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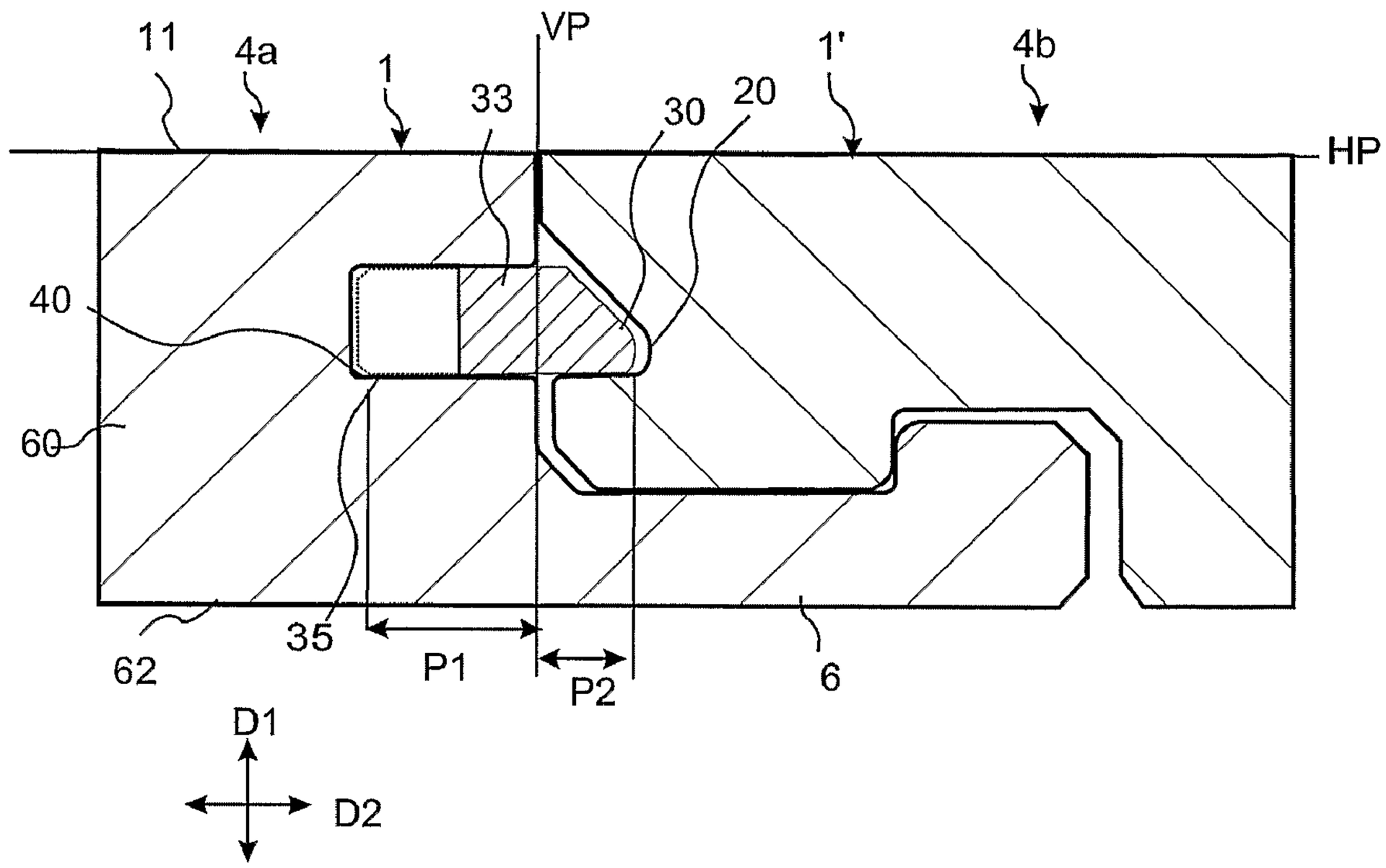

(57) Abrégé/Abstract:
Floor panels (1, 1') are shown, which are provided with a mechanical locking system consisting of a flexible tongue (30) in a displacement groove (40), which during a vertical folding motion is displaced. Moreover, a tongue blank (50), a production method and an installation method are shown.

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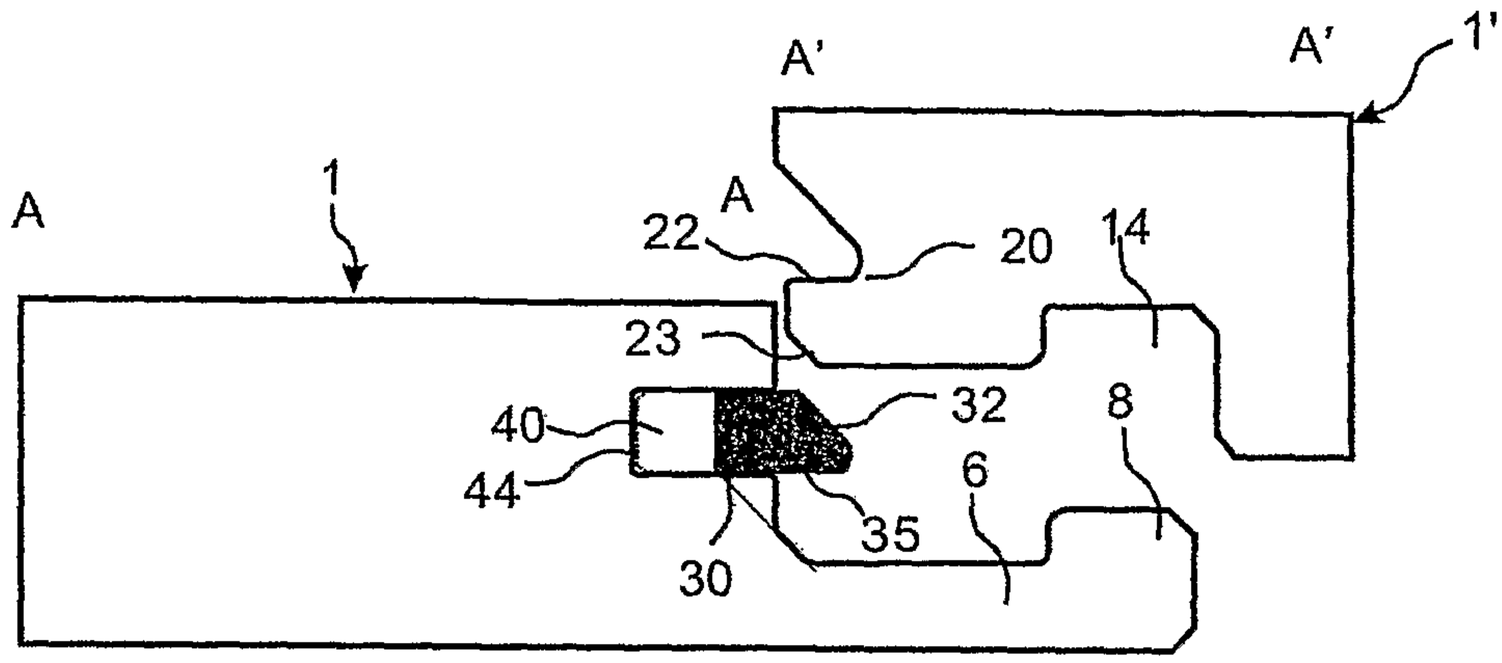
(54) **Title:** MECHANICAL LOCKING OF FLOOR PANELS WITH A FLEXIBLE TONGUE



(57) **Abstract:** Floor panels (1, 1') are shown, which are provided with a mechanical locking system consisting of a flexible tongue (30) in a displacement groove (40), which during a vertical folding motion is displaced. Moreover, a tongue blank (50), a production method and an installation method are shown.

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MECHANICAL LOCKING OF FLOOR PANELS WITH A FLEXIBLE TONGUE

Technical field

The invention generally relates to the field of floor panels with mechanical locking systems and such building panels that are made of a board material. The invention relates to tongues for such locking systems and methods for providing and installing panels with such locking systems.

Field of Application of the Invention

The present invention may be suitable for use in floating floors, which are formed of floor panels which are joined mechanically with a locking system integrated with the floor panel, i.e. mounted at the factory, are made up of one or more upper layers of veneer, decorative laminate or decorative plastic material, an intermediate core of wood-fibre-based material or plastic material and preferably a lower balancing layer on the rear side of the core. The following description of prior-art techniques, problems of known systems, and features of the invention will therefore, as a non-restrictive example, be aimed above all at this field of application and in particular laminate flooring formed as rectangular floor panels with long and shorts sides intended to be mechanically joined on both long and short sides. The long and shorts sides are mainly used to simplify the description of the invention. The panels could be square, the sides could have an angle other than 90 degree and they could have more than 4 sides. It should be emphasized that the invention can be used in any floor panel and it could be combined with all types of known locking system, on an adjacent side of the same panel, where the floor panels are intended to be joined using a mechanical locking system in the horizontal and vertical directions. The invention can thus also be applicable to, for instance, solid wooden floors, parquet

floors with a core of wood or wood-fibre-based material and a surface of wood or wood veneer and the like, floors with a printed and preferably also varnished surface, floors with a surface layer of plastic or cork, linoleum, rubber. Even floors with hard surfaces and or core materials such as stone, tile, glass and similar are included as well as floorings with soft wear layer, for instance needle felt glued to a board. With diamond tools it is possible to form one piece angling system on for instance a long side of a hard material, such as marble, ceramics, glass or similar materials. In a similar way locking system could also be formed in solid metal plates and other types of non-flexible composite boards, all such embodiments could have a flex tongue on long or short side, according to the basic principle of the invention. The invention can also be used for joining building panels which preferably contain a board material for instance wall panels, ceilings, furniture components and similar.

Background of the Invention

Laminate flooring usually consists of a core of a 6-12 mm fibre board, a 0.2-0.8 mm thick upper decorative surface layer of laminate and a 0.1-0.6 mm thick lower balancing layer of laminate, plastic, paper or like material. The surface layer provides appearance and durability to the floor panels. The core provides stability, and the balancing layer keeps the panel plane when the relative humidity (RH) varies during the year. The floor panels are laid floating, i.e. without gluing, on an existing sub floor. Laminate flooring and also many other types of flooring are made by the surface layer and the balancing layer being applied to a core material. This application may take place by gluing a previously manufactured decorative layer, for instance when the fibre board is provided with a decorative high pressure laminate which is made in a separate operation where a

plurality of impregnated sheets of paper are compressed under high pressure and at a high temperature. The currently most common method when making laminate flooring, however, is direct laminating which is based on a more modern principle where both manufacture of the decorative laminate layer and the bonding to the fibre board take place in one and the same manufacturing step. Impregnated sheets of paper are applied directly to the panel and pressed together under pressure and heat without any gluing.

Traditional hard floor panels in floating flooring of this type are usually joined by means of glued tongue-and-groove joints.

In addition to such traditional floors, which are joined by means of glued tongue-and-groove joints, floor panels have recently been developed which do not require the use of glue and instead are joined mechanically by means of so-called mechanical locking systems. These systems comprise locking means, which lock the panels horizontally and vertically. The mechanical locking systems are usually formed by machining of the core of the panel. Alternatively, parts of the locking system can be formed of a separate material, for instance aluminium or HDF, which is integrated with the floor panel, i.e. joined with the floor panel in connection with the manufacture thereof.

The main advantages of floating floors with mechanical locking systems are that they can easily and quickly be laid by various combinations of inward angling, snapping-in and insertion. They can also easily be taken up again and used once more at a different location. A further advantage of the mechanical locking systems is that the joint edges of the floor panels can be made of materials, which need not to have good gluing properties. The most common core material is fibreboard with high density and good stability usually called HDF - High

Density Fibreboard. Sometimes also MDF - Medium Density Fibreboard - is used as core.

Definition of Some Terms

In the following text, the visible surface of the installed floor panel is called "front side", while the opposite side of the floor panel, facing the sub floor, is called "rear side". The edge between the front and rear side is called "joint edge". By "horizontal plane" is meant a plane, which extends parallel to the outer part of the surface layer. Immediately juxtaposed upper parts of two adjacent joint edges of two joined floor panels together define a "vertical plane" perpendicular to the horizontal plane.

By "joint" or "locking system" are meant co acting connecting means, which connect the floor panels vertically and/or horizontally. By "mechanical locking system" is meant that joining can take place without glue. Mechanical locking systems can in many cases also be combined with gluing. By "integrated with" means formed in one piece with the panel or factory connected to the panel.

By a "flexible tongue" is meant a separate tongue which has a length direction along the joint edges and which is forming a part of the vertical locking system and could be displaced horizontally during locking. The tongue could be for example flexible and resilient in such a way that it can bend along its length and spring back to its initial position.

By "flexible tongue blank" are meant two or more flexible tongues, which are connected to a one-piece component. Examples of such flexible tongue blanks will be described in more detail below.

By "fixing the flexible tongue" is meant that the flexible tongue should at least be sufficiently attached to the floor panel so as not to incidentally fall off during handling of the floor panel, at the factory,

during transport and/or in installation. By "mechanically fixed" is meant that the fixing is essentially due to shape or friction force.

By "angling" is meant a connection that occurs by a turning motion, during which an angular change occurs between two parts that are being connected, or disconnected. When angling relates to connection of two floor panels, the angular motion takes place with the upper parts of joint edges at least partly being in contact with each other, during at least part of the motion.

By "vertical folding" is meant a connection of three panels where a first and second panel are in a connected state and where an angling action connects two perpendicular edges of a new panel to the first and second panel. Such a connection takes place for example when a long side of first panel in a first row is already connected to a long side of a second panel in a second row. The third panel is than connected by angling to the long side of the first panel in the first row. This specific type of angling action, which also connects the short side of the new panel and second panel, is referred to as vertical folding

Prior-Art Technique and Problems thereof

For mechanical joining of long sides as well as short sides in the vertical and horizontal direction (direction D1, D2) several methods are used but the locking is always performed in 3 steps where angling or snapping are combined with displacement along the joint edge in the locked position after an optional side has been joined.

- Angling of long side, displacement and snapping-in of short side
- Snapping-in of long side, displacement and snapping-in of short side.

➢ Angling of short side, displacement of the new panel along the short side edge of the previous panel and finally downward angling of two panels.

These laying methods can also be combined with insertion along the joint edge.

It is known that the locking system may, however, be formed so that snapping-in may occur by a motion which is vertical to the surface of the floor panel. Generally, the long side is locked by angling and the short side with a vertical angling which locks with a snap action. Such a system in described in WO 01/0248127 (Akzenta). The connection of panels is complicated and difficult since fibres must be compressed and a hammer with a tapping block must be used. The panels are locked in vertical direction, mainly by a friction force and the locking strength is low.

It is known that floor panels may be locked on long and short side vertically and horizontally with one simple vertical folding action (WO 03/083234 Applicant Välinge Aluminium).

The object of WO 03/083234 is to provide a joint system and floor panels which can be laid with a vertical folding.

A floor panel with a vertical joint in the form of a flexible tongue and a groove is provided, the tongue being made of a separate material and being flexible so that at least one of the sides of the floor panel can be joined by a vertical motion parallel to the vertical plane.

This document also show how a joint system can be made with a flexible spring tongue which can be displaced and/or compressed horizontally in and out or alternatively be bent vertically up or down. It describes a separate tongue of, for instance, wood fibre material, which can be displaced horizontally by means of a flexible material, for instance a rubber paste. It also

describes an embodiment with a tongue, which has an inner part that is resilient.

This known technology with a tongue, which during locking moves horizontally in relation to the adjacent edges, offers several advantages over the known installation methods. The locking is easy and faster since 3 steps are reduced to one step.

The invention described in WO 03/083234 does not however show the best mode of locking floor panels with a vertical folding. The production cost and the locking function could be improved considerably.

Brief Description of the Invention

Some embodiments of the present invention may provide a locking system based on a vertical folding with a flexible tongue fixed in a tongue groove. The locking system may make it possible to lock all four sides of one panel vertically and horizontally to other panels with angling action only. The costs and functions may be favourable compared to the known technology. Some embodiments of the present invention may improve the function and costs of those parts of the locking system that causes the flexible tongue to displace during locking and spring back in locked position.

Some embodiments of the present invention may provide a vertical folding locking system with a flexible tongue where one or several of the following advantages are obtained.

The flexible tongue should preferably be possible to displace during locking with such a low force that no tools will be needed in connection with installation.

