a fourth edge comprising a single downward tongue, at least one downward flank lying at a distance from the downward tongue, and a single downward groove formed between the downward tongue and the downward flank, wherein at least a part of a side of the downward tongue facing toward the downward flank extends in the direction of the normal of the lower side of the core, and wherein the downward flank comprises a substantially rigid second locking element adapted for co-action with the first locking element of a third edge of yet a further panel,
- the third and fourth edges being designed such that locking takes place during angling down of a panel to be coupled at a first edge to a second edge of a further panel, wherein the fourth edge of a panel to be coupled makes a scissoring movement toward a third edge of yet another panel, such that the downward tongue of the fourth edge of the panel to be coupled will be forced into the upward groove of the third edge of said other panel and the upward tongue of said other panel will be forced into the downward groove of the panel the be coupled, by deformation of the third edge and/or the fourth edge, leading to locking of adjacent panels at the third and fourth edges in both horizontal direction and vertical direction.

The panel according to the invention comprises at a first pair of opposing edges a first set of complementary coupling profiles and at a second pair of opposing edges a distinctive second set of complementary coupling profiles. The first and second edges facilitate an easy installation of a panel by inserting the sideward tongue of the first edge of the panel to be coupled in an inclined position into the recess of the second edge of an already installed panel, after which that panel will be angled (pivoted) downwardly until both panels are situated in the same plane. Although this angling down process leads to locking of both panels at the first and second edges both in horizontal direction and in vertical direction, an improved locking will be realized due to the presence of the third and fourth edges, and more in particular by forcing the fourth edge of the panel to be coupled to snap into the third edge of another panel during the angling down movement of the panel to be coupled. Since the third

and fourth edges are commonly perpendicular to the first and second edge, a scissoring movement will occur, leading to snapping or zipping of the fourth panel of a panel to coupled and the third edge of an already installed panel into each other. Since the third profile is provided with a closed upward groove, whereas at least a part of a side of the upward tongue facing toward the upward flank extends in the direction of the normal of the upper side of the core, and since the fourth profile is provided with a closed downward groove, whereas at least a part of a side of the downward tongue facing toward the downward flank extends in the direction of the normal of the lower side of the core, an interconnection of the third and fourth edges of adjacent panels can only be established after a (temporary), preferably resilient, deformation of the third edge and/or the fourth edge leading to a relatively firm, reliable, and durable connection at the third and fourth edges. Hence, the panel according to invention can be assembled in a relatively easy manner, without the need of additional connection elements, while leading to a firm and durable connection.

At the first and second edges, a locking in horizontal direction between two panels is established by the presence of upwardly protruding shoulder, which prevents the bottom front region of the sideward tongue to be displaced in a horizontal direction. Hence, the shoulder locks the bottom front region of the sideward tongue in place. A locking in vertical direction at the first and second edges of two panels is established by the engagement of a top surface of the sideward tongue to a bottom surface of the upper lip acting as locking surface. In fact, the upper lip prevents the inserted sideward tongue to be displaced in vertical direction.

At the third and fourth edges, a locking in horizontal direction between two panels is established by the presence of the upward tongue at the third edge which engages to the downward tongue at the fourth edge (of another panel), which prevents the two panels to be drifted apart. At the third and fourth edges, a locking in vertical direction between two panels is established by the application of the closed grooves as indicated above, and moreover, due to the presence of the additional first and second locking elements. Moreover, due to the particular shape of the third and fourth edges, a locking in rotational directional will commonly also be established.

The (floor) panel according to the invention is primarily intended for so-called laminated floors, but generally it can also be applied for other kinds of covering, consisting of hard floor panels, such as veneer parquet, prefabricated parquet, or other floor panels which can be compared to laminated flooring. The panel according to the invention can also be applied to form an alternative covering, for example a wall covering or a ceiling covering.

The recess is preferably terminated by the shoulder. By using this definition, the recess will be configured to accommodate that front region of the tongue, while the back region acting as bearing region will be positioned outside the recess. The recess will therefore in vertical direction be limited and defined by the upper lip and the lower lip, and will in horizontal direction be limited and defined by the core and the shoulder. As indicated above, a bottom surface of the front region of the sideward tongue is at least partly rounded, which facilitates angling down of the panel, wherein a more or less central part of the front region of the sideward tongue will act as pivoting axis. Since the sideward tongue is inserted into the recess during angling down, the pivoting axis will be displaced slightly during the angling down process. Commonly, the shape of a bottom surface of the lower lip defining the recess, configured for supporting the front region of the sideward tongue, is preferably complementary to the shape of the bottom front region of the sideward tongue. In this manner, the number of gaps between the sideward tongue and the bottom surface of the lower lip defining the recess can be kept to a minimum, which will commonly be in favour of the prevention of play between the edges, and hence to the solidness of the connection. Therefore, the bottom surface of the recess is preferably also at least partly rounded. The roundness of the matching surface can be either smooth or (somewhat) hooked, for example by hooked surface segments, to form a rounded shape. Alternatively, the bottom surface of the lower lip defining the recess can also be given another shape, for example a substantially flat shape, which could be in favour of minimizing the resistance between two panels during the angling down process, which could facilitate the installation process.

The upper lip and the lower lip are connected to the core, and preferably extend in a direction which is substantially parallel to the upper side of the core. Preferably, the lower lip is substantially longer than the upper lip, more preferably at least four times longer. In between the upper lip and the lower lip a cavity is created, which cavity makes part of the recess. This cavity will commonly act as locking part of the recess, wherein a top surface of said locking part acts as locking surface and is configured to co-act with a top surface of the front region of the sideward tongue of a further panel. This locking surface preferably has an inclined orientation, and wherein at least a front region of the top surface of the sideward tongue has a corresponding inclined orientation. An inclined orientation of the locking surface commonly facilitates coupling of panels at the first and second edge.

It is commonly advantageous in case a side of the shoulder facing the core has an inclined orientation for forcing two panels, in an assembled state, toward each other. Preferably a complementary surface of the bearing region of the sideward tongue has a substantially identical inclined orientation. This inclination preferably runs downward from the shoulder in the direction of the core. By applying such an inclined orientation a driving surface will be created for driving (forcing) an inserted sideward tongue in the direction of the core of the panel, which will be in favour of the firmness of the coupling at the first and second edges.

In a preferred embodiment, the width of the bearing region of the sideward tongue is greater than the width of the shoulder. The width is perpendicular to the length of the sideward tongue and the shoulder, and hence perpendicular to the longitudinal axis of the first and second edge. By applying a bearing region having a greater width than the width of the shoulder, a gap will be created between the shoulder and the core of an adjacent panel. This gap will commonly facilitate the angling down process, since more space during the angling down process.

The panel according to the invention can either have a square shape or a rectangular shape. The first pair of opposite edges have a substantially parallel orientation. The same applies to the second pair of opposites edges which also have a mutually substantially parallel orientation. The angle enclosed by the first pair of edges and the second pair of edges is substantially perpendicular. In a preferred embodiment the panel has a substantially rectangular shape, wherein the first pair of opposite edges are located on the long sides of the panel, and the second pair of opposite edges are located on the short sides of the panel. This orientation allows the long edges of a first panel and a second panel to be engaged first, after which the short edges of the first panel and a third panel will be connected during lowering (angling down) of the first panel. It is imaginable to modify this embodiment by applying the first and second edges to the short edges, and the third and fourth edges to the long edges. In this latter embodiment, first the short edges of different panels will be brought in contact which each other, after which during angling down of one of the panels the long sides of the panel will be connected to another panel.

In a preferred embodiment at least a part of a side of the upward tongue facing toward the upward flank forms an upward aligning edge for the purpose of coupling the third edge to a

fourth edge of an adjacent panel. This upward aligning edge can be flat and/or rounded. The upward aligning edge facilitates a correct positioning (alignment) of the fourth edge of a panel with respect to a third edge of an adjacent panel which will commonly facilitate mutual coupling of the third edge and the fourth edge.

Preferably, at least a part of a side of the downward tongue facing away from the downward flank forms a downward aligning edge for the purpose of coupling the fourth edge to a third edge of an adjacent panel. Also this aligning edge, which may also be flat and/or rounded, also serves to facilitate a correct mutual positioning of the fourth and third edges, and therefore the ease of mutual coupling of both edges.