The spring effect should be reliable and the flexible tongue should move back, partly or completely, to a pre-determined position when the panels have been brought to the position where they are to be locked.

The vertical locking should be strong and prevent that two locked panels will move vertically when humidity is changing or when people walk on a floor.

The locking system should be able to lock floor panels vertically with high precision so that the surfaces are essentially in the same plane.

The vertical locking system should be designed in such a way that the material and production costs could be low.

The separate flexible tongue should be possible to fix to the floor panel in a simple and cost effective way. The fixing should keep the flexible tongue at least fixed to the panel during production, transport and installation.

Some embodiments of the present invention may provide methods to produce the flexible tongue and flexible tongue blanks which are later to constitute parts of the mechanical locking system of the floor panels.

Some embodiments of the present invention may provide a rational method for fixing the flexible tongues with the joint portion of the floor panel to form an integrated mechanical locking system where the flexible tongue is factory fixed to the floor panel.

Some embodiments of the present invention may provide installation methods to connect floor panels with vertical folding.

Some embodiments of the present invention may provide a tool and a method to take up the floor panels.

Some embodiments of the present invention provide a locking system, floor panels, a flexible tongue, a flexible tongue blank and production and installation methods.

Although it is an advantage to integrate the flexible tongue with the panel in the factory before

installation, the invention does not exclude an embodiment in which flexible tongues are delivered as separate components to be fixed to the panel by the installer prior to installation, the invention does not exclude glue, sealing compounds, wax or other similar chemicals in the locking system.

According to one embodiment of the invention, a new floor panel comprising connecting means, which are integrated with the floor panel and adapted to connect the new floor panel with an essentially identical first and second floor panel is provided.

The upper joint edges of said new and second floor panels define in the connected state a vertical plane.

The connecting means are designed to connect said new floor panel with said second floor panel in a horizontal direction perpendicular to said vertical plane and in a vertical direction parallel to the vertical plane. The vertical connection comprising a flexible tongue in a displacement groove, in one of the new or the second floor panels. The displacement groove is formed in the edge of the panel and is open towards the vertical plane. The flexible tongue has a length direction along the joint edges, a width in the horizontal plane perpendicular to the length and a thickness in the vertical direction.

The flexible tongue is designed to cooperate, in said connected state with a tongue groove of another one of the new or second floor panels.

The horizontal connection comprising a locking strip which projects from said vertical plane and carries a locking element 8 in the second panel.

The locking strip 6 is designed to cooperate, in said connected state, with a downward open locking groove of the new floor panel. The new floor panel could be locked to the first and second floor panel with vertical folding. The flexible tongue is during the vertical folding displaced two times in the displacement groove.

The first displacement is effected by the vertical folding of the new floor panel whereby at least a part of the flexible tongue is bent in the length direction and parallel with the width.

A second displacement of the flexible tongue towards its initial position is accomplished substantially by a spring effect caused by said bending of said flexible tongue.

According to another embodiment of the invention a tongue blank is provided comprising of several flexible tongues connected to each other. This facilitated automatic handling of the tongues in connection with the fixing of the flexible tongues into the displacement groove. In an alternative embodiment, separate tongues are produced, which are preferably moved by means of vibration to a pre-determined positioned, where the tongue is displaced into and fixed in the displacement groove.

According to another embodiment of the invention a production method is provided to fix the flexible tongue in the displacement groove. The flexible tongue is separated from a tongue blank and displaced essentially parallel to its width or length into the displacement groove where it is fixed with a friction force.

According to another embodiment of the invention installation methods are provided which make it possible to connect floor panels vertically and horizontally long side to short side with a simple angling motion.

According to another embodiment of the invention, there is provided a floor panel having an edge portion presenting a sidewardly open groove, in which a tongue formed as a separate part is received. The tongue is bendable in a plane substantially parallel with a main plane of the floor panel, such that the tongue is resiliently displaceable in said plane.

According to another embodiment of the invention, there is provided a tongue adapted for being received in a sidewardly open groove of a floor panel. The

tongue, when received in the groove, is bendable in a plane substantially parallel with a main plane of the floor panel, such that the tongue is at least partially resiliently displaceable in said plane.

According to another embodiment of the invention a reinstallation tool to take up installed floor panels with a flexible tongue is provided. The tool is inserted into a tongue groove or a displacement groove of an installed panel and the tongue is pulled or pushed out of the tongue groove.

According to another embodiment of the invention methods to take up installed floor panels with a flexible tongue is provided. One method comprising removing of a tongue from a first edge of an installed floor panel, preferably using the reinstallation tool, and preferably angle up the floor panel along a second edge. One advantage is that last installed floor panel in one row could be angle up, while the other floor panels in the same row are laying flat on the subfloor in a connected state to a previously installed row. This method to take up a floor panel reduces considerably the risk of damaging the locking system, especially if the floorboards are thick and heavy or installed a tight fit. Further methods is to use the conventional methods adopted to taking up floor panels with a conventional non flexible tongue, e.g. angling-angling, angling-sliding, snaping-sliding or snaping-angling. In such traditional methods, generally the whole row has to be angled up.

Some embodiments of the invention may allow horizontal and vertical locking of all sides of floor panels with a simple angling of the long sides only. Such embodiments are especially suited for use in floor panels which are difficult to displace in locked position for example because they are long, in panels where parts of the locking system is made of a material with high friction, such as wood and in locking systems which are produced with tight fit, without play or even with pretension. Especially panels with such pretension where the locking strip is bent in locked position and presses the panels together are very difficult to displace. A

locking system that allows a vertical folding according to some embodiments of the invention may decrease the installation time of such panels considerably.

Some embodiments of the invention may also be especially well suited for panels which are connected long side to short side and for panels which are wide for example with a width larger than 20 cm. Such panels are difficult to snap on short side and in most materials they must have a vertical locking to avoid height differences between the joint surfaces. Such embodiments could preferably be combined with bevels or similar edge configurations on short and/or long sides. In such a floor, a simple and low cost embodiment of the flexible tongue, could be used, since height differences of adjacent edges preferably short side edges, will be less visible.

According to another embodiment of the invention there is provided a set of two identical floor panels comprising a fold panel and a strip panel, each of the floor panels comprising connectors on at least two edges, said connectors being integrated with the respective floor panel and adapted to connect the fold panel to the strip panel, so that upper joint edges of said floor panels in the connected state define a vertical plane; wherein said connectors are adapted to connect said fold panel to said strip panel in a horizontal direction perpendicular to said vertical plane and in a vertical direction parallel to the vertical plane; wherein one of the connectors for making a vertical connection comprises a flexible tongue in a displacement groove in one of the floor panels; wherein the displacement groove is formed in an edge of the panel associated therewith, and is open towards the vertical plane; wherein the flexible tongue has a length direction along the joint edges, a width in a horizontal plane perpendicular to the length and a thickness in the vertical direction; wherein the flexible tongue is adapted to cooperate, in a connected state, with a tongue groove of the other of the floor panels; wherein another one of the connectors, for making a horizontal connection comprises a locking strip that projects from said vertical plane in the strip panel and carries a locking element; wherein said locking strip is adapted

to cooperate, in a connected state, with a downward open locking groove of the fold panel; wherein the fold panel is adapted to be locked to the strip panel with vertical folding; wherein the displacement groove is in the strip panel, the flexible tongue has a groove portion that, is located in the displacement groove and a projection portion that in a connected state, projects outside the displacement groove and cooperates with the tongue groove; said projection portion has at least one of a bevelled and rounded sliding surface, and the fold panel has a sliding surface adapted to cooperate therewith during locking; wherein the flexible tongue, during the vertical folding, is displaced twice in the displacement groove; wherein a first displacement is effected by the vertical folding of the fold panel whereby at least a part of the flexible tongue is bent in the horizontal direction, and a second displacement of the flexible tongue towards its initial position is accomplished substantially by a spring effect caused by said bending of said flexible tongue.

According to another embodiment of the invention, there is provided a floor panel having an edge portion presenting a sidewardly open groove, in which a tongue formed as a separate part is received, wherein the tongue is bendable in a plane substantially parallel with a front face of the floor panel and bendable in a direction parallel to a direction in which the tongue is received in the groove, such that a part of the tongue is resiliently displaceable in said plane and wherein the width of the tongue varies in the longitudinal direction of the tongue, the longitudinal direction extending parallel to the edge portion and the front face of the floor panel.

According to another embodiment of the invention, there is provided a tongue adapted for being received in a sidewardly open groove of an edge portion of a floor panel, wherein the tongue, which is of an elongated shape, when received in the groove is bendable in a plane substantially parallel with a front face of the floor panel and bendable in a direction parallel to a direction in which the tongue is received in the groove, such that the tongue is at least partially resiliently displaceable in said plane and wherein the width of the tongue, which is parallel to an insertion direction of the tongue into the groove, varies in the longitudinal direction of

the tongue, the longitudinal direction extending parallel to the edge portion of the floor panel and the front face of the floor panel, and the tongue, when received in the groove, includes an upper displacement surface facing the front face of the floor panel and a lower displacement surface facing a rear face of the floor panel, and the upper displacement surface or the lower displacement surface has a beveled edge in the longitudinal direction.

According to another embodiment of the invention, there is provided a tongue adapted for being received in a sidewardly open groove of an edge portion of a floor panel, wherein the tongue, which is of an elongated shape, when received in the groove is displaceable in a plane substantially parallel with a front face of the floor panel and bendable in a direction parallel to a direction in which the tongue is received in the groove and wherein the width of the tongue, which is parallel to an insertion direction of the tongue into the groove, varies in the longitudinal direction of the tongue, the longitudinal direction extending parallel to the edge portion of the floor panel and the front face of the floor panel, and the tongue, when received in the groove, includes an upper displacement surface facing the front face of the floor panel and a lower displacement surface facing a rear face of the floor panel, and the upper displacement surface or the lower displacement surface has a beveled edge in the longitudinal direction.

According to another embodiment of the invention, there is provided a floor panel having an edge portion presenting a sidewardly open groove, the floor panel comprising a tongue adapted for being received in the sidewardly open groove of the floor panel, wherein the tongue, which is of an elongated shape, when received in the groove is displaceable in a plane substantially parallel with a front face of the floor panel and parallel to a direction in which the tongue is received in the groove, wherein the width of the tongue, which is parallel to an insertion direction of the tongue into the groove, varies in the longitudinal direction of the tongue, the longitudinal direction being perpendicular to the width of the tongue and parallel to the front face of the floor panel.

According to another embodiment of the invention, there is provided a tongue adapted for being received in a sidewardly open groove of an edge portion of a floor panel, wherein in the tongue, which is of an elongated shape, when received in the groove is displaceable in a plane substantially parallel with a front face of the floor panel, and wherein, the width of the tongue is parallel to an insertion direction of the tongue into the groove, the tongue is bow shaped in a direction parallel with the front face of the floor panel, and the tongue, when received in the groove, includes an upper surface facing the front face of the floor panel and a lower surface facing a rear face of the floor panel, and the upper surface or the lower surface has a beveled edge in a longitudinal direction, the longitudinal direction extending parallel to the edge portion and the front and rear faces of the floor panel.

Brief Description of the Drawings

Figs 1a-d illustrate one embodiment of a locking system according to the invention.

Figs 2a-e illustrate in different steps mechanical joining of a floor panels according to an embodiment of the invention.

Figs 3a-b show floor panels with a mechanical locking system on a short side.

Figs 4a-b show the flexible tongue during the locking action.

Figs 5a-b show how short sides of two floor panels could be locked with vertical folding.

Figs 6a-c show another embodiment of the invention.

Figs 7a-f show different embodiments of a flexible tongue.

Figs 8a-8d show schematically how a flexible tongue could be separated, positioned and fixed to a floor panel.

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Figs 9a-d show schematically how a flexible tongue could be separated, positioned and fixed to a floor panel.

Figs 10a-e show schematically how a separate flexible tongue could be positioned and fixed to a floor panel.

Figs 11a-c show schematically how a separate flexible tongue could be displaced into a displacement groove of a floor panel.

Figs 12a-c show schematically how two separate flexible tongues could be displaced, at the same time, into the displacement groove of a floor panel.

Figs 13a-f show schematically different embodiments according to the invention.

Figs 14a-d show how two types of panels could be locked vertically and horizontally long side to short side with a simple angling action only.

Figs 15a-d show another embodiment according to the principles in fig 10a-d.

Figs 16a-f show square panels and alternative locking methods.

Figs 17a-c show how widely used traditional panels could be adjusted to vertical folding.

Fig 18 shows the flexible tongue in another embodiment according to the invention.

Figs 18 a-c show the flexible tongue in another embodiment according to the invention.

Figs 18 d-f show embodiments for a splited floor panel.

Figs 19a-b show embodiments of the flexible tongue with various shapes of indentations

Figs 19c-d show an embodiment for compensating for production tolerances of the flexible tongue

Figs 20a-d show embodiments with different lengths and numbers of the flex tongue

Figs 21a-d show another embodiment with a displacement groove, which is not continuous over the whole edge

Figs 22a-d various embodiments of the tongue blank and separate flexible tongues

Figs 23a-g show the flexible tongue in combination with different embodiments of the displacement groove, the locking strip, the locking groove and the lower contact surface of locking groove panel.

Figs 24a-g Show different embodiments of a dismounting tool and dismounting methods.

Description of Embodiments of the Invention

A first preferred embodiment of a floor panel 1, 1' provided with a mechanical locking system according to the invention is now described with reference to Figs 1a-1d. To facilitate understanding, the locking systems in all figures are shown schematically. It should be emphasized that improved or different functions can be achieved using combinations of the preferred embodiments. The inventor has tested all known and especially all commercially used locking systems on the market in all type of floor panels, especially laminate and wood floorings and the conclusion is that at least all these known locking systems which have one or more tongues could be adjusted to a system with one ore more flexible tongues according to the invention. Most of them could easily be adjusted in such a way that they will be compatible with the present systems. Several flexible tongues could be located in both adjacent edges, one over the other and they could be on different levels in the same edge or installed in the same groove after each other. The flexible tongue could be on long and/or short sides and one long or short side could be combined with a flexible tongue on another long or short side, which could have all known locking systems, preferably locking

systems which could be locked by angling or a vertical movement. The invention does not exclude floor panels with flexible tongues on for example a long and a short side. Such panels could be installed by a vertical motion without any angling. Angles, dimensions, rounded parts etc are only examples and could be adjusted within the principles of the invention.

A first preferred embodiment of a floor panel 1, 1' provided with a mechanical locking system according to the invention is now described with reference to Figs 1a-1d.

Figure 1a illustrates schematically a cross-section of a joint between a short side joint edge 4a of a panel 1 and an opposite short side joint edge 4b of a second panel 1'.

The front sides 61 of the panels are essentially positioned in a common horizontal plane HP, and the upper parts 21, 41 of the joint edges 4a, 4b abut against each other in a vertical plane VP. The mechanical locking system provides locking of the panels relative to each other in the vertical direction D1 as well as the horizontal direction D2.

To provide joining of the two joint edges in the D1 and D2 directions, the edges of the floor panel have in a manner known per se a locking strip 6 with a locking element 8 in one joint edge, hereafter referred to as the "strip panel" which cooperates with a locking groove 14 in the other joint edge, hereafter referred to as the "fold panel", and provides the horizontal locking.

The mechanical locking system according to the invention comprises a separate flexible tongue 30 fixed into a displacement groove 40 formed in one of the joint edges. The flexible tongue 30 has a groove portion P1, which is located in the displacement groove 40 and a projecting portion P2 projecting outside the displacement groove 40. The projecting portion P2 of the flexible

tongue 30 in one of the joint edges cooperates with a tongue groove formed in the other joint edge.

In this embodiment, the panel 1 could for example have a body or core 60 of wood-fibre-based material such as HDF, plywood or solid wood.

The flexible tongue 30 has a protruding part P2 with a rounded outer part 31 and a sliding surface 32, which in this embodiment if formed like a bevel. It has upper 33 and lower 35 tongue displacement surfaces and an inner part 34.

The displacement groove 40 has an upper 42 and a lower 46 opening, which in this embodiment are rounded, a bottom 44 and upper 43 and lower 45 groove displacement surfaces, which preferably are essentially parallel with the horizontal plane HP.