Each of the upward tongue and the downward tongue is preferably substantially rigid, which means that the tongues are not configured to be subjected to deformation. The tongues as such are relatively stiff and hence non-flexible. Moreover, the tongues are preferably substantially solid, which means that the tongues are substantially massive and thus completely filled with material and are therefore not provided with grooves at an upper surface which would weaken the construction of the tongue and hence of the floor panel connection to be realised. By applying a rigid, solid tongue a relatively firm and durable tongue is obtained by means of which a reliable and the durable floor panel connection can be realised without using separate, additional components to realise a durable connection. The upward tongue and the downward tongue are each connected to the core by means of a bridge. Preferably, the bridges are resilient to some extent to allow slight and commonly temporary deformation of the third and fourth edges during coupling of these edges.

In an embodiment of the floor panel, at least a part of the upward flank adjoining the upper side of the floor panel is adapted to make contact with at least a part of the downward tongue adjoining the upper side of another floor panel in a coupled state of these floor panels. Engagement of these surfaces will lead to an increase of the effective contact surface between the coupling elements and hence to an increase of stability and sturdiness of the connection between two floor panels. In a favourable embodiment the upper side of the floor panel is adapted to engage substantially seamless to the upper side of another floor panel, as a result of which a seamless connection between two floor panels, and in particular the upper surfaces thereof, can be realised.

In another embodiment the first locking element is positioned at a distance from an upper side of the upward tongue. This is favourable, since this will commonly result in the situation that the first locking element is positioned at a lower level than the upward aligning edge of the floor panel, which has the advantage that the maximum deformation of the fourth edge can be reduced, whereas the connection process and deformation process can be executed in successive steps. Less deformation leads to less material stress which is in favour of the life span of the coupling part(s) and hence of the floor panel(s). In this embodiment the second locking element is complementary positioned at a distance from an upper side of the downward groove. In an alternative embodiment, the first locking element is positioned at a distance from a lower side of the upward tongue, which may also facilitate coupling. The positioning of the complementary second locking element will be such that both locking element will co-act in the coupled state of the third and fourth edge.

In yet another embodiment the effective height of the downward aligned edge is larger than the effective height of the upward tongue. This commonly results in the situation that the downward aligning edge of a floor panel does not engage another floor panel in case of a pre-aligned state (intermediate state). The position-selective contactless pre-alignment does prevent or counteract forcing the downward aligning edge of a floor panel along the upper surface of another floor panel, which could damage the floor panels.

In an embodiment the mutual angle enclosed by at least a part of a side of the upward tongue facing toward the upward flank and the normal of the upper side of the core is substantially equal to the mutual angle enclosed by at least a part of a side of the downward tongue facing toward the downward flank and the normal of the lower side of the core. A close-fitting connection of the two tongue parts to each other can hereby be realized, this generally enhancing the firmness of the coupling between the two floor panels. In an embodiment variant the angle enclosed by on the one hand the direction in which at least a part of a side of the upward tongue facing toward the upward flank extends and on the other the normal of the upper side of the core lies between 0 and 60 degrees, in particular between 0 and 45 degrees, more particularly between 0 and 10 degrees. In another embodiment variant the angle enclosed by on the one hand the direction in which at least a part of a side of the downward tongue facing toward the downward flank extends and on the other the normal of the lower side of the core lies between 0 and 60 degrees, in particular between 0 and 45 degrees, more particularly between 0 and 10 degrees. The eventual inclination of the tongue side facing

toward the flank usually also depends on the production means applied to manufacture the floor panel. In an embodiment inclination of the downward aligned edge is less than the inclination of at least an upper part of the upward flank, as result of which an expansion chamber will be formed between both surface which will be favourable to allow play and to compensate expansion, e.g. due to moist absorption by the floor panels.

In a variant at least a part of an upper side of the upward tongue extends in a direction toward the normal of the upper side of the core. This has the result that the thickness of the upward tongue decreases in the direction of the side of the tongue facing away from the upward flank. By having the downward groove substantially connect to the upper side of the upward tongue, in a coupled position of two floor panels according to the invention wherein an upper side of the downward groove extends in the direction of the normal of the lower side of the core, a fourth edge can be provided which is on the one hand relatively strong and solid and can on the other guarantee sufficient resilience to enable a coupling to be realized to a third edge of an adjacent floor panel.

Preferably, at least a part of an upper side of the upward tongue runs inclining downward in the direction of the side of the upward tongue facing away from upward flank, and wherein an upper side of the downward groove having a likewise inclining orientation upward in the direction of the side of the downward tongue facing towards to downward flank. Apart from the fact that the inclined upper side of the upward tongue may act as aligning edge for aligning the fourth edge and the third edge (of another panel) with respect to each other, the inclined surface also allows a thicker bridge for connecting the downward tongue to the core of the panel, which is in favour of the reliability and durability of the panel. This inclination may be either flat or rounded, or eventually hooked. It is even imaginable that the inclined upper side of the upward tongue is rounded and seamlessly fits to the first locking element, which may also have a rounded shape.

In another embodiment variant at least a part of the aligning edge of the fourth edge has a substantially flatter orientation than at least a part of the upward flank of the third edge. By applying this measure there is generally created in a coupled position an air gap between the aligning edge of the fourth edge and a flank of the third edge. This clearance intentionally created between the two coupling parts is usually advantageous during coupling of adjacent floor panels, since this clearance does not prevent a temporary deformation of the coupling

parts, this facilitating coupling of the coupling parts. Furthermore, the created clearance is advantageous for the purpose of absorbing expansion of the floor panel, for instance resulting from moisture absorption, this not being inconceivable when the floor panel is at least partially manufactured from wood.

In an embodiment variant a part of the upward flank of the third edge connecting to the core forms a stop surface for at least a part of the side of the downward tongue facing away from the downward flank. In this way a close fitting of at least the upper side of the floor panels can be realized, this usually being advantageous from a user viewpoint. A part of the upward flank of the third edge connecting to the core is here preferably oriented substantially vertically. At least a part of the side of the downward tongue facing away from the downward flank is here also preferably oriented substantially vertically. Applying substantially vertical stop surfaces in both coupling parts has the advantage that in the coupled position the coupling parts can connect to each other in relatively close-fitting and firm manner.

It is generally advantageous for the upward groove to be adapted to receive with clamping fit a downward tongue of an adjacent panel. Receiving the upward groove, or at least a part thereof, with clamping fit in the downward tongue has the advantage that the downward tongue is enclosed relatively close-fittingly by the upward groove, this usually enhancing the firmness of the coupled construction. The same applies for the embodiment variant in which the downward groove is adapted to receive with clamping fit an upward tongue of an adjacent panel.

In an embodiment variant the upward flank and the downward flank extend in a substantially parallel direction. This makes it possible to connect the flanks, as well as the locking elements, relatively closely to each other in a coupled position, this generally enhancing the locking effect realized by the locking elements.

In another embodiment variant the first locking element comprises at least one outward bulge, and the second locking element comprises at least one recess, or vice versa, which outward bulge is adapted to be at least partially received in a recess of an adjacent coupled floor panel for the purpose of realizing a locked coupling. This embodiment variant is generally advantageous from a production engineering viewpoint. The first locking element and the second locking element preferably take a complementary form, whereby a form-fitting

connection of the locking elements of adjacent floor panels to each other will be realized, this enhancing the effectiveness of the locking.

The third edge and the fourth edge are preferably integrally connected to the core. The same applies to the first and second edges, which are preferably also integrally connected to the core. From a structural, production engineering and logistics viewpoint this integral connection between the core and the edges to form a single piece panel is generally recommended.