The tongue groove 20 has a tongue-locking surface 22, which cooperates with the flexible tongue 30 and locks the joint edges in a vertical direction D1. The fold panel 1′ has a vertical locking surface 24, which is closer to the rear side 62 than the tongue groove 20. The vertical locking surface 24 cooperates with the strip 6 and locks the joint edges in another vertical direction. The fold panel has in this embodiment a sliding surface 23 which cooperated during locking with the sliding surface 32 of the tongue. Preferably there are spaces of 0,1 mm or more between all surfaces, which are not active in the vertical or horizontal locking as shown in figure 1, especially between inner and upper part of the tongue groove 20 and the flexible tongue 30.

Figures 2a-2e shows how a fold panel 1′ could be locked to a strip panel 1. The figures show a vertical motion of two panels towards each other. The figures also shows a part of a vertical folding connecting three panels to each other as shown in figure 5a. The figures 2a-2e shows how the two cross sections A-A and A′-A′ of figure 5a will be connected when the fold panel 1′ will be angled towards the strip panel 1. Figure 2b-c show how

the sliding surfaces cooperate when the folding panel 1' is moved vertically towards the strip panel 1. The flexible tongue 30 is displaced with a first displacement essentially horizontally in the displacement groove 40 towards the bottom 44. When the panels are in the position where they are to be locked to each other, the flexible tongue 30 springs back with a second displacement towards its initial position and the panels are locked vertically between the vertical locking surface 24 and the strip 6 and the lower displacement surface 35 and the tongue locking surface 22.

The flexible tongue 30 should preferably be fixed to the displacement groove 40 with high precision. Depending on the compressibility and friction between the flexible tongue 30 and the displacement groove 40, the tongue as whole or different parts could be fixed with a small play, for example 0,01-0,10 mm, a precise fit or a pre tension. Wax or other friction reducing materials or chemicals could be applied between the flexible tongue and the displacement groove and/or in the tongue groove and/or in the locking system in order to facilitate displacement of the tongue and the locking and/or to facilitate the fixing of the flexible tongue in the displacement groove.

Even with a play, a precise fit between the upper joint edges could be accomplished. The lower tongue displacement surface 35 could be formed to press the tongue locking surface 22 and the vertical locking surface 24 towards the strip 6. For example the protruding part P2 of the tongue displacement surface 35 could be formed with a small angle to the horizontal plane HP. The protruding part P2 of the flexible tongue will tilt towards the front side 61 and a part of the upper tongue displacement surface 33 will press against the upper groove displacement surface 43 while parts of lower displacement surfaces 35,45 close to the bottom 44 of the displacement groove 40 will press against each

other. In such an embodiment, the vertical fit between the upper joint edges will mainly depend on the production tolerances between the vertical locking surfaces 24 and a vertical contact surface 6', in this embodiment located on the upper part of the strip 6, which in locked position, will be in contact with each other and preferably press against each other. The flexible tongue 30 could be formed to cause a permanent pressure force horizontally in the locked position. This means that the flexible tongue 30 will only partly spring back to the initial position. The flexible tongue 30 could optionally be designed with a such dimensions that in locked position it will move slightly towards its initial position when people walk on the floor or when the panels at warping in different humidity. Gradually a perfect vertical connection will be accomplished.

Figure 3a shows a cross section A-A of a panel according to figure 3b seen from above. The flexible tongue 30 has a length L along the joint edge, a width W parallel to the horizontal plane and perpendicular to the length L and a thickness T in the vertical direction D1. The sum of the largest groove portion P1 and the largest protruding part P2 is the total width TW. The flexible tongue has also in this embodiment a middle section MS and two edge sections ES adjacent to the middle section. The size of the protruding part P2 and the groove portion P1 varies in this embodiment along the length L and the tongue is spaced from the two corner sections 9a and 9b. This shape is favourable in order to facilitate the first and the second displacement of the flexible tongue 30.

Figure 4a and 4b shows the position of the flexible tongue 30 after the first displacement towards the bottom 44 of the displacement groove 40. The displacement is caused essentially by bending of parts of the flexible tongue 30 in its length direction L parallel to the width W. This feature is essential for this embodiment of the invention and offers several advantages

A first important advantage is that the tongue could be made of rather rigid material, which is strong and stabile in the vertical direction while at the same time flexible in the horizontal direction D2 is possible to accomplish. The bending portions are could be made considerably larger than the horizontal displacement needed to accomplish the locking.

A second advantage is that the parts, which are flexible and facilitates the first and second horizontal displacement also supports the vertical stability of the tongue. The advantage is that the total width TW of the flexible tongue and the depth of the displacement groove could be rather limited. This improves the strength and moisture deformation of the joint edge. As a non-restrictive example it could be mentioned that the total width TW of the flexible tongue could be about 5- 15 mm

A third advantage is that the flexible tongue could be made in one piece of a single material without any soft and compressible materials. This will decrease the production cost and facilitate the fixing of the tongue in the displacement groove.

The sliding grove is in this preferred embodiment a continuous groove over the whole length of the join edge. The displacement groove (40) could however be formed in only a part of the edge and it does not have to be parallel with the edge. The displacement groove (40) could for instance be curved. Such a groove is easy to produce with a rotating tool, which could move against the edge.

The fold panel could be disconnected with a needle shaped tool, which could be inserted from the corner section 9b into the tongue grove 20 and press the flexible tongue back into the displacement groove 40. The fold panel could than be angled up while the strip panel is still on the sub floor. Of course the panels could also be disconnected in the traditional way.

Figure 5a and 5b shows one embodiment of a vertical folding. A first panel 1'' in a first row is connected to a second 1 panel in a second row. The new panel 1' is connected with its long side 5a to the long side 5b of the first panel with angling. This angling action also connects the short side 4b of the new pane with the short side 4a of the second panel. The fold panel 1' is locked to the strip panel 1 with a combined vertical and turning motion along the vertical plane VP. The protruding part P2 has a rounded and or angled folding part P2'which during folding cooperates with the sliding surface 23 of the folding panel 1'. The combined effect of a folding part P2', and a sliding surface 32 of the tongue which during the folding cooperates with the sliding surface 23 of the fold panel 1' facilitates considerably the first displacement of the flexible tongue 30. The horizontal pressing force could be spread over a much larger portion than the thickness T of the flexible tongue and the fold panel could easily be folded down with a low force even if the spring effect of the bending is high. As a non restrictive example it could be mentioned that a vertical pressing force of 10 N against a piece, which has a length of 100 mm along the long side, applied on the long side 5b of the fold panel, as shown in figure 5a, could displace a projecting portion P2 to the inner position even if the spring force is 20 N. Most of the pressure force will be horizontal and the flexible tongue will be displaced into the displacement groove 40 without any risk of a block effect caused by friction or a tilting and/or vertically bending of the flexible tongue 30. It is an advantage if the locking system is designed in such a way that the locking element 8 is partly in the locking groove 14 when the first displacement starts. This is shown in figure 5b. The top edges 41,21 are partly in contact with each other and the fold panel 1' is in the correct starting position. The locking element 8 and the locking groove 14 prevents the strip panel 1 and the fold

panel 1′ to separate when the flexible tongue 30 is pressed into the displacement groove 40. En essential feature of this embodiment is the position of the projecting portion P2, which is spaced from the corner section 9a and 9b. The spacing should be preferably at least 10 % of the length of the joint edge, in this case the visible short side 4a. Figure 5a shows that the spacing from the both corner section 9a and 9b gives the flexibility that the fold panel could during the vertical folding be connected to the long side of the first panel 1′′ with the tongue side 5a or the strip side 5b

Fig 6a- 6b show that the flexible tongue could be in the edge of the fold panel 1′. The sliding surface 32 of the tongue cooperates in this embodiment with the top edge of the strip panel. Thanks to the folding part P2′, the locking could be made without any risk of damaging the top surface layer at the edge. The advantage of this embodiment is that a short side with a flexible tongue could be connected to a traditional long side or short side locking system with a strip 6 and a tongue groove 20 in the same edge.

Figure 6c shows an embodiment where the displacement groove 40 is not parallel with the horizontal plane HP. This facilitates the connection of the flexible tongue 30 into the displacement groove 40. The protruding part of the flexible tongue 30 is wedge shaped in order to press the vertical contact surface 6′ and the vertical locking surface 24 against each other. The locking surfaces between the locking element 8 and the locking groove 14 are angled and have an angle which is less than 90 degree against the horizontal plane HP and the locking system could be connected with a tight fit and/or pre tension.

Figures 7a-7e shows different embodiments of the flexible tongue 30. In figure 7a the flexible tongue 30 has on one of the edge sections a friction connection 36 which could be shaped for instance as a local small vertical protrusion. This friction connection keeps the

flexible tongue in the displacement groove 40 during installation, or during production, packaging and transport, if the flexible tongue is integrated with the floor panel at the factory. Figure 4b show that the friction connection 36 keeps one edge section ES essentially still while the other edge section ES' moves along the edge. The length L' in the inner position is in this embodiment larger than the length L in locked position.

Figure 7b shows a tongue blank 50 comprising several flexible tongues 30 connected to each other. In this embodiment the flexible tongue 30 is made with moulding preferably injection moulding. Any type of polymer materials could be used such as PA (nylon), POM, PC, PP, PET or PE or similar having the properties described above in the different embodiments. These plastic materials could be reinforced with for instance glass fibre, Kevlar fibre, carbon fibre or talk or chalk. A preferred material is glass fibre, preferably extra long, reinforced PP or POM.

Figures 7c-e show different embodiments made by injection moulding. With this production method a wide variety of complex three-dimensional shapes could be produced at low cost and the flexible tongues 30 could easily be connected to each other to form tongue blanks 50. Of course the flexible tongue 30 could be made from metal. Figure 7 e shows that the flexible tongue could be made of an extruded or machined plastic section, which could be further shaped with for example punching to form a flexible tongue according to the invention. Materials such as plastic, metals preferably aluminium, solid wood, wood based sheet material such as HDF and compact laminate could be used.

Figure 7f shows an embodiment, which comprises two sections 38 and 39, which are connected to each other. This will be explained more in connection to figures 16d-f.

In general any shape which allows that a part of the tongue could bend in length direction and spring back in such a way that the projecting portion could be displaced with 0,1 mm or more, will be possible to use. Normally the displacement should be 1-3 mm but very small displacements of some 0,1 mm could be enough to form a vertical locking which prevent vertical movement especially in HDF material.

Figures 8a-8d show schematically a production method to fix the flexible tongue to the displacement groove. In this embodiment the flexible tongue is mechanically fixed. Of course glue or mechanical devices can also be used. To simplify the understanding the panel 1' is located with its front side up. The panel could also be turned with the rear side up. The tongue blanks 50 are moved trough a separation unit 51, which separates the flexible tongue 30 from the tongue blank 50. The flexible tongue 30 could than be moved to a lower level with a vertical device 55. This motion could also be combined with the separation. A pusher 54 moves the flexible tongue 30 into the displacement groove 40 and fixes it with the friction connection 36. The flexible tongue is guided over the strip 6 between an upper 52 and lower 53 guiding devices. Vacuum could also be used to connect the flexible tongue 30 to the upper 52 guiding device during the horizontal displacement into the displacement groove 40. A lot of alternatives are possible within the main principles that the flexible tongue is separated from a tongue blank containing at least two connected flexible tongues and displaced essentially parallel to its width and/or length into the displacement groove 40 where it is fixed with a friction force.

Figures 9a-d show schematically an alternative production method to mechanically fix the flexible tongue to the displacement groove. The tongue blanks 50 are moved trough a separation unit 51, which separates the flexible tongue 30 from the tongue blank 50. The flexible

tongue 30 is in this embodiment positioned using a fan wheel 58. The fan wheel provides a safe handling of the flexible tongues. A pusher 54 moves the flexible tongue 30, via a tongue-guiding device, into the displacement groove 40 and fixes it with the friction connection 36. The flexible tongue is guided over the strip 6 between an upper 52 and lower 53 guiding devices.

Figures 10 a-e show schematically a further production method to mechanically fix the flexible tongue to the displacement groove. Separates tongues are stored in a vertical magazine 59 and the outermost tongue is feeded in the horizontal direction by a feeding device to a vertical device 55. The tongue is feeded between an upper horizontal feeding means 65 and a lower horizontal feeding means to the vertical device 55, which lower the tongue. In this embodiment the lower feeding means is also a pusher. A pusher 54 moves the flexible tongue 30, via a tongue-guiding device, into the displacement groove 40 and fixes it with the friction connection 36. The flexible tongue is guided over the strip 6 between an upper 52 and lower 53 guiding devices.

Figures 11 a-c show schematically a tongue-fixing device, which uses a fixing wheel 61. The tongue is feeded in a feeding device 67 and a pusher 54 pushes an end of the tongue preferably provided with a friction connection 36 into the displacement groove of the floor panel. A relative motion between the panel and the fixing wheel 61, causes a gradually fixing of the whole tongue into the displacement groove, as the panel 1' passes the fixing wheel 61. An alternative embodiment comprising two or more wheels, gradually fixing the tongue.

Figures 12 a-c show schematically an alternative tongue-fixing device, which in the same process fixes two tongues. In this embodiment the fixing device comprising two feeding devices and pushers and one fixing wheel, but

alternative the fixing device comprising additional fixing wheels, pushers and feeding devices.

Figures 13a to 13f are examples which show that all known locking systems could be adjusted to vertical folding with a flexible tongue 30 according to the invention and that the flexible tongue 30 could be attached optionally to the strip or fold panel. In the embodiment of figure 13e, the strip 6 is not rigid enough to form a vertical contact surface. This could be solved by a tongue 10 and a groove 9 above the flexible tongue 3 30. Of course the vertical contact surface 6'could be a part of the tongue groove and the vertical locking surface 24 could be the projecting portion of the tongue as shown in figure 13e.

Figure 14a-b shows how a locking system could be designed to lock long side 4a to long side 4b with angling, short side 5a to short side 5b by vertical folding and/or angling and short side to long side with vertical folding or angling. Figures 14c-14d show how two panels A and B with mirror inverted locking systems could be locked to a floor with an advanced installation pattern. Panels 1-6 could be installed with angling. Panel 7 could be installed by angling the short side to the long side of pane 6. Panels 8-9 could be installed by angling. Panel 12 is installed by angling the short side. Panels 13-23 are installed by folding. Panels 24-26 are installed by angling and panels 27- 34 by folding. Thanks to the flexible tongue 30 on the short side the whole floor could be installed with a simple angling action in spite of the fact that all panels are connected on all sides vertically and horizontally and all panels are connected long to long side and long to short side. This installation method could be used in connection with all types of flexible tongues and not only those embodiments that bend along the length direction. Figure 14b show that the locking system could be locked with a pressure force F caused by the flexible tongue 30.

Figures 15a- 15d show how A and B panels with a flexible tongue could be installed and locked vertically D1 and horizontally D2 in a single or double herringbone pattern with only a simple angling action.

Figure 16 a-c shows vertical folding installation with square panels. The flexible tongue 30 has several protruding parts P2. This embodiment could be used as an alternative to several separate flexible tongues when the length of the joint edge exceeds for example 200 mm. The friction connection 36 could be located for example in a middle section.

Figure 16d-e show an alternative way to displace the flexible tongue. The method could be combined with a flexible tongue according to figure 7f. The new panel 1′ is in angled position with an upper part of the joint edge in contact with the first panel 1′′ in the first row. The first panel 1′, the fold panel, is than displaced towards the second panel 1 until the edges are essentially in contact and a part of the flexible tongue 30 is pressed into the displacement groove 40 as can be seen in the figure 16e. The new panel 1′ is than folded down towards the second panel 1. Figure 16f show that the tongue could be on the folding panel. Since the displacement of the new panel 1′ presses an edge section of the flexible tongue 30 into the displacement groove 40, vertical folding will be possible to make with less resistance. Such an installation could be made with a flexible tongue that has a straight protruding part. The flexible tongue 30 does not have to bend in the length direction if it has a flexible device such as rubber that could be compressed. The bending could be replaced by a horizontal turning action where one edge section of the flexible tongue during locking is closer to the bottom 44 of the displacement groove 40 than another opposite edge section.

Figures 17a-d shows how a known locking system, used in large volumes on the marked, could be converted to a

vertical folding, preferably in two steps. The first step is to replace the traditional tongue 10 with a flexible tongue 30. In this embodiment the locking systems will be compatible which means that an old and new panel could be locked to each other. The tongues could be fixed to either the fold panel (see Fig 17c) or the strip panel (see Fig 17 d). After a while when all products in the shops are sold, the groove 9 of the strip part could be adjusted.