In an embodiment variant the panel is manufactured at least partially from wood. The floor panel can herein form a wooden plank and/or a parquet floor panel. The panel according to the invention is however also exceptionally suitable for application as laminated floor panel, wherein the floor panel comprises a laminate of a balancing layer (backing layer), a core layer comprising a wood and/or plastic product and at least one top structure arranged on an upper side of the carrier layer. The top structure commonly comprises a decorative layer on top of which a transparent protective layer is applied. A wood or tile structure can further be pressed into the protective layer, whereby the top layer in fact also forms an embossed layer. The decorative layer is generally formed by a photo of wood or of tiles printed on paper usually saturated in melamine resin. It is also possible these days to print a decorative pattern directly onto the core layer by using dedicated printing devices. The core layer generally comprises a wood fibreboard, in particular an MDF board (Medium Density Fibreboard) or HDF board (High Density Fibreboard). It is also possible to envisage the floor panel being manufactured wholly from metal and/or textile instead of being manufactured from wood and/or plastic.
In a preferred embodiment variant the panel is manufactured at least partially from plastic, in particular thermoplastic, preferably polyvinylchloride (PVC). It is possible here to envisage the floor panel according to the invention being manufactured substantially wholly from plastic. Preferably, the core is made of a laminate of material layers, wherein a central layer is made of at least one thermoplastic material, wherein the core has a top surface and a bottom surface. Affixed to the top surface of the core is print layer, wherein the print has a top surface and a bottom surface. Also, an overlay layer can be affixed directly to the top surface of the core, or affixed to the top surface of the print layer. The panel can optionally contain an underlay layer located and affixed between the bottom surface of the print layer and the top surface of the core. In more detail, the core in the thermoplastic laminate panel preferably comprises at least one thermoplastic material, the at least one thermoplastic material being

polyvinyl chloride. Generally, any combinations thereof, alloys thereof, or mixtures of two or more thermoplastics wherein at least one thermoplastic material is polyvinyl chloride can be used to form the core, or at least a central layer thereof. Generally, such thermoplastic materials include, but are not limited to, vinyl containing thermoplastics such as polyvinyl acetate, polyvinyl alcohol, and other vinyl and vinylidene resins and copolymers thereof; polyethylenes such as low density polyethylenes and high density polyethylenes and copolymers thereof; styrenes such as ABS, SAN, and polystyrenes and copolymers thereof; polypropylene and copolymers thereof; saturated and unsaturated polyesters; acrylics; polyamides such as nylon containing types; engineering plastics such as acetyl, polycarbonate, polyimide, polysufone, and polyphenylene oxide and sulphide resins and the like. One or more conductive polymers can be used to form the plank, which has applications in conductive flooring and the like. The thermoplastic polymers set forth in Kirk Othmer (3rd Edition, 1981) at pp. 328 to 848 of Vol. 18 and pp. 385-498 of Vol. 16, can also be used as long as the resulting plank has sufficient strength for its intended purpose. More preferably, the thermoplastic material is a rigid polyvinyl chloride but semi-rigid or flexible polyvinyl chloride may also be used. The flexibility of the thermoplastic material can be imparted by using at least one liquid or solid plasticizer which is preferably present in an amount of less than about 20 phr (parts per hundred parts of resin), and more preferably, less than 1 phr. A typical rigid PVC compound used in the present invention to form the core can also include, but is not limited to, pigments, impact modifiers, stabilizers, processing aids, lubricants, fillers, wood flours, other conventional additives, and the like.

The invention also relates to a covering, in particular a floor covering, consisting of mutually coupled panels consisting of mutually coupled floor panels according to the invention.

The invention further relates to a method of assembling interconnectable panels, in particular panels according to the invention, for forming a covering, comprising the steps of:

A) providing a first panel,

B) inserting a sideward tongue of a first edge of a second panel in an inclined position into a recess of a second edge of the first panel,

C) angling down the second panel with respect to the first panel, until both panels are situated in the same plane,

D) inserting a sideward tongue of a first edge of a third panel in an inclined position into a recess of a second edge of the first panel, and

E) angling down the third panel with respect to the first and second panels, until the panels are situated in the same plane, wherein a downward tongue of a fourth edge of the third panel will zip into an upward groove of a third edge of the second panel, en wherein an upward tongue of the third edge of the second panel will snap into a downward groove of the fourth edge of the third panel, leading to locking of third panel with respect to the first panel at the first and second edges and with respect to the second panel at the third and fourth edges in both horizontal direction and vertical direction.

Advantages and further aspects of the method according to the invention have been described above already in a comprehensive manner.

It will be apparent that the invention is not limited to the exemplary embodiments shown and described here, but that within the scope of the appended claims numerous variants are possible which will be self-evident to the skilled person in this field.

The invention will be elucidated on the basis of non-limitative exemplary embodiments shown in the following figures. Herein:
Figure 1

Figure 1 shows a rectangular floor panel 1 according to the present invention. The panel 1 is interconnectable with similar panels for forming a covering, as will be shown in further figures. The floor panel 1 can be made of any material, though typical materials are wood, in particular HDF, MDF, and LDF, and plastic, in particular thermoplastic, more in particular PVC. Commonly, the floor panel 1 is made of a laminate comprising a central layer (core layer) enclosed by a backing structure and a top structure (not shown). The top structure commonly comprises a decorative layer, which may be printed onto the central layer, on top of which a protective layer is applied. The panel 1 comprises a centrally located core 2 provided with an upper side 3 and a lower side 4. The core 2 is integrally connected with a first pair of opposite edges, in particular a first edge 5 and a complementary second edge 6, located at the long lateral sides of the panel 1. The core is also integrally connected with a second pair of opposite edges, in particular a third edge 7 and a complementary fourth edge 8, located a the short sides of the panel 1 in this exemplary embodiment.

Figure 2 is a cross-sectional view indicated by section A-A in Figure 1. In this cross-section, the shape of the complementary first edge 5 and second 6 edge are shown in detail. The first edge 5 comprises a sideward tongue 9 which is integrally connected to the core 2. By means of the vertical dashed line the border between the sideward tongue 9 and the core 2 is visualised. A front region 9a of the sideward tongue 9 is provided with a rounded bottom surface 10. An outer end of the rounded bottom surface 10 adjoins an inclined locking surface 11. An opposite end of the rounded bottom surface 10 adjoins a bearing surface 12 making part of a back region 9b of the sideward tongue 9. The second edge 6 of the panel 1 comprises an upper lip 13 and a lower lip 14 defining a recess 15. Both lips 13, 14 are integrally connected to the core 2. By means of the vertical dashed line the border between the lips 13, 14 and the core is visualised. As shown in Figure 2, the width of the upper lip 13 is substantially smaller than the width of the lower lip 14. The recess 15 has a shape which is complementary to the shape of the sideward tongue 9. More in particular, a top surface 16 of a back region 14a of the lower lip 14 has a (complementary) rounded shape, configured to co-act with the rounded front region 9a of the sideward tongue 9, while a front region 14b of the lower lip 14 is provided with a upwardly protruding shoulder 17, configured to co-act with the bearing surface 12 of the sideward tongue 9. A lower surface 18 of the upper lip 13 is inclined and corresponds to the locking surface 11 of the sideward tongue 9. Locking at the first edge 5 and the second edge 6 of adjacent panels 1 by insertion of the sideward tongue 9 of a panel 1 to be coupled into the recess 15, wherein said panel 1 is initially held in an inclined position. After insertion of the sideward tongue 9 into the recess, the panel 1 to be coupled will be pivoted (angled) in downward direction about an axis parallel to the first edge 5 until both panels 1 are positioned in the same – commonly horizontal – plane, wherein the locking surface 11 of the sideward tongue 9 will engage the locking surface of the upper lip 18, and wherein at least a bottom front part is accommodated substantially form-fittingly in the recess 15, and wherein the bearing surface 12 is supported by the shoulder 17. Locking at the first edge 5 and the second edge 6 leads to locking of the connected panels 1 in both horizontal direction and vertical direction. The angling down locking principle of the first and second edges 5, 6 is a relatively easy locking principle which facilitates mutual coupling of panels at these edges 5, 6 tremendously. Further details relating to this locking mechanism are visualised in Figures 4 and 5.