Within the invention a lot of alternatives are possible to accomplish vertical folding with a flexible tongue.

A flexible tongue could be produced according to the same principle as known mechanical devices, which create a spring effect similar to locking devices used in doors, windows, furniture, cars and mobile phones. The flexible tongue with these mechanical devices could be formed with dimensions suitable for 6-15 mm floorings, especially wood floorings, and inserted into the edge. Figure 18 shows that the flexible tongue (30) could for example be mounted in a separate sliding section 56 made of plastic or metal or any other suitable material and containing a compressible or flexible rubber, metal or plastic component (57) or similar able to create the spring effect. This sliding section 56 could be connected into the edge of the floor panel in a holding groove 40′ which in this embodiment is rounded and has a shape similar to a part of a rotating saw blade. Since the holding groove 40′ only is formed in a part of the short side edge, it could be made rather deep and the edge will still have sufficient strength. A preferable feature of this embodiment is that the deepest part of the holding groove 40′ is only located in a part of the edge. Contrary to the other embodiments the holding groove 40′ is not parallel with the joint edge and does not cover the whole edge. Of course other shapes are possible and the parallel groove is not excluded.

Especially on long and wide floor panels rather complicated devices could be used since only 2-4 pieces are required per m2 of flooring. Even with a rather high unit price, the advantages with vertical folding are considerable and could overcome a rather high cost for the locking system. Due to the fact that the short sides are not sawn very often, metal components could also be used and these components could be formed in such a way that they are easy to remove from the floor panel if the short side edge must be sawn.

In floor panels with a width of about 20 cm a flexible tongue with a length of a few cm is enough if it is positioned in the middle part of the short side about 6-9 cm from the corner section.

The flexible tongue could also be made of one single component as described in the embodiment above and with a thickness of about 1 mm only and could be used to connect floorboards with a thickness down to 4 mm. A locking system with the flexible tongue, according to the inventions, is also very suitable for connecting thicker floorboards or about 10-15 mm, especially wood and laminate floorboards. The displacement groove 33 and/or the tongue groove 20, could be formed in separate materials, which are connected as an edge portion to the core. In engineered wood floors, with for instance a lamella core, the edge portion could be made of e.g. HDF, plywood, plastic or special hard wood, which are stronger than the core material. This separate edge portion could be fixed between the top layer and the balancing layer.

Al features of the embodiment described above could be combined with each other or used separately. The flexible tongues could be combined with all shown displacement or holding grooves. The locking systems could be used in any shown joint or floor panel. The system according to figure 18 could for example be used in floor panels described in figures 14a-d. The tongue as shown in figure 7f could also have a shape as shown I

figure 7b and it could be made to bend in the length direction where this bending is partly supported by a flexible material 38. The locking strips could in all embodiments be made of a separate material or in one piece. Part of the strip 6 in figure 18 could be removed under the plastic component 56 to facilitate fixing to the joint.

Figures 18a-c show different shapes of the flexible tongue. Figure 18a show one embodiment with an essentially sine shaped tongue, comprising two periods, and straight parts at the down periods and at the top periods. A second and third embodiments comprising two periods with different lengths of the top periods. A fourth embodiment comprising one period and a fith embodiment comprising one period involving an assymetric top period. The different lengths of the periods and asymetri is used to fascilitate the connection, and lower resistance. Figure 18b shows an embodiment before the ingates are removed and with recesses 66 at the inner part, wich increase the flexibility of the tongue. Figure 18c show an embodiment with different radius at the inner part R3, at the bevel R2 and at the outer part R1. The figure shows that the total width TW of the tongue could vary between a postion when the panel is not conneted TWS and a posion when the panel is connected TWE. In the connected position is in this embodiment the tongue slightly compressed and pretensioned and therefore also shows a different shape. In an embodiment without the straight part at the top period of the sine shaped tongue it is possible to create a higher degree of pretension, at least initially after installation, in the connected postion, which might be an advantage. After a while the pretension might decrease. Figures 18d-f show embodiments to solve the problem wich occur when the panel is splitted. In one embodiment the tongue is replaced by another tongue (see fig. 18d and f), which is shorter. In another embodiment (see fig 18e) the shape of the tongue

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is adopted so that the tongue could be cut and still work.

Figures 19a-b show an embodiment of the tongue with indentations 63, of different shapes. The indentation counteracts the effect of shrinkage by moulding, and could also be usufeul to help orientation of the tongue, when handling the tongue in connection with fixing. The bottom of the tongue is a suitable place for identification text or contact surface of a pusher (e.g when removing the tongue from a mould), since it doesn't change the sliding/displacing characteristics of the tongue. Figure 19 c-d shows how different sisez of the tongue, due to production tolerances, could be compensated by a bevel 64 at the lower displacement surface of the tongue and an inclined tongue locking surface 22 of the tongue groove.

Figures 20a-d illustrate that various types, lengths and numbers of tongues could be combined and fixed to one displacement groove. An advantage is that different combination could be used to create different strength and characteristics of the locking system, which could be adopted to different types of panels. A use of several tongues could also replace product (panel) specific lengts of the tongues.

Figures 21a-d illustrates embodiments with a non continous displacing grooves. The non continous displacing groove could be procused by a jumping head 69 or created by inserting a filler 67 or inserting and fastening, e.g by friction or gluing, of a divider 68.

Figures 22a-c illustrate embodiments of a tongue blank, straight or circular and with ingates at one or both ends of the tongue. The tongue could also be handled separatly according to figure 22d.

Figures 23a-g show different embodiments of a mechanial locking system in combination with a flexing tongue. Figures 23a and 23b show one embodiment of the same panel at the short side 23a and at the longside 23b.

Figure 23c shows an embodiment, which is not possible to take up with anling. Figures 23a-d show an embodiment of a displacing groove with an inclined upper displacing groove surface, which couteract the effect of humidity related shrinking and swelling of the panel and reduces the risk of jaming of the tongue.

Figures 24a-g show embodiments of a tool 100-103 to be used when taking up panels with the flexible tongue. The tool comprising a handle part 104 and a tool part 105, which is adapted to be inserted in the tongue groove or the displacement groove of a panel. In one embodiment the tongue is compressed when the tool 100 is inserted and pushed out of the tongue groove. In another embodiment (figure 24d-e) the tool part 103 comprising a protrusion or recess 106 at the one end of the tool, which is adapted to catch an end of the tongue, preferably provided with a recess or protrusion. This embodiment pulls out the tongue.

In order to increase the accessibility the tool might also comprising a curved part and/or produced of an elastic material, e.g. elastic bendable plastic or metal.

An alternative, for which a tool not is necessary (figure 24e), is that the tongue has an end part, outside the displacement and tongue groove, such that it is visible when the panels are connected. The end part is adapted to be easy to grab and used when pulling out the tongue.

A floor panel with a flexible tongue could also be taken up using the conventional methods adapted to taking up floor panels with a conventional non-flexible tongue, e.g. angling-angling, angling-sliding, snapping-sliding or snapping-angling.

The method to produce a separate tongue, which is inserted into a groove, could of course be used to save material and improve friction properties even if the tongue is not flexible or displaceable. The methods and principle could also be used together with a flexible

tongue that could be bent in vertical direction up and/or down during locking. Extruded V- or U-shaped sections, were an outer or inner part is flexible and which could cause at least a part of the section to move essentially horizontally during the vertical folding could also be used to lock floorboards in a vertical direction, according to the same basic principal as the above described flexible tongue.

The system could be used to connect tile shaped panes installed on a wall and. The tile could be connected to each other and to a locking member fixed to the wall.

The flexible tongue according to the invention may be used without the locking strip to accomplish vertical locking only.

CLAIMS:

1. A set of two identical floor panels comprising a fold panel and a strip panel, each of the floor panels comprising connectors on at least two edges, said connectors being integrated with the respective floor panel and adapted to connect the fold panel to the strip panel, so that upper joint edges of said floor panels in the connected state define a vertical plane;

wherein said connectors are adapted to connect said fold panel to said strip panel in a horizontal direction perpendicular to said vertical plane and in a vertical direction parallel to the vertical plane;

wherein one of the connectors for making a vertical connection comprises a flexible tongue in a displacement groove in one of the floor panels;

wherein the displacement groove is formed in an edge of the panel associated therewith, and is open towards the vertical plane;

wherein the flexible tongue has a length direction along the joint edges, a width in a horizontal plane perpendicular to the length and a thickness in the vertical direction;

wherein the flexible tongue is adapted to cooperate, in a connected state, with a tongue groove of the other of the floor panels;

wherein another one of the connectors, for making a horizontal connection comprises a locking strip that projects from said vertical plane in the strip panel and carries a locking element;

wherein said locking strip is adapted to cooperate, in a connected state, with a downward open locking groove of the fold panel;

wherein the fold panel is adapted to be locked to the strip panel with vertical folding;

wherein the displacement groove is in the strip panel, the flexible tongue has a groove portion that is located in the displacement groove and a projection portion that, in a connected state, projects outside the displacement groove and cooperates with the tongue groove;

said projection portion has at least one of a bevelled and rounded sliding surface, and the fold panel has a sliding surface adapted to cooperate therewith during locking;

wherein the flexible tongue, during the vertical folding, is displaced twice in the displacement groove;

wherein a first displacement is effected by the vertical folding of the fold panel whereby at least a part of the flexible tongue is bent in the horizontal direction, and

a second displacement of the flexible tongue towards its initial position is accomplished substantially by a spring effect caused by said bending of said flexible tongue.

2. The set of floor panels as claimed in claim 1, wherein the flexible tongue along a length of the flexible tongue has at least two sections, and said first displacement or said second displacement of one of the sections is larger than the first displacement or the second displacement of the other one of the sections.

3. The set of floor panels as claimed in claim 2, wherein the flexible tongue along the length of the flexible tongue has a middle section and two edge sections on both sides of the middle section, and the middle section is able to be displaced more than one of the edge sections.

4. The set of floor panels as claimed in any one of claims 1 to 3, wherein said flexible tongue has a projecting portion that in a connected state is located outside the displacement groove and a groove portion in the displacement groove

such that the size of at least one of (i) said projecting portion and (ii) the groove portion varies along the length of the flexible tongue.

5. The set of floor panels as claimed in claim 4, wherein the projecting portion is spaced from a corner section of a panel.

6. The set of floor panels as claimed in any one of claims 1 to 5, wherein the flexible tongue is made of moulded polymer material.

7. The set of floor panels as claimed in claim 5, wherein the locking element is partly in the locking groove when the first displacement starts.

8. A floor panel having an edge portion presenting a sidewardly open groove, in which a tongue formed as a separate part is received, wherein the tongue is bendable in a plane substantially parallel with a front face of the floor panel and bendable in a direction parallel to a direction in which the tongue is received in the groove, such that a part of the tongue is resiliently displaceable in said plane and wherein the width of the tongue varies in the longitudinal direction of the tongue, the longitudinal direction extending parallel to the edge portion and the front face of the floor panel.

9. The floor panel as claimed in claim 8, wherein the tongue along its length has at least two sections, wherein, during displacement of the tongue, said sections displace to different extents.

10. The floor panel as claimed in claim 9, wherein the tongue along its length has a middle section and two edge sections on both sides of the middle section, wherein the middle section is displaceable to a greater extent than the edge sections.

11. A tongue adapted for being received in a sidewardly open groove of an edge portion of a floor panel, wherein the tongue, which is of an elongated shape, when received in the groove is bendable in a plane substantially parallel with a front

face of the floor panel and bendable in a direction parallel to a direction in which the tongue is received in the groove, such that the tongue is at least partially resiliently displaceable in said plane and wherein the width of the tongue, which is parallel to an insertion direction of the tongue into the groove, varies in the longitudinal direction of the tongue, the longitudinal direction extending parallel to the edge portion of the floor panel and the front face of the floor panel, and the tongue, when received in the groove, includes an upper displacement surface facing the front face of the floor panel and a lower displacement surface facing a rear face of the floor panel, and the upper displacement surface or the lower displacement surface has a beveled edge in the longitudinal direction.

12. The tongue as claimed in claim 11, wherein a protrusion is arranged at the upper displacement surface or at the lower displacement surface.

13. The tongue as claimed in claim 11, wherein the tongue is made of plastic and reinforced with fibres.

14. The tongue as claimed in claim 13, wherein plastic is PP or POM and the fibres are glass fibres.

15. A tongue adapted for being received in a sidewardly open groove of an edge portion of a floor panel, wherein the tongue, which is of an elongated shape, when received in the groove is displaceable in a plane substantially parallel with a front face of the floor panel and bendable in a direction parallel to a direction in which the tongue is received in the groove and wherein the width of the tongue, which is parallel to an insertion direction of the tongue into the groove, varies in the longitudinal direction of the tongue, the longitudinal direction extending parallel to the edge portion of the floor panel and the front face of the floor panel, and the tongue, when received in the groove, includes an upper displacement surface facing the front face of the floor panel and a lower displacement surface facing a rear face of the floor panel, and the upper displacement surface or the lower displacement surface has a beveled edge in the longitudinal direction.

16. The tongue as claimed in claim 15, wherein a protrusion is arranged at the upper displacement surface or at the lower displacement surface.

17. The tongue as claimed in claim 15, wherein the tongue is made of plastic and reinforced with fibres.

18. The tongue as claimed in claim 17, wherein the plastic is PP or POM and the fibres are glass fibres.

19. A floor panel having an edge portion presenting a sidewardly open groove, the floor panel comprising a tongue adapted for being received in the sidewardly open groove of the floor panel, wherein the tongue, which is of an elongated shape, when received in the groove is displaceable in a plane substantially parallel with a front face of the floor panel and parallel to a direction in which the tongue is received in the groove, wherein the width of the tongue, which is parallel to an insertion direction of the tongue into the groove, varies in the longitudinal direction of the tongue, the longitudinal direction being perpendicular to the width of the tongue and parallel to the front face of the floor panel.

20. The floor panel as claimed in claim 19, wherein the groove has a part which is rounded in the plane.

21. The floor panel as claimed in claim 19, wherein a protrusion is arranged at an upper surface or a lower surface of the tongue.

22. The floor panel as claimed in claim 19, wherein the groove has a lower part comprising a strip with a locking element.

23. The floor panel as claimed in claim 19, wherein the tongue is made of plastic and reinforced with fibres.

24. The floor panel as claimed in claim 23, wherein the plastic is PP or POM and the fibres are glass fibres.

25. A tongue adapted for being received in a sidewardly open groove of an edge portion of a floor panel, wherein in the tongue, which is of an elongated shape, when received in the groove is displaceable in a plane substantially parallel with a front face of the floor panel, and wherein, the width of the tongue is parallel to an insertion direction of the tongue into the groove, the tongue is bow shaped in a direction parallel with the front face of the floor panel, and the tongue, when received in the groove, includes an upper surface facing the front face of the floor panel and a lower surface facing a rear face of the floor panel, and the upper surface or the lower surface has a beveled edge in a longitudinal direction, the longitudinal direction extending parallel to the edge portion and the front and rear faces of the floor panel.

26. The tongue as claimed in claim 25, wherein the width of the tongue varies in the longitudinal direction of the tongue.

27. The tongue as claimed in claim 25, wherein a protrusion is arranged at an upper surface or a lower surface of the tongue.

28. The tongue as claimed in claim 25, wherein the tongue is made of plastic and reinforced with fibres.

29. The tongue as claimed in claim 28, wherein the plastic is PP or POM and the fibres are glass fibres.

30. The floor panel as claimed in claim 8, wherein the width of the tongue varies in the longitudinal direction of the tongue before bending or displacing during insertion of the tongue into the sidewardly open groove and during locking of the floor panel with another floor panel.

31. The floor panel as claimed in claim 8, wherein the tongue is bendable to have at least one curve shape as viewed in plan view from above the front face of the floor panel, such that the curve arcs in a plane substantially parallel with the front face of the floor panel.