Figure 3 is a cross-sectional view indicated by section B-B in Figure 1. In this cross-section, the shape of the complementary third edge 7 and second 8 edge are shown in detail. The third

edge 7 comprises an upward tongue 19, an upward flank 20 and an upward groove 21 formed between upward tongue 19 and upward flank 20. The upward tongue 19 is connected to the core 2 by means of a bridge 22, which is preferably resilient to some extent. A side 19a of upward tongue 19 facing toward upward flank 20 extends in the direction of the normal N_1 of the upper side 3 of the core 2. The tangent R_1 and the normal N_1 of the upper side 3 of the core 2 are thus directed toward each other (converging orientation), wherein the angle enclosed by R_1 and N_1 is preferably between 0 and 10 degrees in this exemplary embodiment. Due to the converging orientation of the upward flank 20 and the side 19a of the upward tongue 19 facing toward to the upward flank 20, the upward groove 22 is a closed groove, which is only accessible to a complementary counterpart by deformation of the upward tongue 19 and/or bridge 22. Another side 19b of upward tongue 19 facing toward upward flank 20 forms an aligning edge enabling facilitated realization of a coupling to an adjacent floor panel 1. As shown, this side 19b functioning as aligning edge is directed away from the normal N_1 of upper side 3 of the core 2. An upper side 19d of upward tongue 19 does however extend in the direction of the normal N_1 of the upper side 3 of the core 2, and runs inclining downward in the direction of the side 19e of upward tongue 19 facing away from upward flank 20. This chamfering provides the option of giving the complementary fourth edge 8 a more robust and therefore stronger form. A part of the side 19e of upward tongue 19 facing away from upward flank 20 is oriented substantially vertically and is moreover provided with an outward bulge 23. A lower part 20a of upward flank 20 is oriented diagonally, while an upper part 20b of upward flank 20 is shown to be substantially vertical and forms a stop surface for fourth edge 8. In between the inclined part 20a and the substantially vertical part 20b of the upward flank an additional coupling element, in particular an additional bulge 24, is provided. A lower wall part 21a of upward groove 21 is oriented substantially horizontally in this exemplary embodiment.

The fourth edge 8 is substantially complementary to third edge 7. The fourth edge 8 comprises a downward tongue 25, a downward flank 26 and a downward groove 27 formed between downward tongue 25 and downward flank 26. The downward tongue 25 is connected to the core 2 by means of a bridge 28, which is preferably resilient to some extent. A side 25a of downward tongue 25 facing toward downward flank 26 lies in the direction of the normal N_2 of the lower side 4 of the core 2. This means that a tangent R_2 of side 25a of downward tongue 25 and the normal of the lower side 4 of the core 2 are mutually converging, wherein the angle enclosed by R_2 and N_2 is preferably between 0 and 10 degrees in this exemplary embodiment. More preferably, the inclination of R_1 is identical to the inclination of R_2; hence,

R_1 and R_2 are preferably parallel. Due to the converging orientation of the downward flank 26 and the side 25a of the downward tongue 25 facing toward to the downward flank 26, the downward groove 27 is a closed groove, which is only accessible for the upward tongue 19 of an adjacent panel 1 by deformation of the downward tongue 25 and/or bridge 28, as a result of which the entrance of the downward groove can be widened (temporary).
A side 25b of the downward tongue 25 facing away from downward flank 26 is diagonally oriented, but has a flatter orientation than the complementary side 20a of upward flank 20, whereby a gap (air space) will be formed in the coupled position, which will generally facilitate coupling between two floor panels 1. The inclining side 25b of downward tongue 25 also functions as aligning edge for the purpose of further facilitating coupling between two floor panels 1. Another side 25c facing away from downward flank 26 takes a substantially vertical form, though is provided with a small cavity 29 configured to co-act with the additional bulge 24 of another panel 1. A top part of the side 25c facing away from downward flank 26 forms a complementary stop surface for stop surface 20b of upward flank 20 (of an adjacent floor panel). Downward flank 26 is oriented substantially vertically and is provided with a recess 30 adapted to receive the outward bulge 23 of the upward tongue 19 (of an adjacent floor panel).

Figures 4a-4f show different views of the successive steps for interconnecting multiple floor panels 1 according to Figures 1-3 for forming a floor covering 31. Figures 4a and 4b relate to the first step of the installation process, wherein a first row of floor panels 1 is generated by connecting the third edge 7 of a panel 1 to the fourth edge 8 of an adjacent panel, by pressing – in a substantially vertical direction (as indicated by the arrow) – the fourth edge 8 of a panel 1 to be coupled onto and into the third edge 7 of an already installed panel 1. Due to the vertical displacement, the third edge 7 and/or the fourth edge 8 will be deformed slightly, such that the downward tongue 25 will be pushed into the upward groove 21, and the upward tongue 19 will be pushed into the downward groove 27. Moreover, the bulges 23, 24 will be positioned in the corresponding recesses 29, 30 to better secure the floor panels 1 with respect to each other. Due to this temporary deformation, wherein both the upward groove 21 and the downward grove 27 will be widened temporary for the insertion of the downward tongue 25 and the upward tongue 19 respectively, both edges 7, 8 will snap into each other.
Figures 4c and 4d relate to the second step of the installation process, wherein a second row of floor panels 1 is created which is connected to the first row of floor panels. To this end, a first edge 5 of a floor panel 1 to be coupled is positioned in an inclined orientation against a

second edge 6 of an already installed panel 1, such that the sideward tongue 9 is at least partially inserted in the complementary recess 15 of the second profile 6. After this partial insertion the inclined panel is pivoted (angled) down – see arrow – around an axis parallel to the first edge 5, until the panel 1 is located in the same plane as defined by the first row of panels, as a result of which the sideward tongue 9 will be locked into the recess 15 both in at least one horizontal direction and in vertical direction.

The first two steps as shown in Figures 4a-4d are preparatory steps for installation of one or more subsequent panels 1 which are to be coupled at multiple edges instead of only at a single edge. Installation of a subsequent floor panel 1 is visualised in Figures 4e and 4f. Again, a floor panel 1 to be coupled is held at inclined position, wherein the sideward tongue 9 of the floor panel 1 is inserted partially into the corresponding recess 15 of a second edge of at least one floor panel already installed. The fourth edge 8 of the floor panel 1 to be installed is positioned substantially above the third edge 7 of the panel 1 already installed in the second row, wherein the fourth edge 8 and the third edge 7 mutually enclose an angle (being the inclination angle of the panel to be coupled). During angling down of the panel 1 to be coupled (see arrow) both the first edge 5 and the fourth edge 8 of the panel 1 will be connected to adjacent panels 1. More in particular, during angling down of the panel 1, the front region of the sideward tongue 9 will be accommodated in the recess 15, and will be held in position by means of the limiting shoulder 17 and the limiting locking surface 18 of the upper lip 13 of the second edge 6 of the panel(s) already installed in the first row. Moreover, simultaneously the fourth edge 8 of the panel 1 to be coupled will make a downward scissoring movement with respect to the underlying third edge 7 and will zip (snap) into the third edge 7 and vice versa, leading to a firm and durable connection between the panels 1.

Figures 5a-5e show different embodiments of the first and second edges of a floor panel according to the invention. In Figure 5a the embodiment according to Figures 1-4f is shown, while in Figures 5b-5e alternative embodiments of these edges are shown. More in particular, Figure 5b shows a first and second edge 40, 41 of a floor panel 42, wherein, instead of a smoothly rounded bottom portion a more hooked (segmented rounded) bottom portion is shown. In Figure 5c, an embodiment of a floor panel 43 is shown which is almost identical to the floor panel shown in Figure 5a, though wherein the first and second edges 44, 45 are provided with horizontal locking surfaces 44a, 45b instead of inclined locking surfaces. In Figure 5d, an alternative embodiment of a floor panel 46 is shown, wherein the first and second edges 47, 48 are shaped such that a bottom contact portion between the two edges 47,

48 is partially smoothly rounded and partially discontinuously rounded (segmented rounded). Locking surfaces 50, 51 of a sideward tongue 49 of the first edge 47 and of an upper lip 52 of the second edge have a substantially horizontal orientation. In Figure 5e, an embodiment of a floor panel 53 almost identical to the floor panel 46 as shown in Figure 5d is shown, with the difference that a front bottom part 54a of a sideward tongue 54 is not smoothly rounded, but flat giving a bottom portion of the sideward tongue 54 as such a segmented rounded (hooked) shape.

Figures 4c and 4d relate to the second step of the installation process, wherein a second row of floor panels 1 is created which is connected to the first row of floor panels. To this end, a

This summary is meant to provide an introduction to the concepts that are disclosed within the specification without being an exhaustive list of the many teachings and variations upon those teachings that are provided in the extended discussion within this disclosure. Thus, the contents of this summary should not be used to limit the scope of the claims that follow.

Inventive concepts are illustrated in a series of examples, some examples showing more than one inventive concept. Individual inventive concepts can be implemented without implementing all details provided in a particular example. It is not necessary to provide examples of every possible combination of the inventive concepts provide below as one of skill in the art will recognize that inventive concepts illustrated in various examples can be combined together in order to address a specific application.

Other panel constructions, assembling methods, features and advantages of the disclosed teachings will be or will become apparent to one with skill in the art upon examination of the following figures and detailed description. It is intended that all such additional panel constructions, assembling methods, features and advantages be included within the scope of and be protected by the accompanying claims.

Claims

1. Panel, in particular a floor panel, interconnectable with similar panels for forming a covering, comprising:

- a centrally located core provided with an upper side and a lower side, said core being provided with:
  - a first pair of opposite edges, comprising:
    - a first edge comprising a sideward tongue extending in a direction substantially parallel to the upper side of the panel, the bottom front region of said sideward tongue being rounded at least partly, the bottom back region of said tongue being configured as bearing region, wherein the bottom back region is located closer to the level of the upper side of the panel than a lowest part of the bottom front region,
    - an opposite, second edge comprising a recess for accommodating at least a part of the sideward tongue of a further panel, said recess being defined by an upper lip and a lower lip, said lower lip being provided with a upwardly protruding shoulder for supporting the bearing region of the sideward tongue,
    - the sideward tongue being designed such that locking takes place by an introduction movement into the recess of the sideward tongue a further panel and a angling down movement about an axis parallel to the first edge, as a result of which a top side of the sideward tongue will engage the upper lip and the bearing region of the sideward tongue will be supported by the shoulder of the lower lip, leading to locking of adjacent panels at the first and second edges in both horizontal direction and vertical direction; and
  - a second pair of opposite edges, comprising:
    - a third edge comprising a single upward tongue, at least one upward flank lying at a distance from the upward tongue and a single upward groove formed between the upward tongue and the upward flank, wherein a at least a part of a side of the upward tongue facing toward the upward flank extends in the direction of the normal of the upper side of the core, and wherein at least a part of a side of the upward

tongue facing away from the upward flank comprises a substantially rigid first locking element, and

- a fourth edge comprising a single downward tongue, at least one downward flank lying at a distance from the downward tongue, and a single downward groove formed between the downward tongue and the downward flank, wherein at least a part of a side of the downward tongue facing toward the downward flank extends in the direction of the normal of the lower side of the core, and wherein the downward flank comprises a substantially rigid second locking element adapted for co-action with the first locking element of a third edge of yet a further panel,
- the third and fourth edges being designed such that locking takes place during angling down of a panel to be coupled at a first edge to a second edge of a further panel, wherein the fourth edge of a panel to be coupled makes a scissoring movement toward a third edge of yet another panel, such that the downward tongue of the fourth edge of the panel to be coupled will be forced into the upward groove of the third edge of said other panel and the upward tongue of said other panel will be forced into the downward groove of the panel the be coupled, by deformation of the third edge and/or the fourth edge, leading to locking of adjacent panels at the third and fourth edges in both horizontal direction and vertical direction.

2. Panel according to claim 1, wherein the recess is terminated by the shoulder.

3. Panel according to claim 1 or 2, wherein a locking part of the recess is located in between the upper lip and lower lip, wherein a top surface of said locking part acts as locking surface and is configured to co-act with a top surface of the sideward tongue of a further panel.

4. Panel according to claim 3, wherein the locking surface has an inclined orientation, and wherein at least a front region of the top surface of the sideward tongue has a corresponding inclined orientation.

5. Panel according to one of the foregoing claims, wherein the upper lip is shorter than the lower lip.

6. Panel according to one of the foregoing claims, wherein the bottom front region of the recess has a substantially complementary shape with respect to the at least partly rounded bottom front region of the sideward tongue.

7. Panel according to one of the foregoing claims, wherein the at least partly rounded bottom front region of the sideward tongue is formed by hooked surface segments.

8. Panel according to one of the foregoing claims, wherein a side of the shoulder facing the core has an inclined orientation for forcing two panels, in an assembled state, toward each other.

9. Panel according to one of the foregoing claims, wherein width of the bearing region of the sideward tongue is greater than the width of the shoulder.

10. Panel according to one of the foregoing claims, wherein the panel has a substantially rectangular shape, wherein the first pair of opposite edges are located on the long sides of the panel, and the second pair of opposite edges are located on the short sides of the panel.

11. Panel according to one of the foregoing claims, wherein at least a part of a side of the upward tongue facing toward the upward flank forms an upward aligning edge for the purpose of coupling the third edge to a fourth edge of an adjacent panel.

12. Panel according to one of the foregoing claims , wherein at least a part of a side of the downward tongue facing away from the downward flank forms a downward aligning edge for the purpose of coupling the fourth edge to a third edge of an adjacent panel.

13. Panel according to one of the foregoing claims, wherein each of the upward tongue and the downward tongue is substantially rigid.

14. Panel according to one of the foregoing claims, wherein each of the upward tongue and the downward tongue as such is substantially solid.

15. Panel according to one of the foregoing claims, wherein at least a part of the upward flank adjoining the upper side of the panel is adapted to make contact with at least a part of the downward tongue adjoining the upper side of another panel in an assembled state.

16. Panel according to one of the foregoing claims, wherein the upper side of the panel is adapted to engage substantially seamless to the upper side of another panel.

17. Panel according to one of the foregoing claims, wherein the first locking element is positioned at a distance from an upper side of the upward tongue.

18. Panel according to one of the foregoing claims, wherein the first locking element is positioned at a distance from an lower side of the upward tongue.

19. Panel according to one of the foregoing claims, wherein the second locking element is positioned at a distance from an upper side of the downward groove.

20. Panel according to one of the foregoing claims, wherein the second locking element is positioned at a distance from an lower side of the downward groove.

21. Panel according to one of the foregoing claims, wherein the effective height of the downward aligned edge is larger than the effective height of the upward tongue.

22. Panel according to one of the foregoing claims, wherein the mutual angle enclosed by at least a part of a side of the upward tongue facing toward the upward flank and the normal of the upper side of the core is substantially equal to the mutual angle enclosed by at least a part of a side of the downward tongue facing toward the downward flank and the normal of the lower side of the core.

23. Panel according to one of the foregoing claims, wherein the incline of the downward aligned edge is less than the incline of at least an upper part of the upward flank.

24. Panel according to one of the foregoing claims, wherein the angle enclosed by on the one hand the direction in which at least a part of a side of the upward tongue facing toward

the upward flank extends and on the other the normal of the upper side of the core lies between 0 and 60 degrees, in particular between 0 and 45 degrees.

25. Panel according to one of the foregoing claims, wherein the angle enclosed by on the one hand the direction in which at least a part of a side of the downward tongue facing toward the downward flank extends and on the other the normal of the lower side of the core lies between 0 and 60 degrees, in particular between 0 and 45 degrees.

26. Panel according to one of the foregoing claims, wherein at least a part of an upper side of the upward tongue extends in a direction toward the normal of the upper side of the core.

27. Panel according to one of the foregoing claims, wherein at least a part of an upper side of the upward tongue runs inclining downward in the direction of the side of the upward tongue facing away from upward flank, and wherein an upper side of the downward groove having a likewise inclining orientation upward in the direction of the side of the downward tongue facing towards to downward flank.

28. Panel according to one of the foregoing claims, wherein at least a part of the aligning edge of the fourth edge has a substantially flatter orientation than at least a part of the upward flank of the third edge.

29. Panel according to one of the foregoing claims, wherein a part of the upward flank of the third edge connecting to the core forms a stop surface for at least a part of the side of the downward tongue facing away from the downward flank.

30. Panel according to one of the foregoing claims, wherein a part of the upward flank of the third edge connecting to the core is oriented substantially vertically.

31. Panel according to one of the foregoing claims, wherein at least a part of the side of the downward tongue facing away from the downward flank is oriented substantially vertically.