Fig. 1a

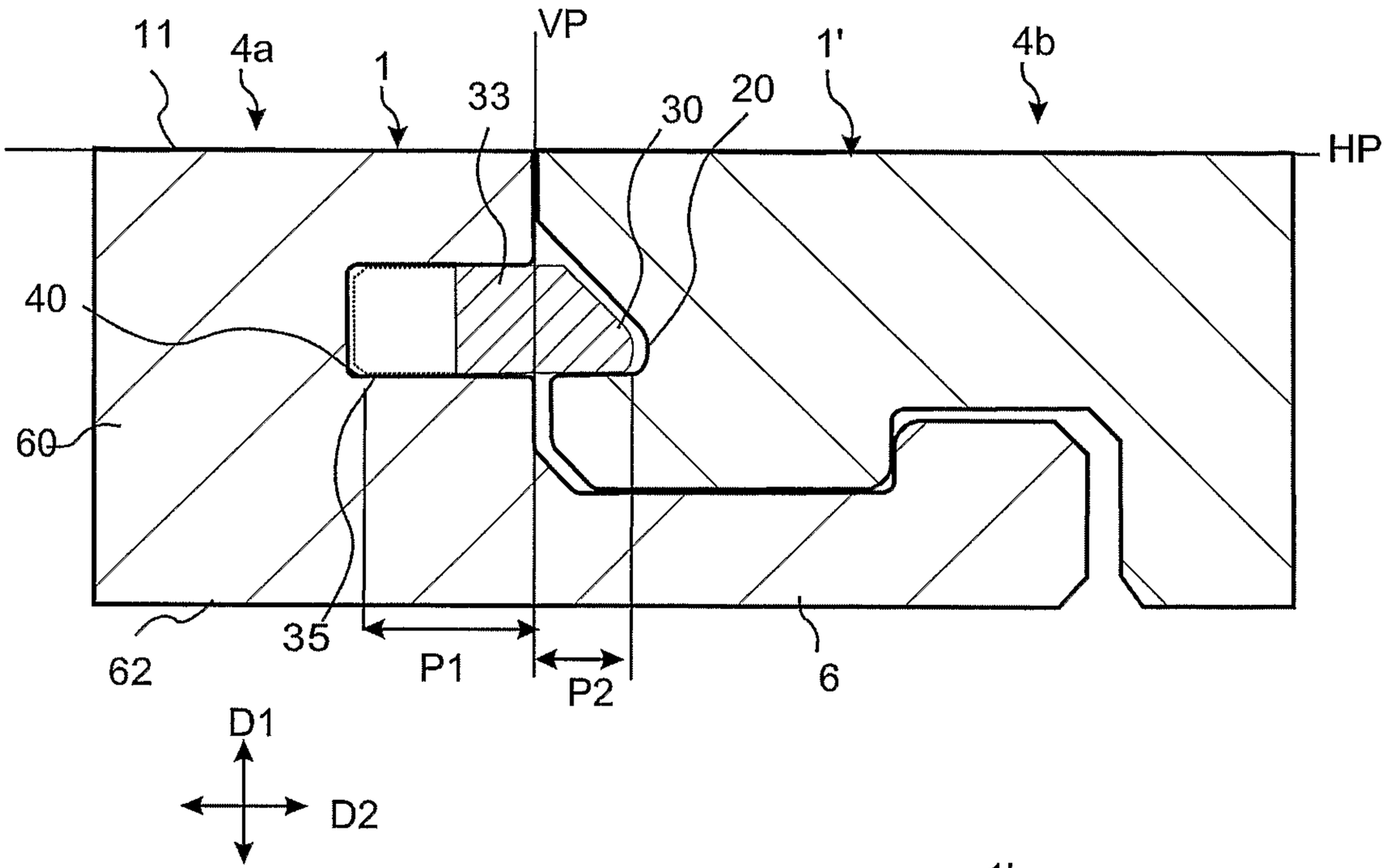


Fig. 1c

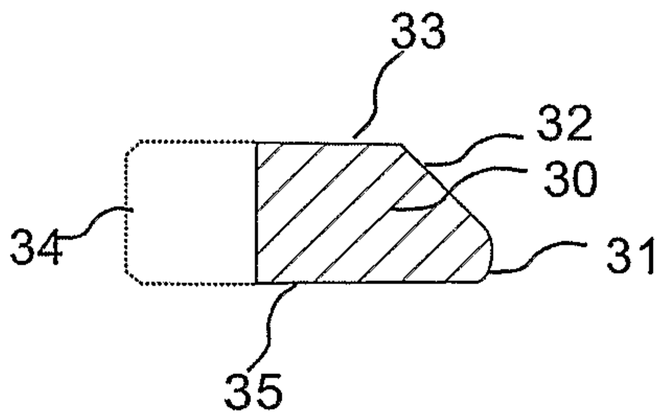


Fig. 1b

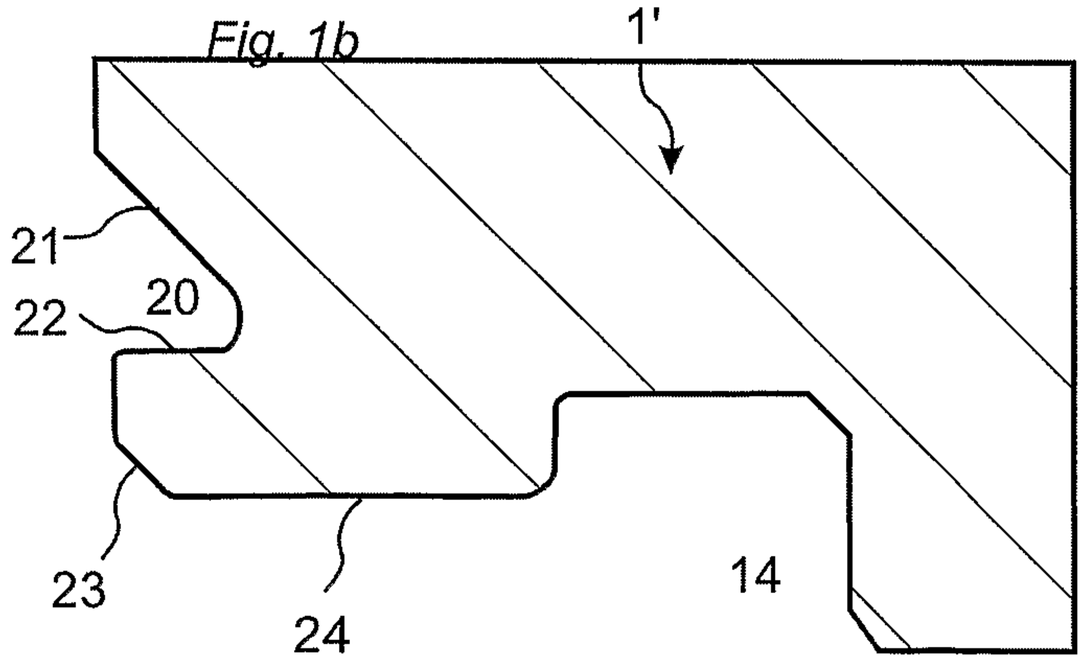
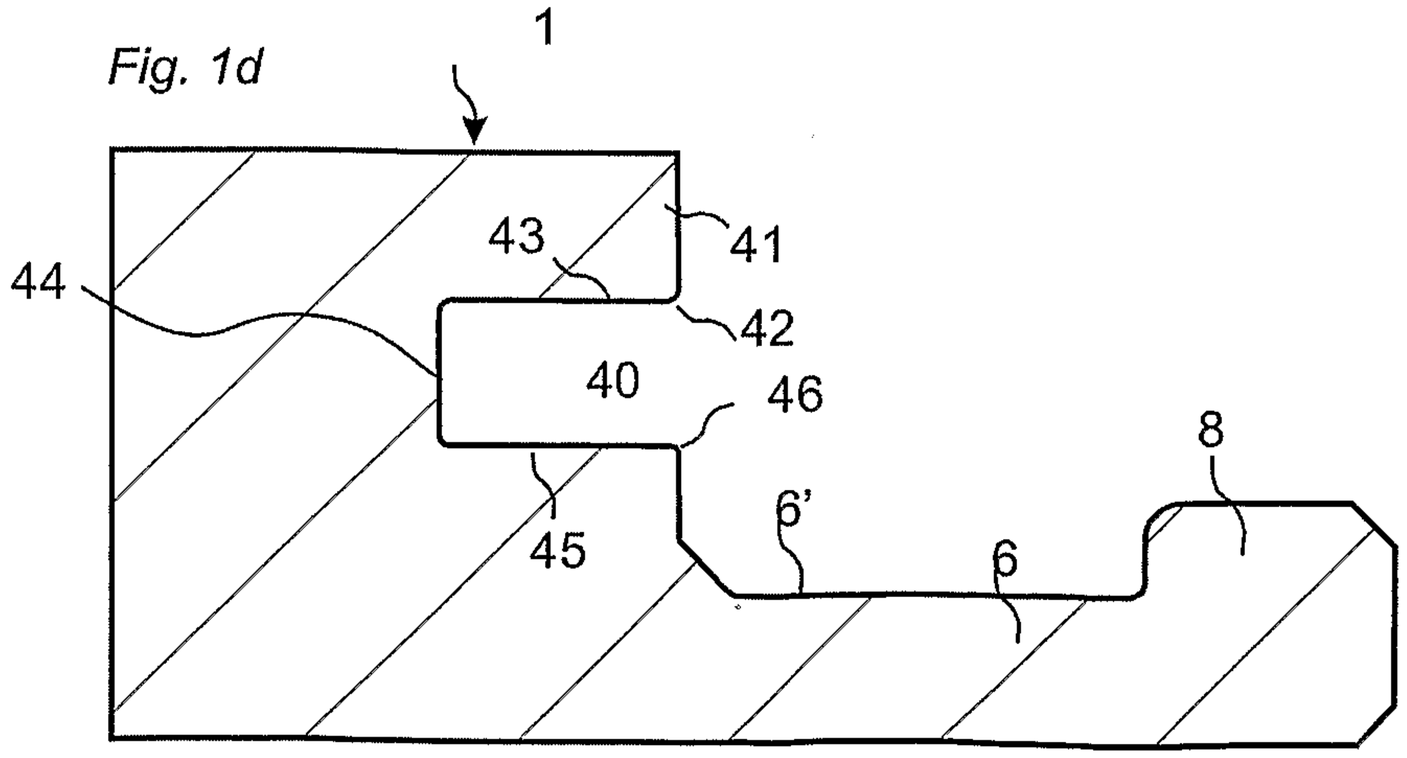


Fig. 1d



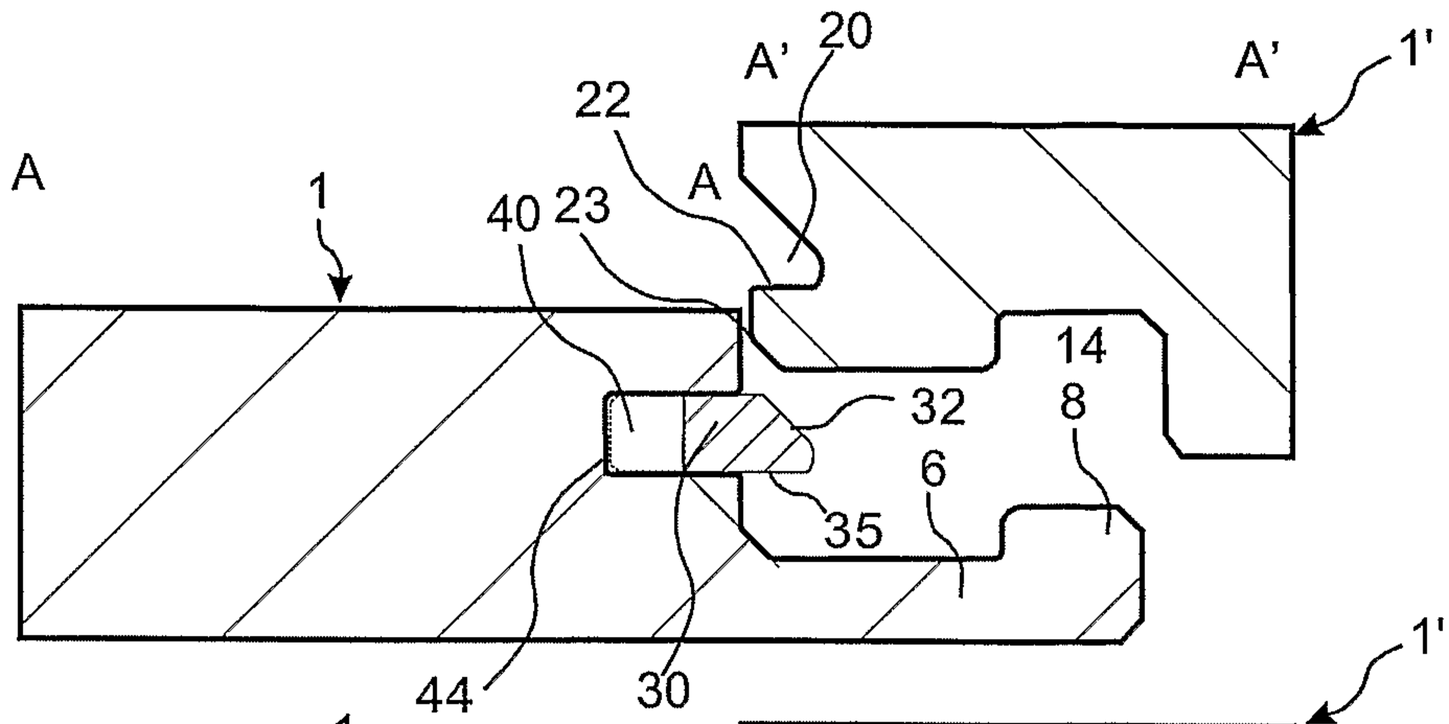


Fig. 2a

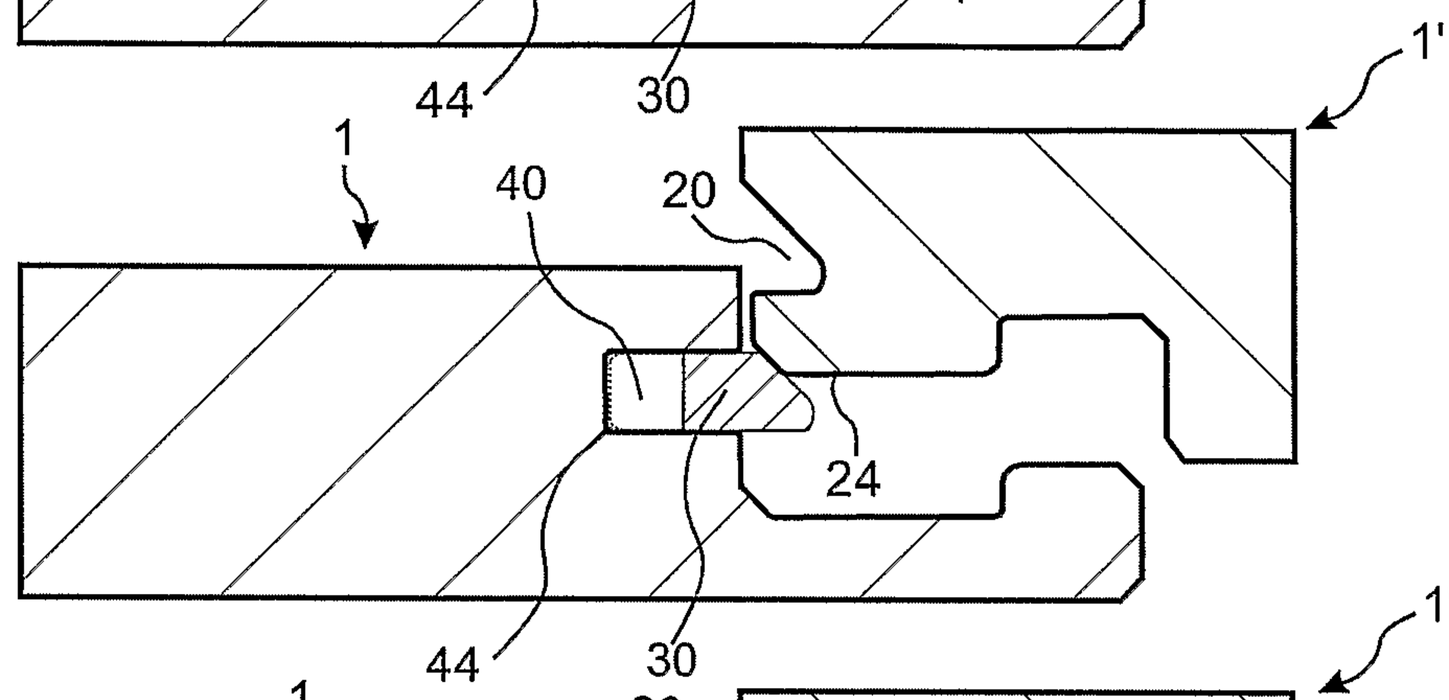


Fig. 2b

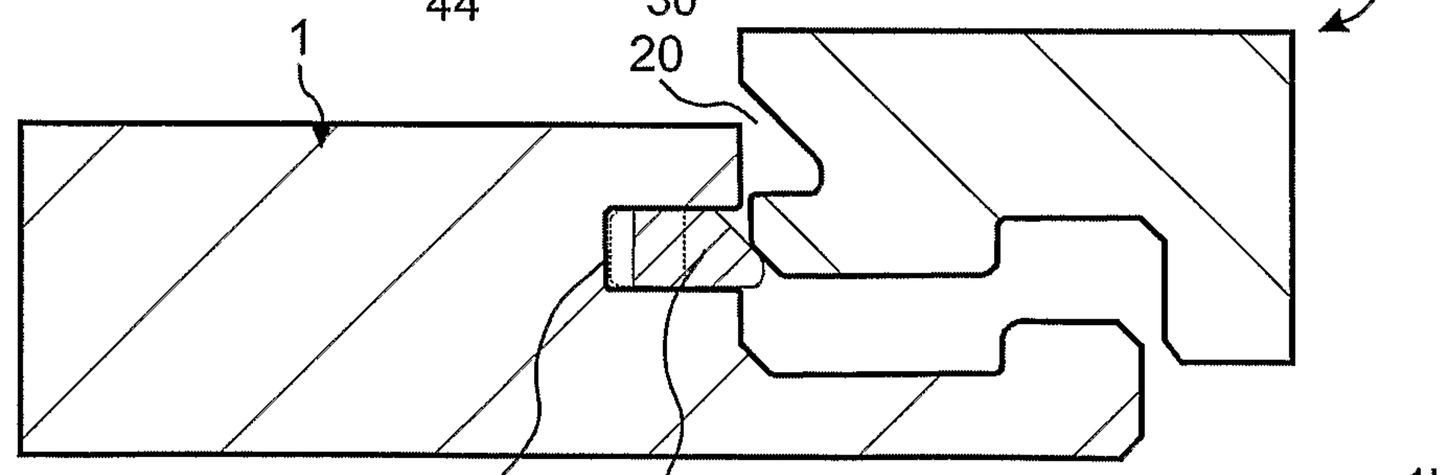


Fig. 2c

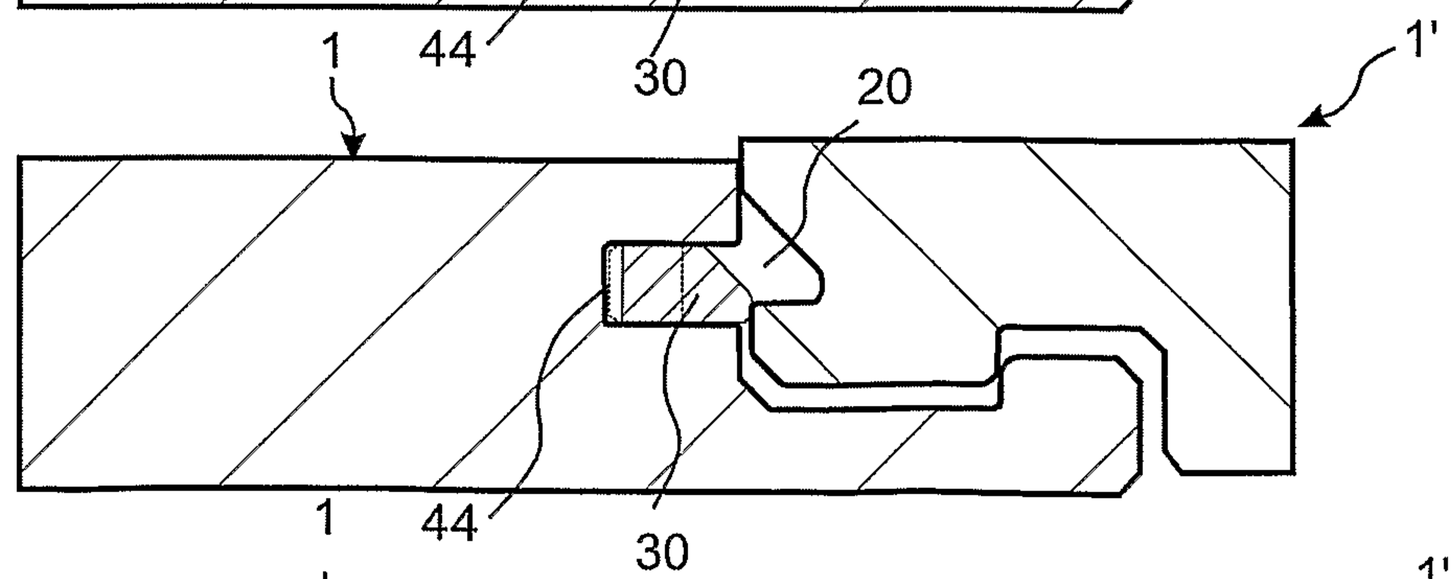


Fig. 2d

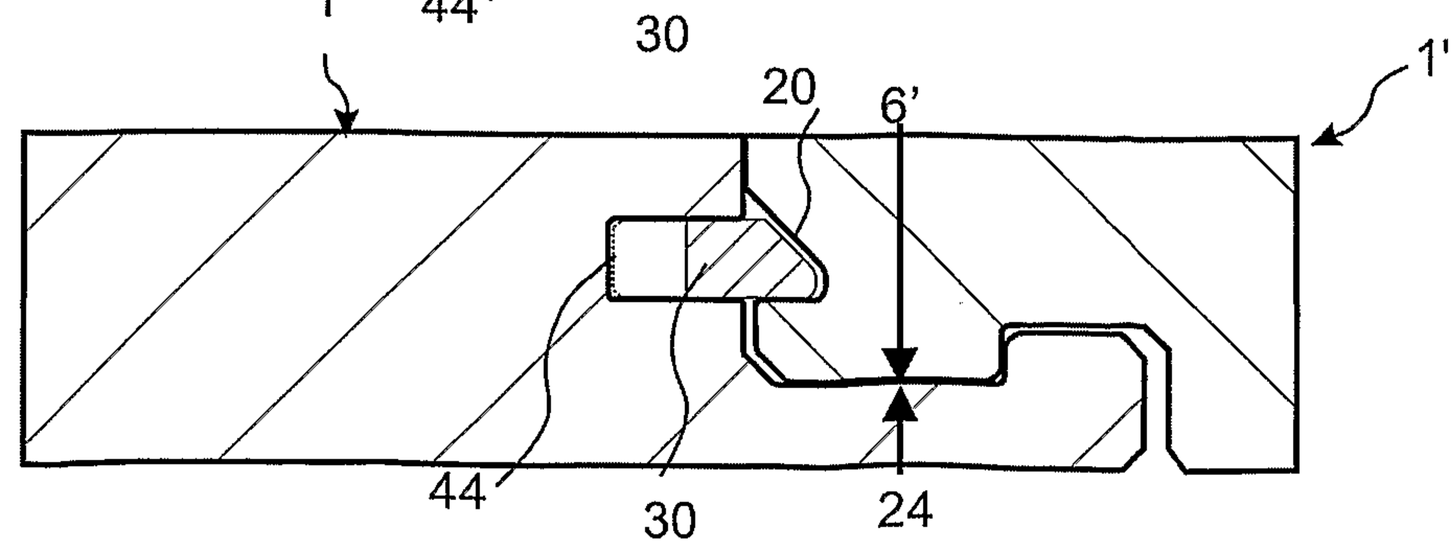


Fig. 2e

Fig. 4a

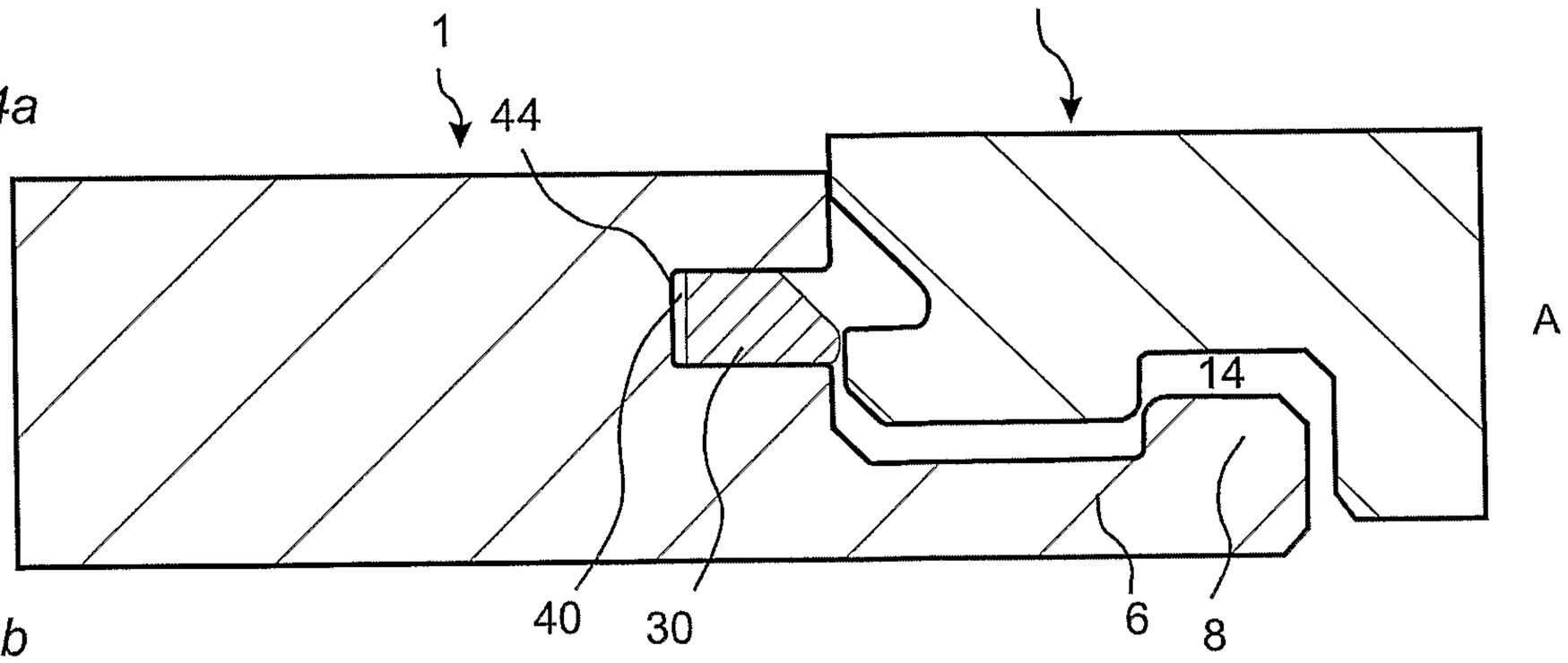


Fig. 4b