32. Panel according to one of the foregoing claims, wherein the upward groove is given a form such that this upward groove is adapted for receiving in locked manner at least a part of a downward tongue of an adjacent panel.

33. Panel according to one of the foregoing claims, wherein the upward groove is adapted to receive with clamping fit a downward tongue of an adjacent panel.

34. Panel according to one of the foregoing claims, wherein the downward groove is adapted to receive with clamping fit an upward tongue of an adjacent panel.

35. Panel according to one of the foregoing claims, wherein the upward flank and the downward flank extend in a substantially parallel direction.

36. Panel according to one of the foregoing claims, wherein the first locking element comprises at least one outward bulge, and that the second locking element comprises at least one recess, which outward bulge is adapted to be at least partially received in a recess of an adjacent coupled panel for the purpose of realizing a locked coupling.

37. Panel according to one of the foregoing claims, wherein the second locking element comprises at least one outward bulge, and that the first locking element comprises at least one recess, which outward bulge is adapted to be at least partially received in a recess of an adjacent coupled panel for the purpose of realizing a locked coupling.

38. Panel according to one of the foregoing claims, wherein a side of the downward tongue facing away from the downward flank is provided with a third locking element, and wherein the upward flank is provided with a fourth locking element, said third locking element being adapted to cooperate with a fourth locking element of another panel.

39. Panel according to one of the foregoing claims, wherein the edges are integrally connected to the core.

40. Panel according to one of the foregoing claims, wherein the panel is manufactured at least partially from wood.

41. Panel according to one of the foregoing claims, wherein the panel is manufactured at least partially from plastic, in particular a thermoplastic, preferably polyvinylchloride (PVC).

42. Panel according to one of the foregoing claims, wherein the comprises a laminate of a balancing layer, a core layer, and a top structure arranged on top of the core layer.

43. Panel according to one of claim 42, wherein the top structure comprises a decorative layer and a protective layer arranged on top of said decorative layer.

44. Panel according to one of the foregoing claims, wherein the first locking element is positioned at a lower level than the upward aligning edge of the upward tongue.

45. Covering, in particular a floor covering, consisting of mutually coupled panels as claimed in any of the foregoing claims.

46. Method of assembling interconnectable panels, in particular as claimed in any of the claims 1-44, for forming a covering, comprising the steps of:

A) providing a first panel,

B) inserting a sideward tongue of a first edge of a second panel in an inclined position into a recess of a second edge of the first panel,

C) angling down the second panel with respect to the first panel, until both panels are situated in the same plane,

D) inserting a sideward tongue of a first edge of a third panel in an inclined position into a recess of a second edge of the first panel, and

E) angling down the third panel with respect to the first and second panels, until the panels are situated in the same plane, wherein a downward tongue of a fourth edge of the third panel will zip into an upward groove of a third edge of the second panel, en wherein an upward tongue of the third edge of the second panel will snap into a downward groove of the fourth edge of the third panel, leading to locking of third panel with respect to the first panel at the first and second edges and with respect to the second panel at the third and fourth edges in both horizontal direction and vertical direction.

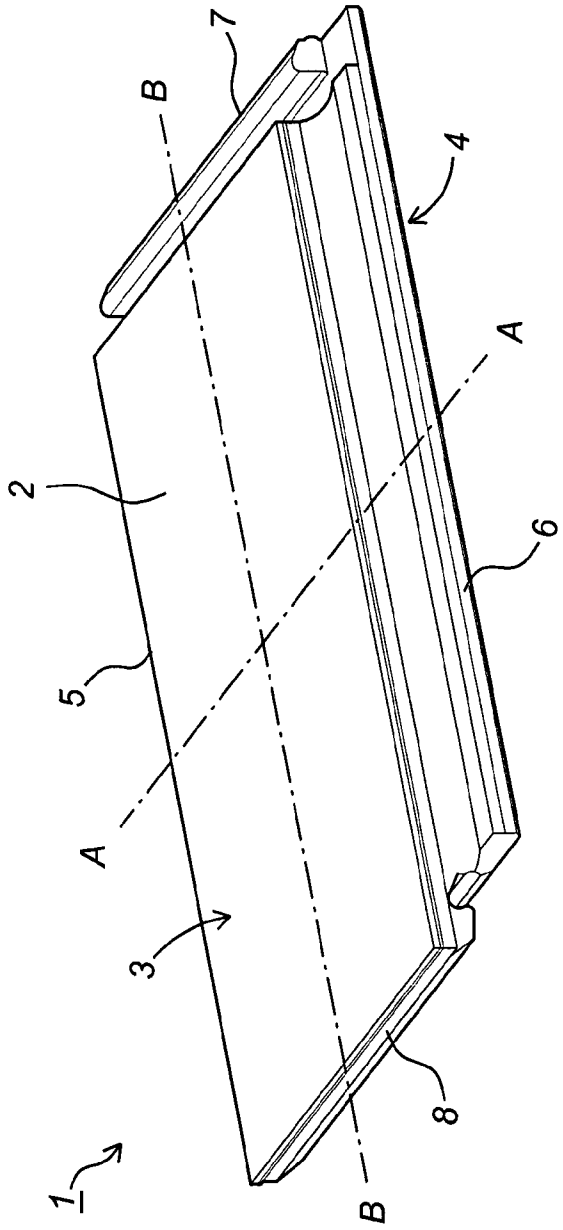
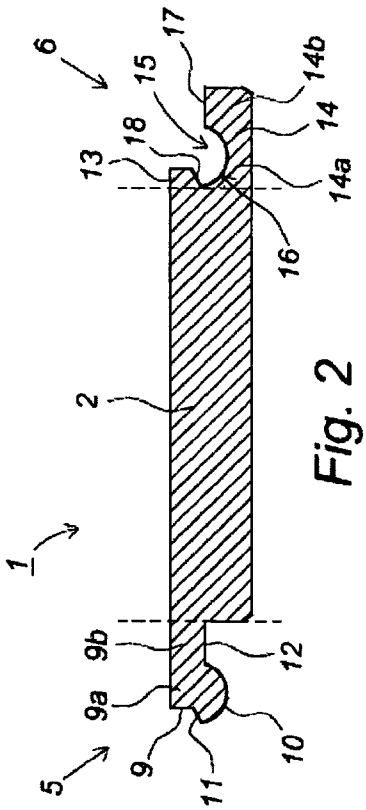


Fig. 1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17
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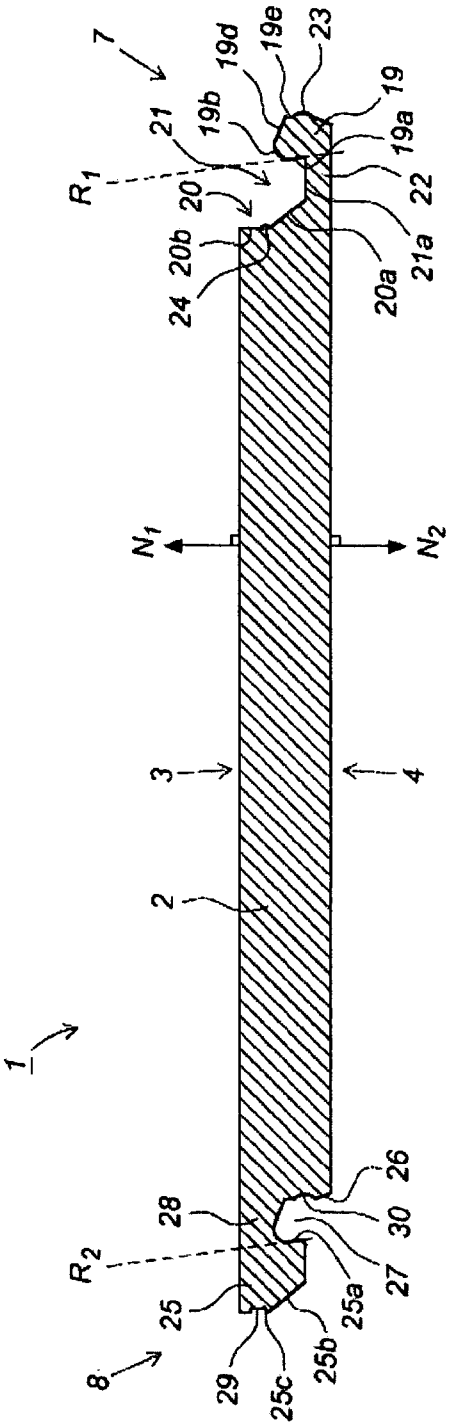
Fig. 2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19b
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20a
N_1
N_2
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28
30
R_2
27
25
25a
8
25b
29
25c