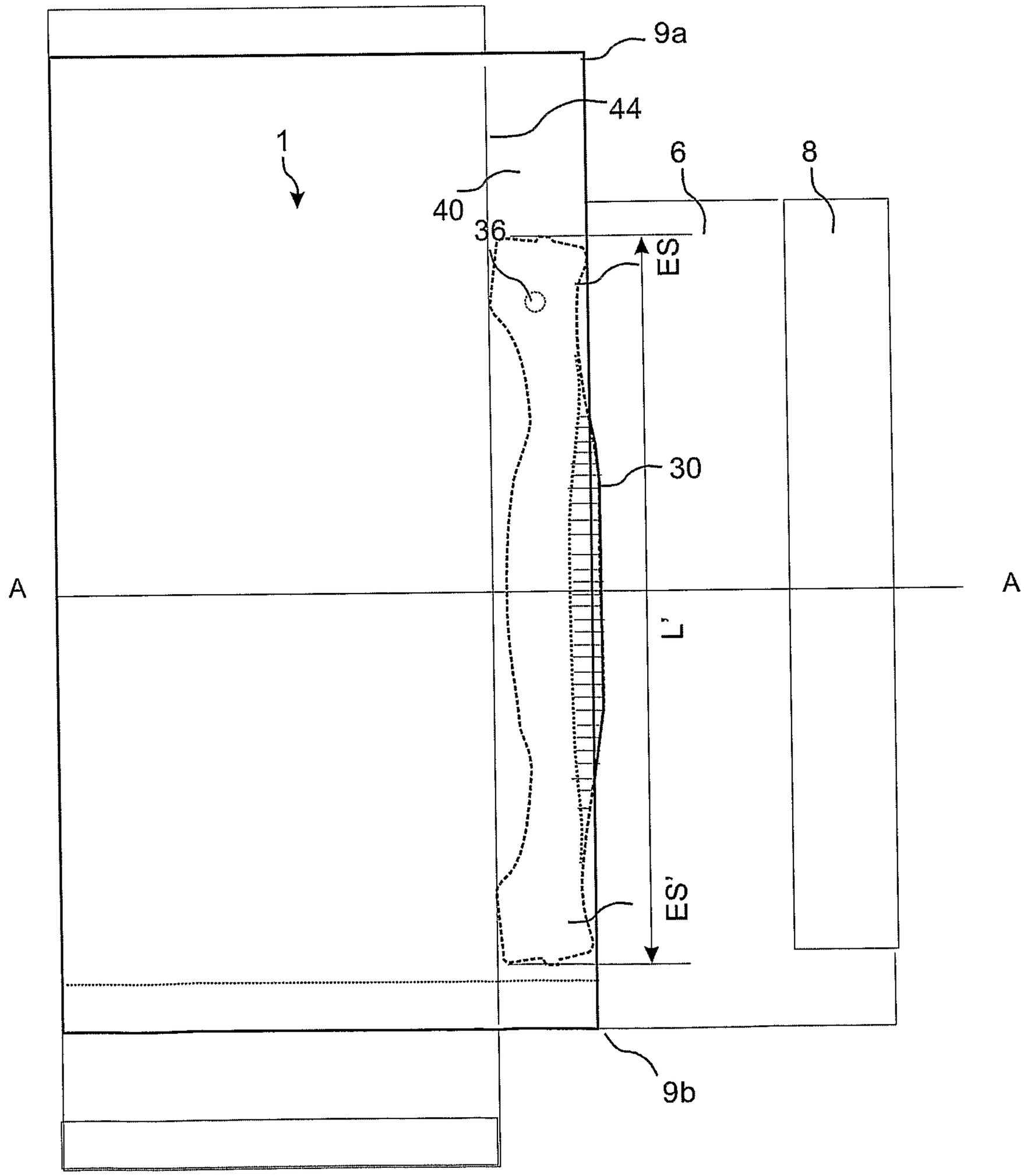


Fig. 3a

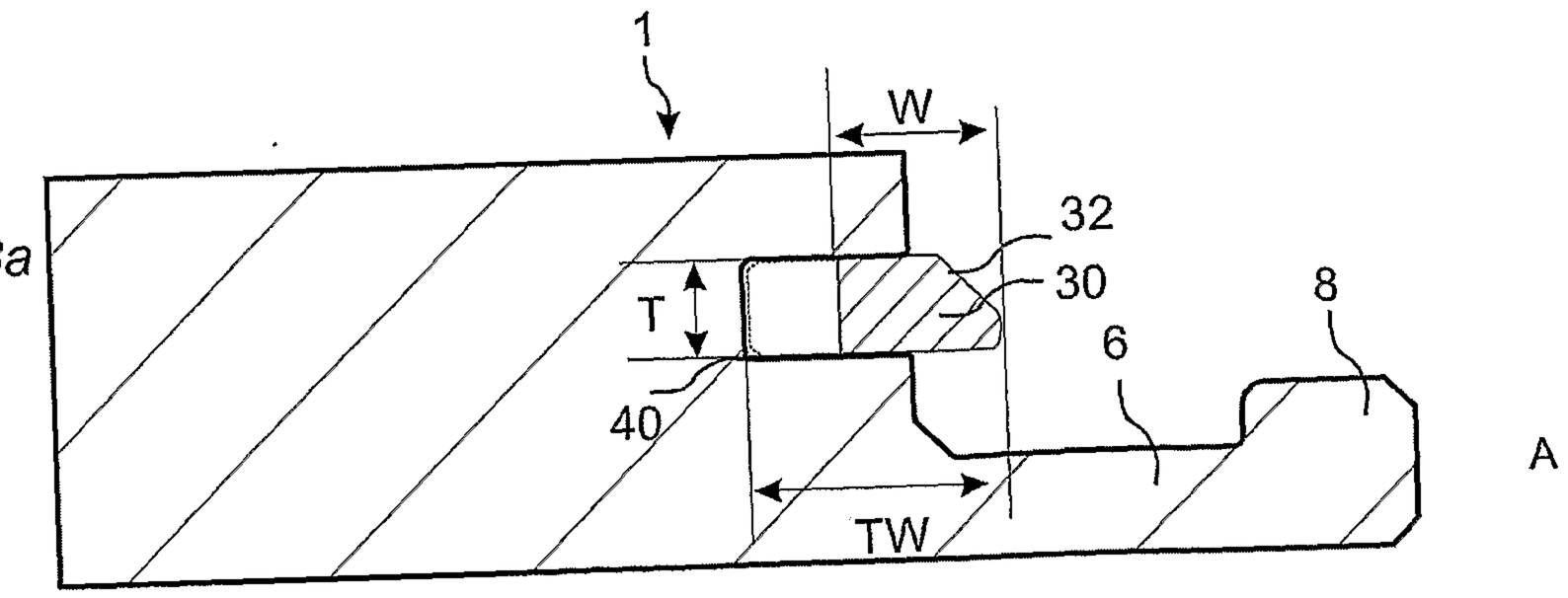


Fig. 3b

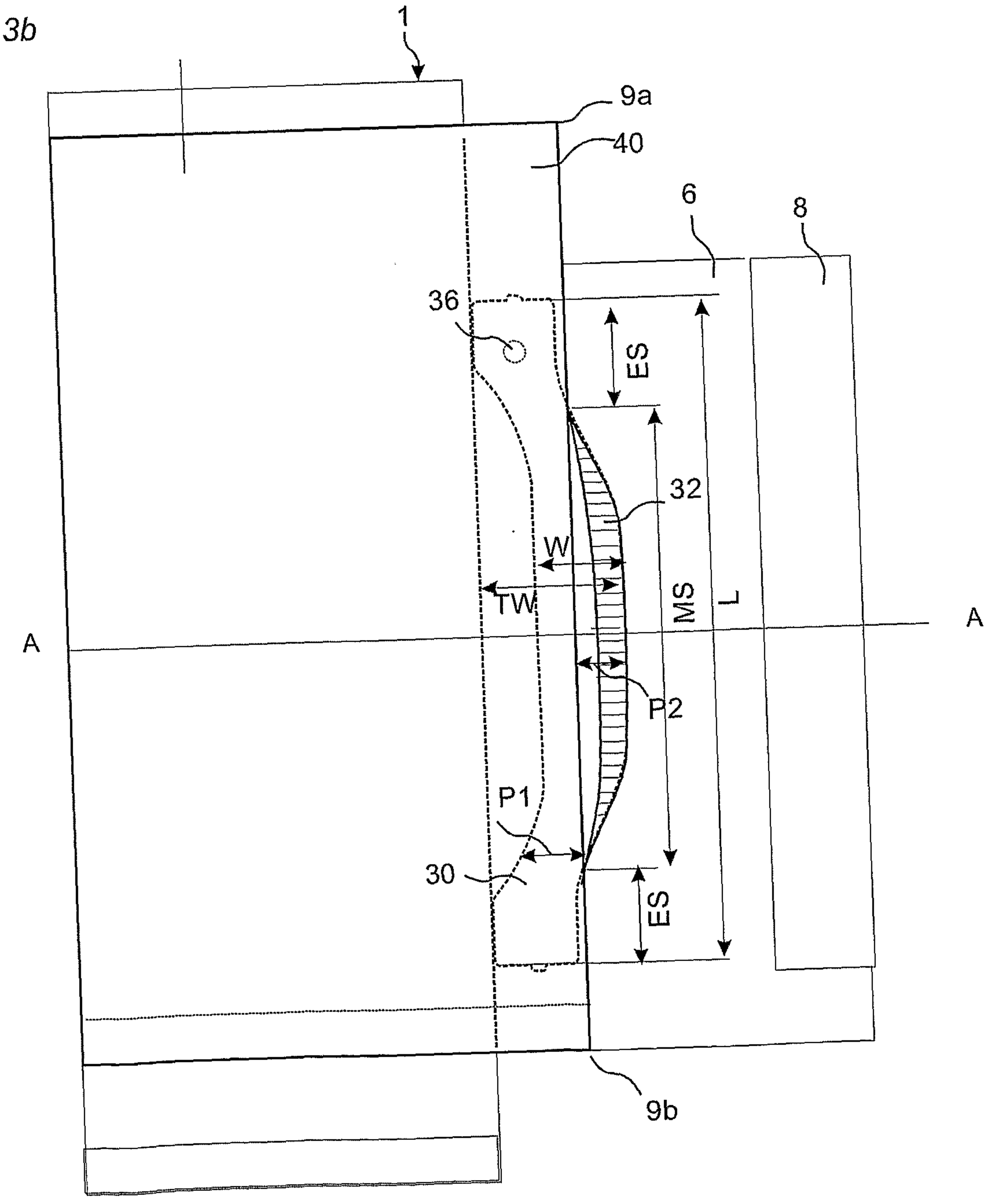
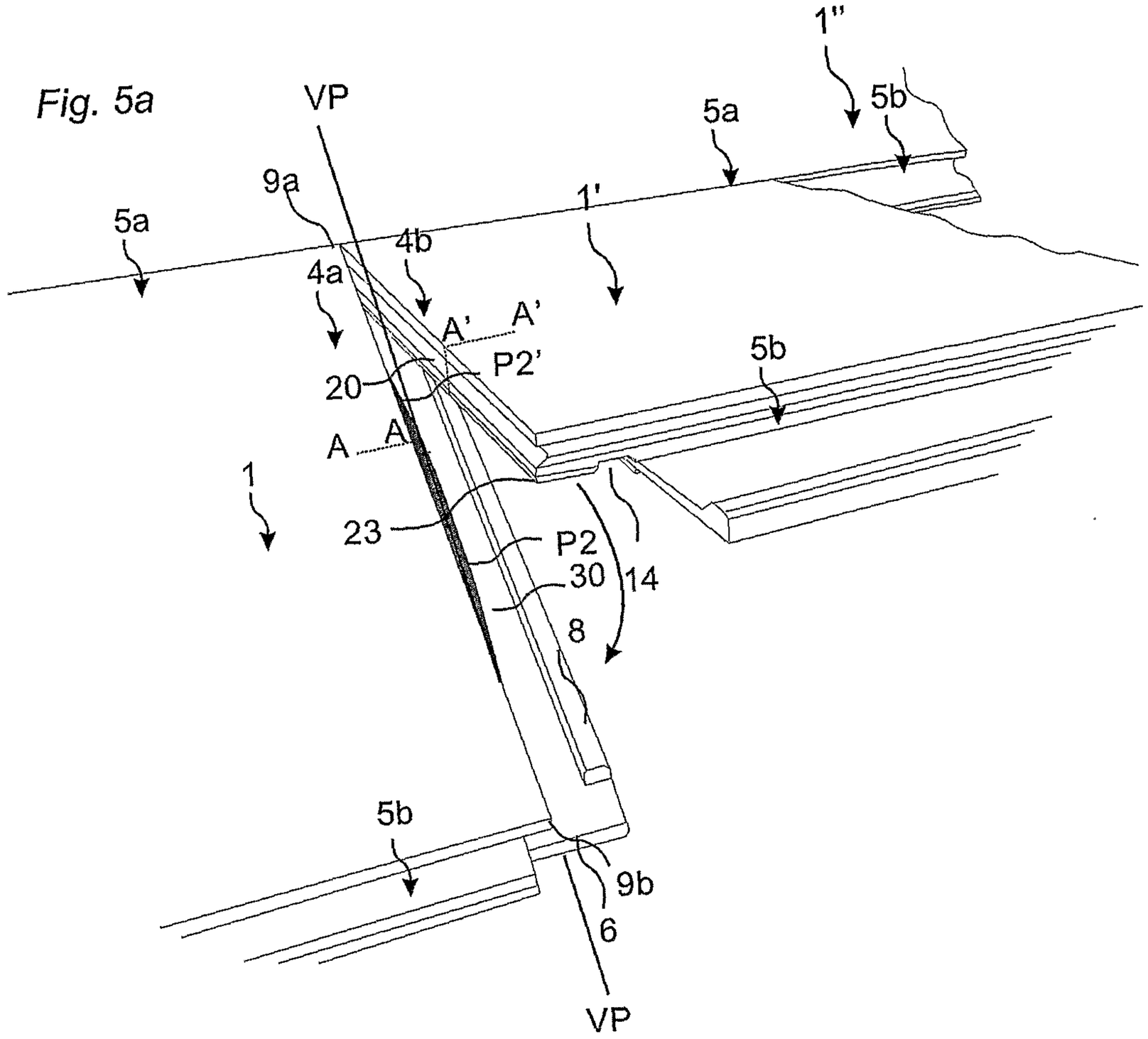


Fig. 5a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VP
5a
5b
9a
1'
5a
4b
4a
A'
A'
P2'
20
5b
A
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1
23
P2
30
14
8
5b
9b
6
VP