Fig. 3

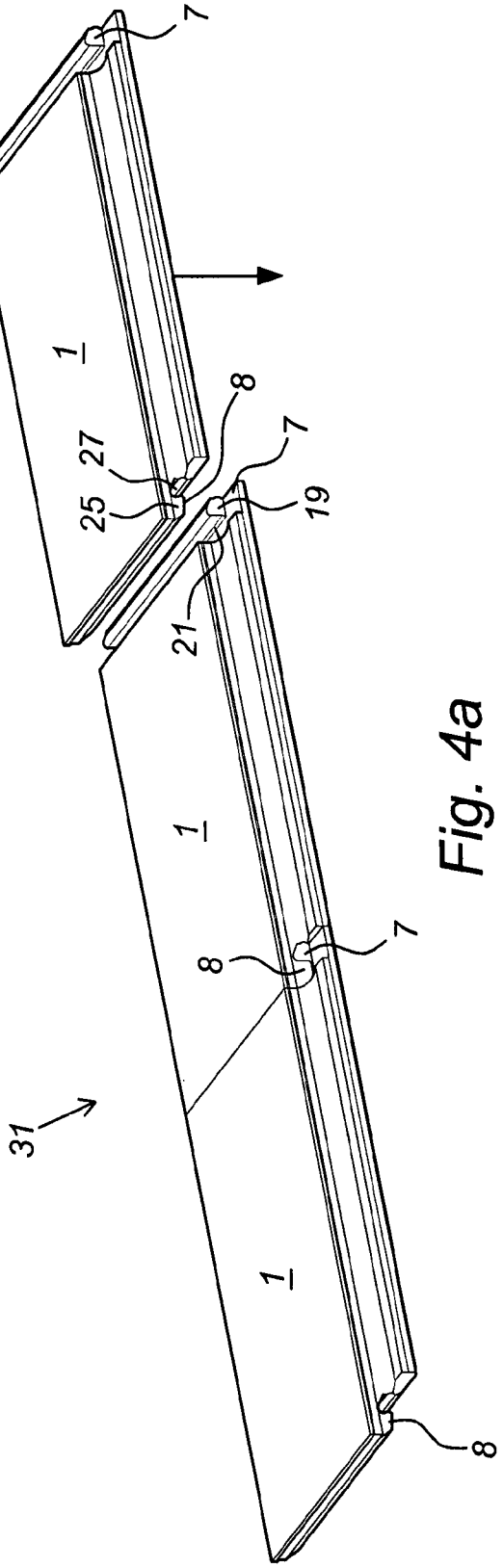

Fig. 4a

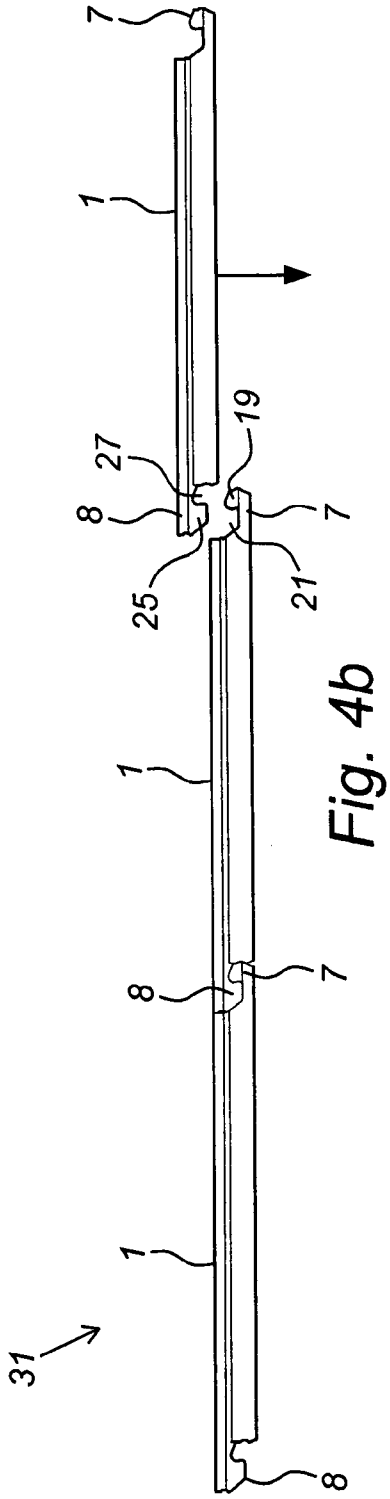

Fig. 4b

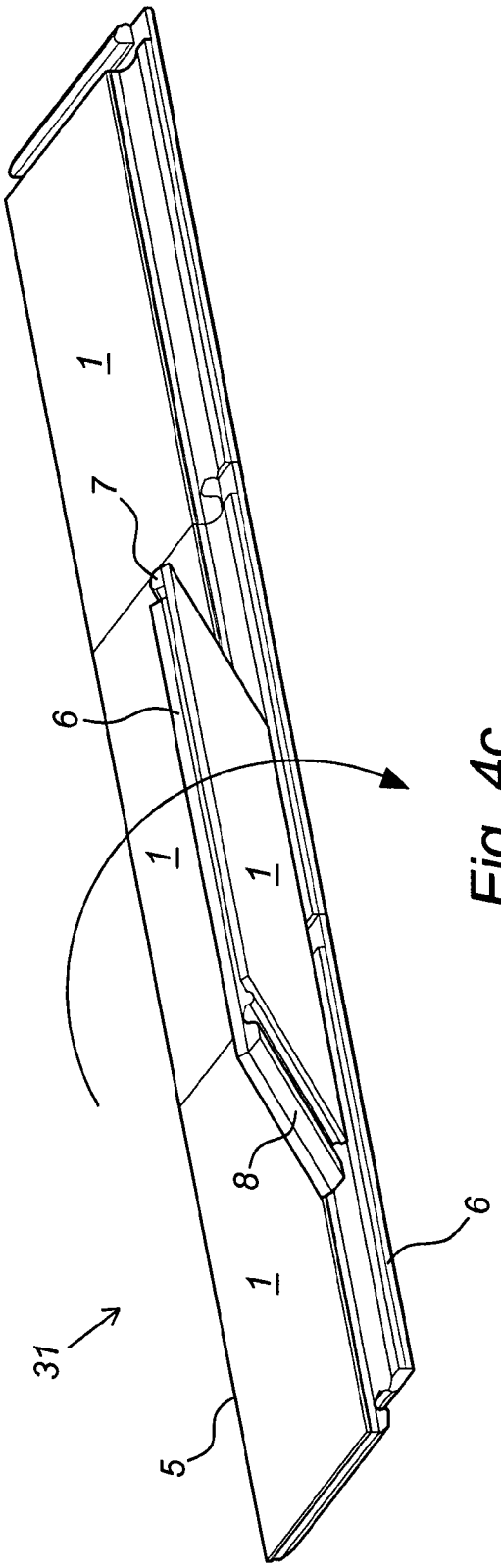

Fig. 4c

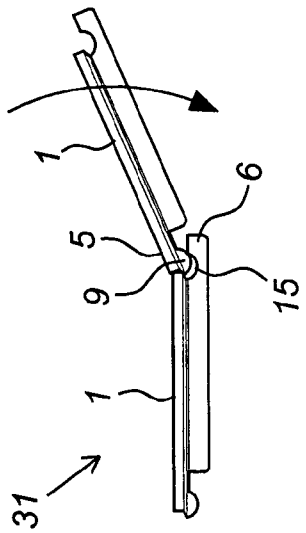

Fig. 4d

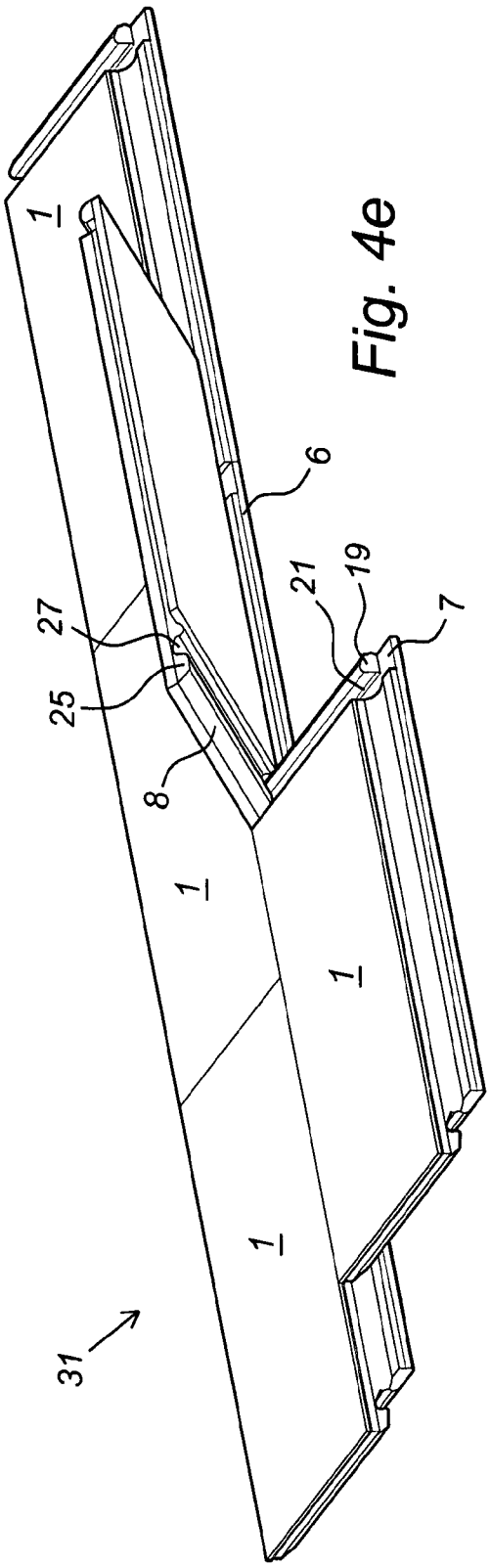

Fig. 4e

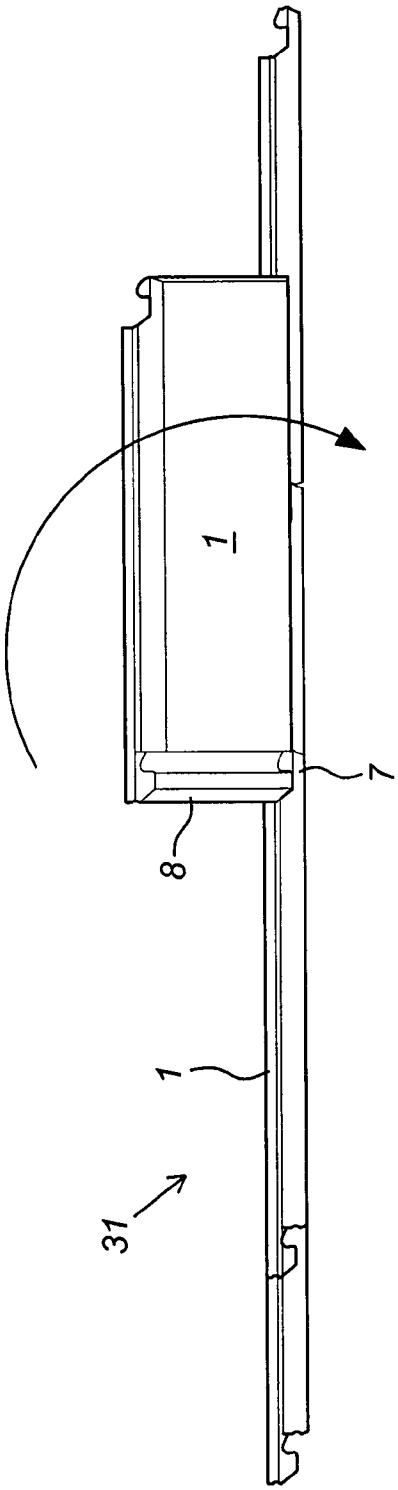

Fig. 4f

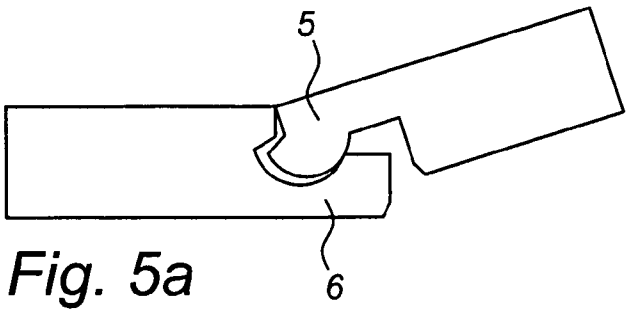

Fig. 5a

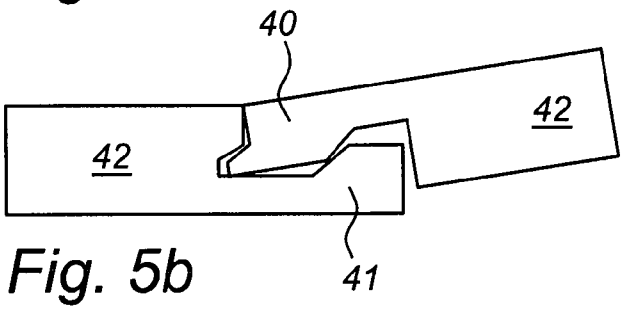

Fig. 5b

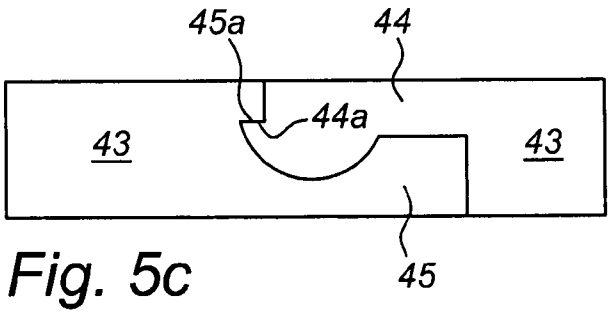

Fig. 5c

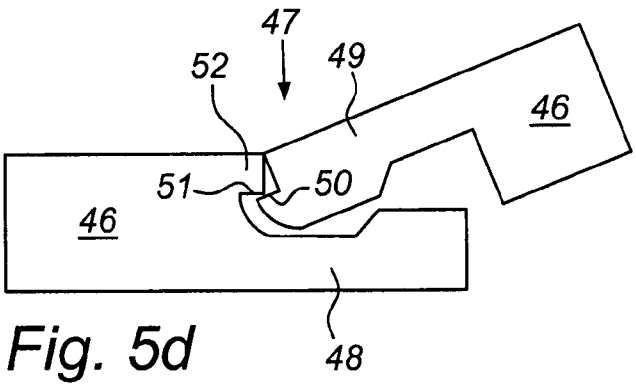

Fig. 5d

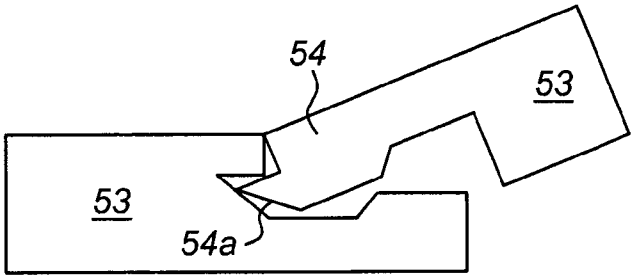

Fig. 5e

INTERNATIONAL SEARCH REPORT

International application No
PCT/NL2014/050118

A. CLASSIFICATION OF SUBJECT MATTER
INV. E04F15/02
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E04F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
15 October 2014	23/10/2014

Name and mailing address of the ISA/	Authorized officer
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