Fig. 5b

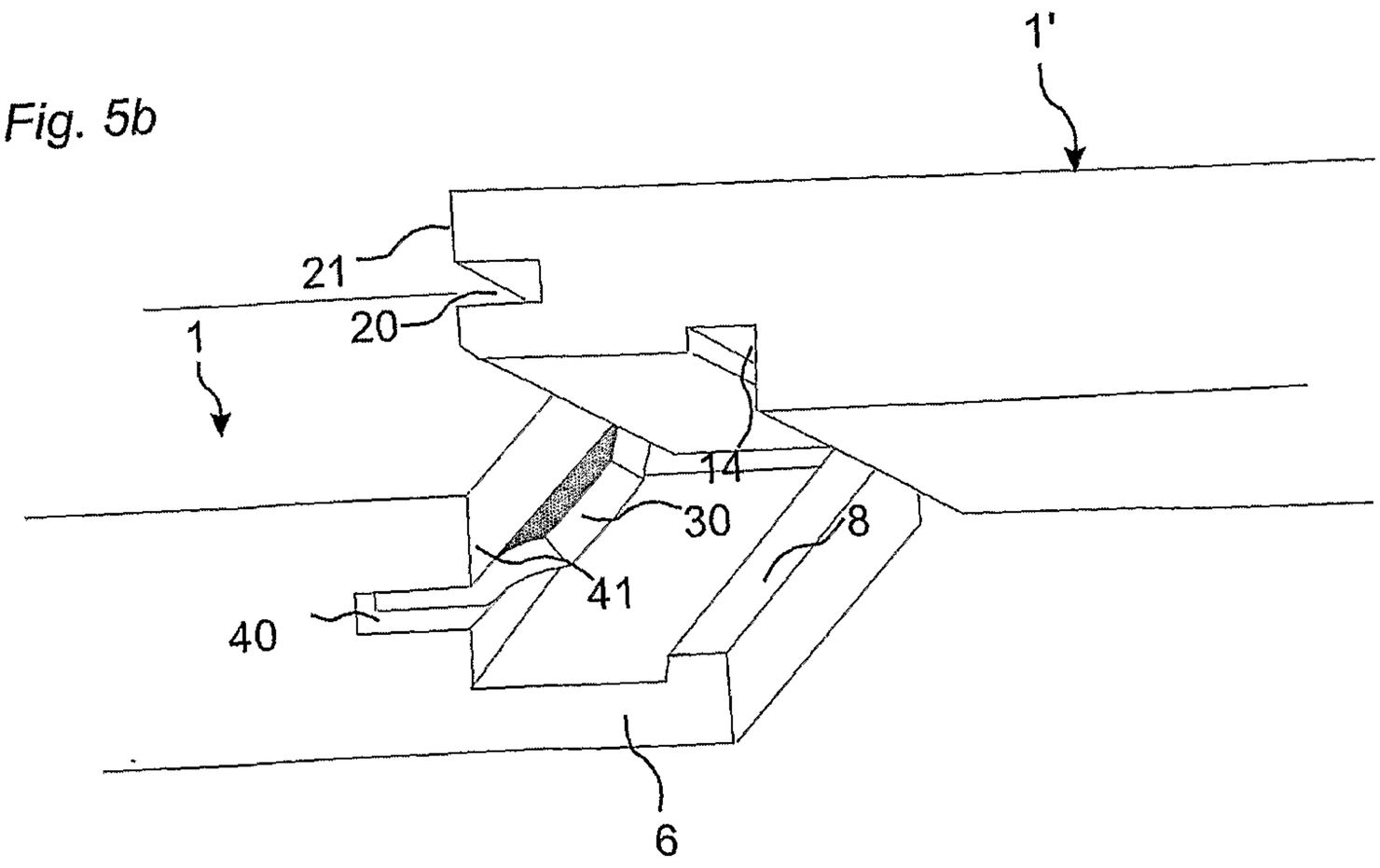

1'
21
20
1
14
30
8
41
40
6

Fig. 6a

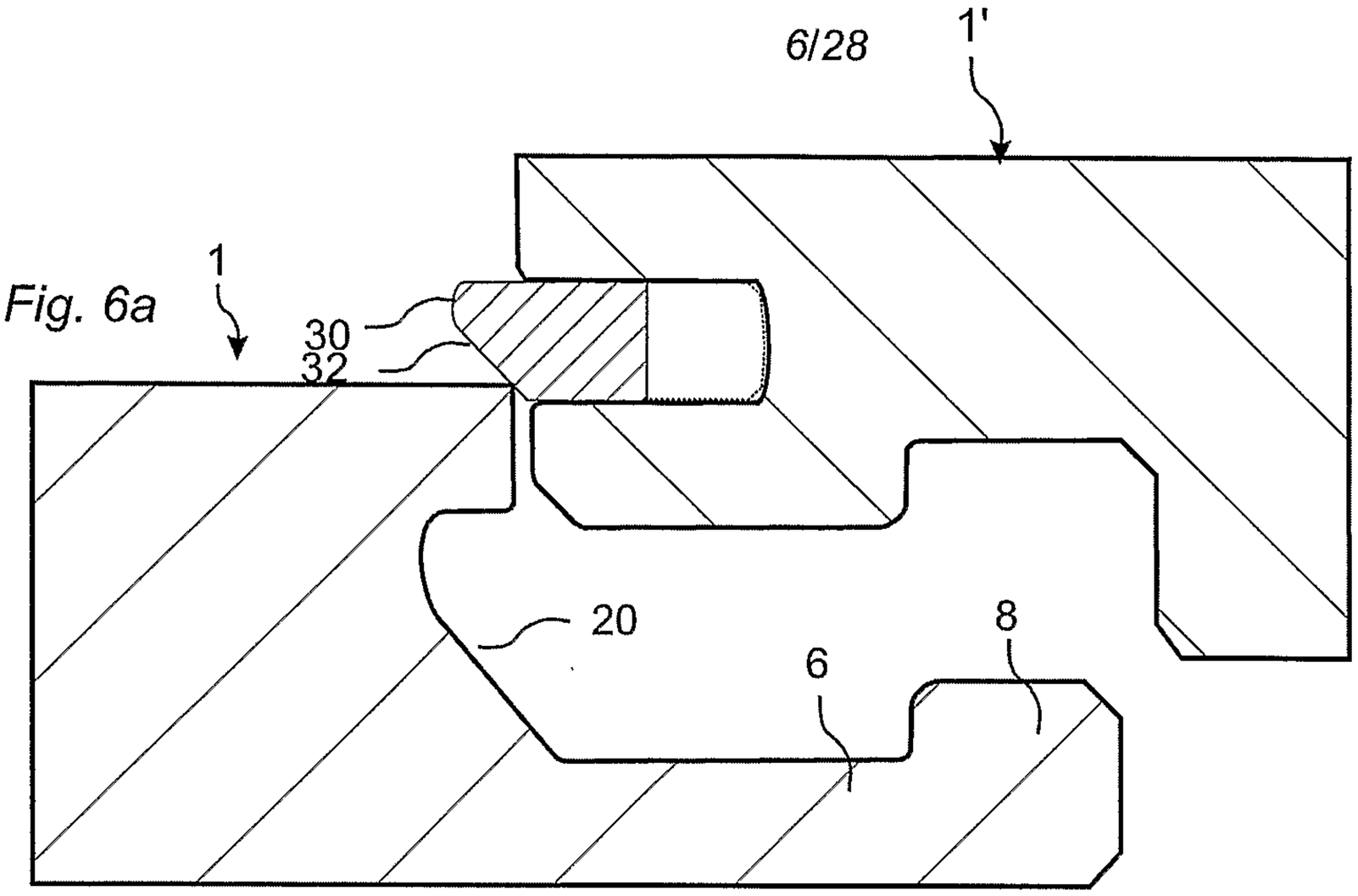


Fig. 6b

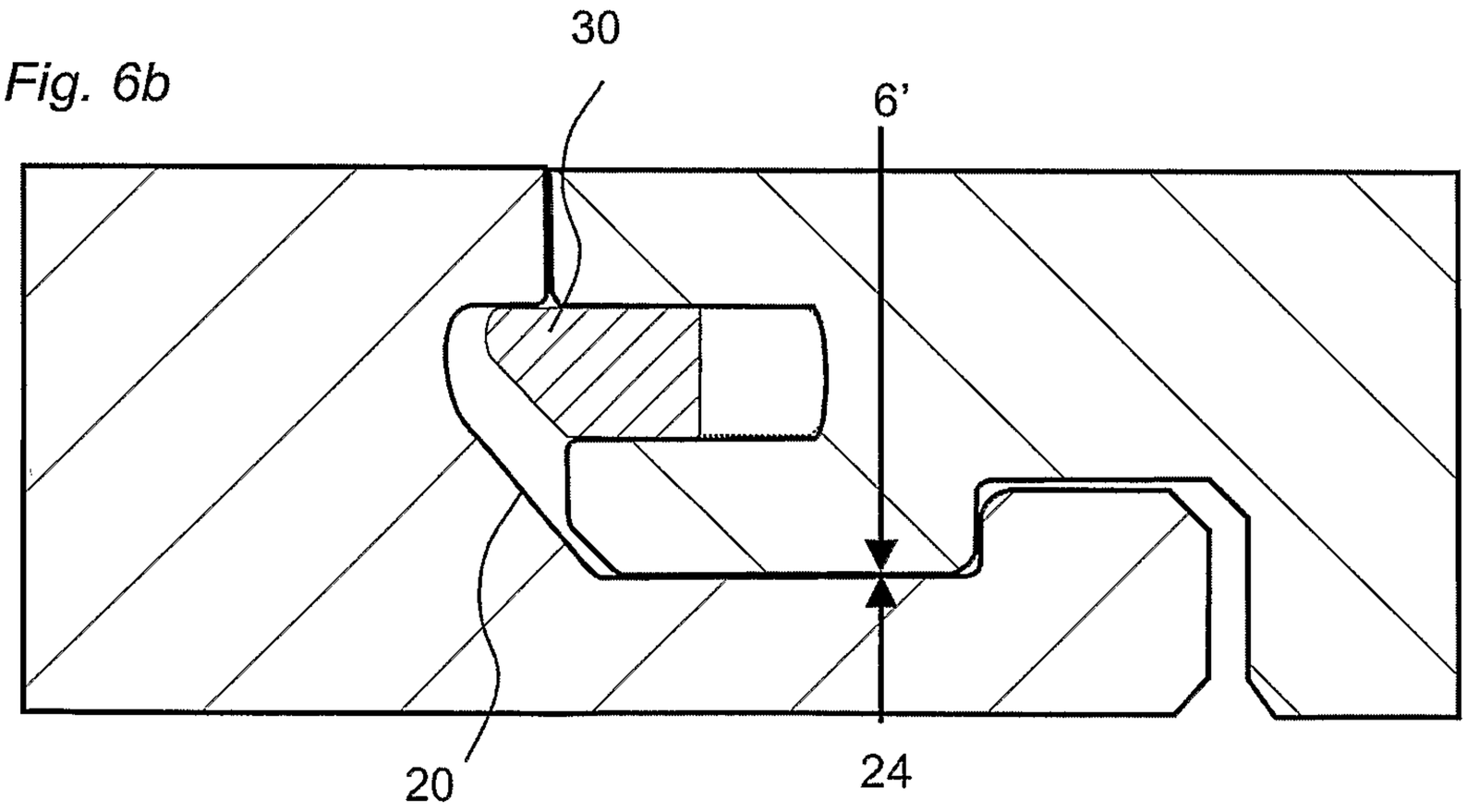


Fig. 6c

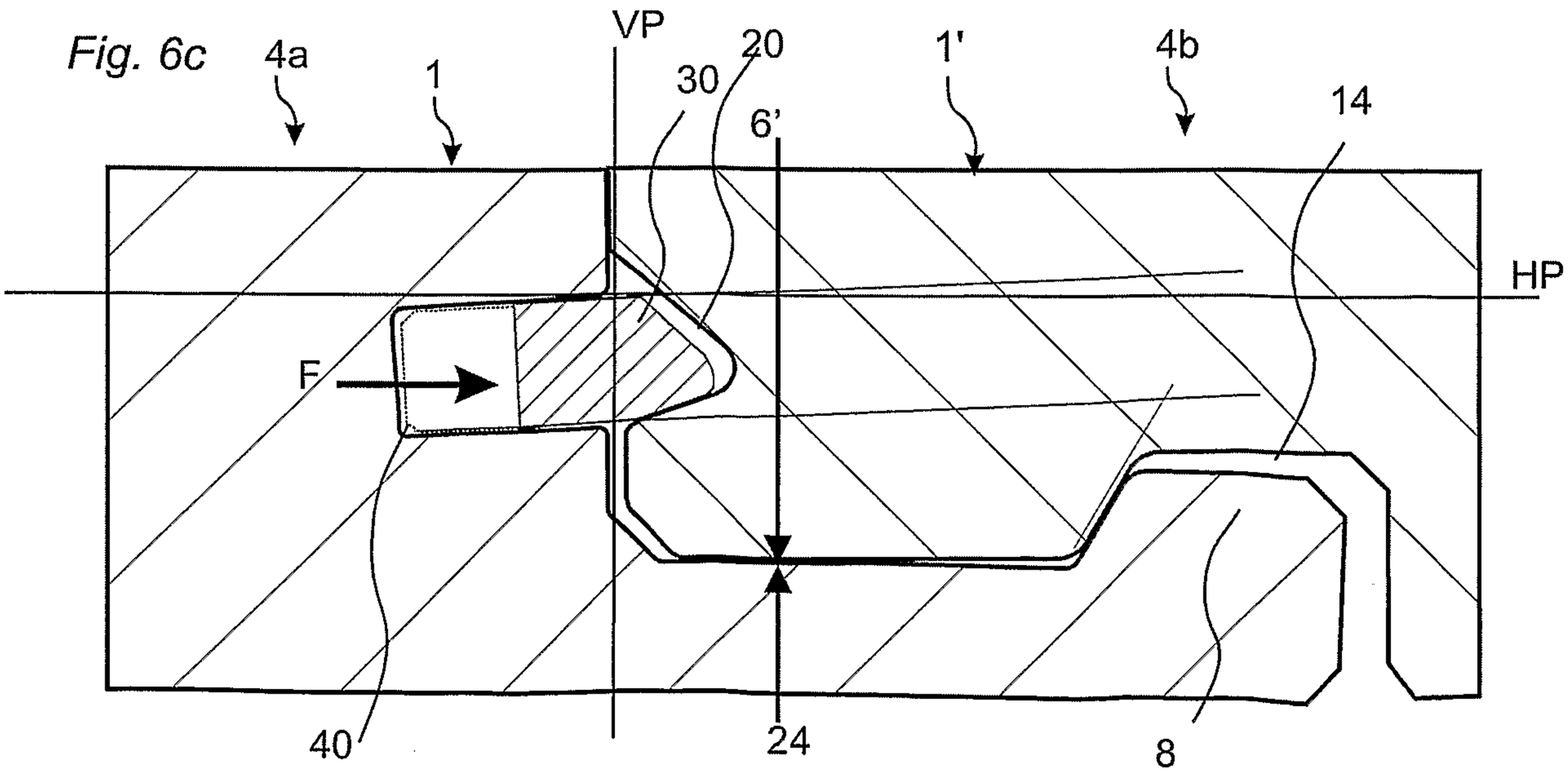


Fig. 7a

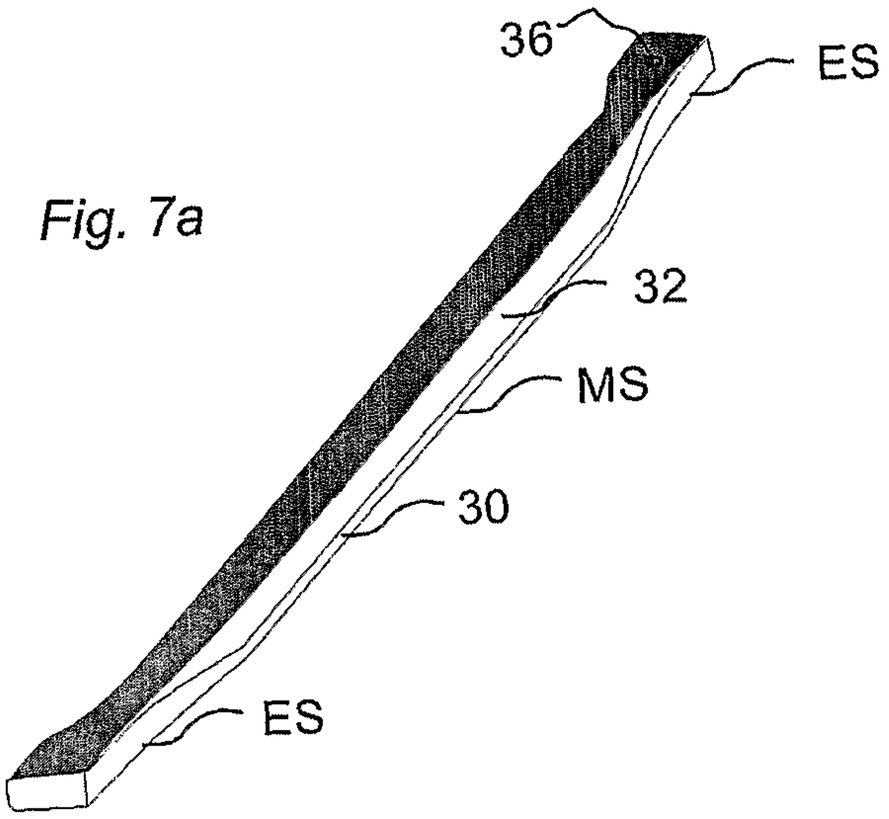


Fig. 7b

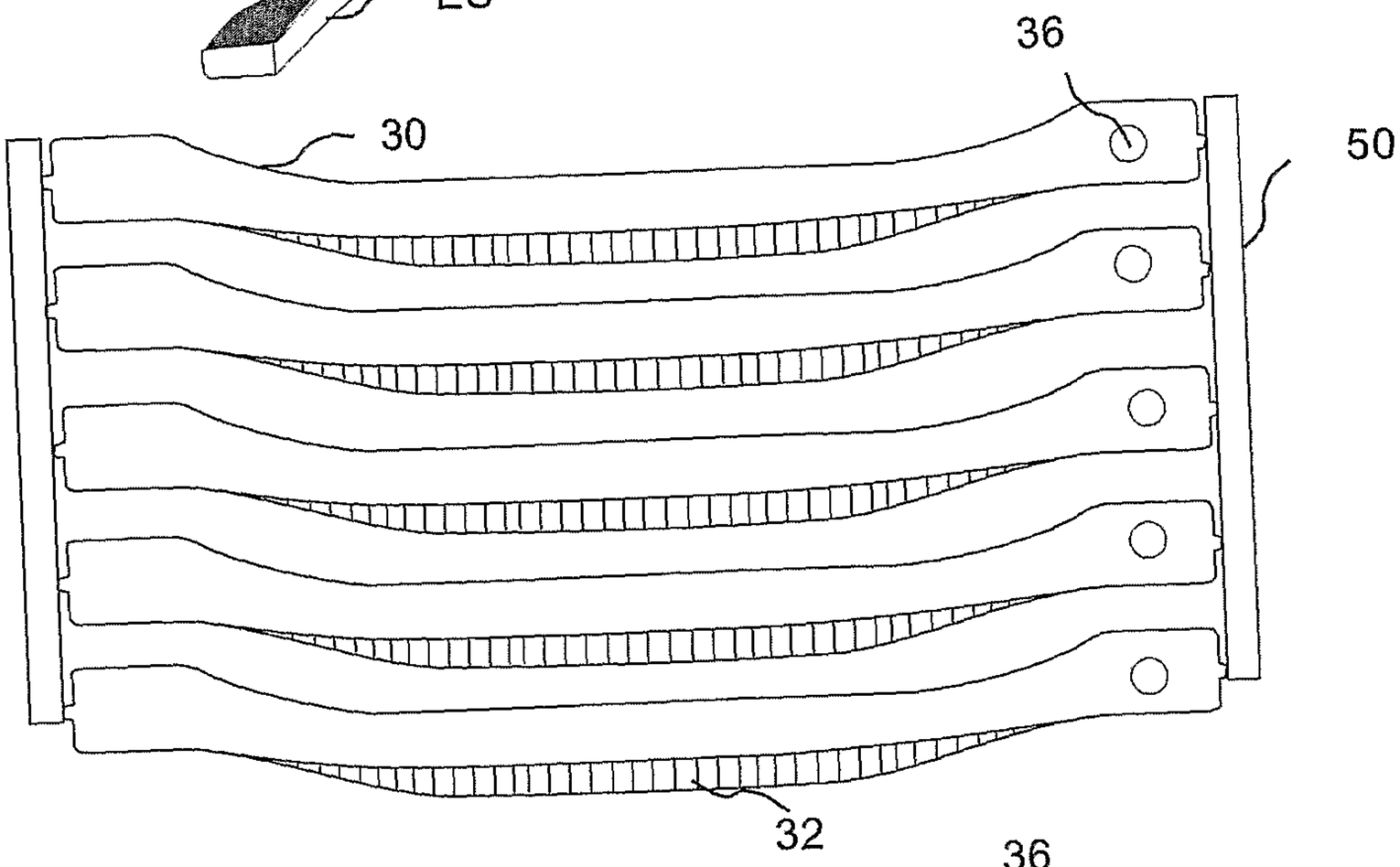


Fig. 7c

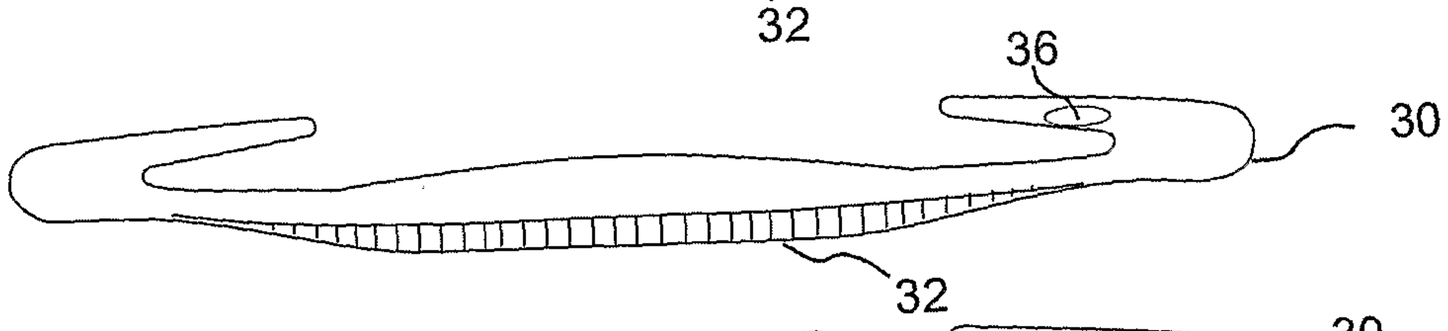


Fig. 7d

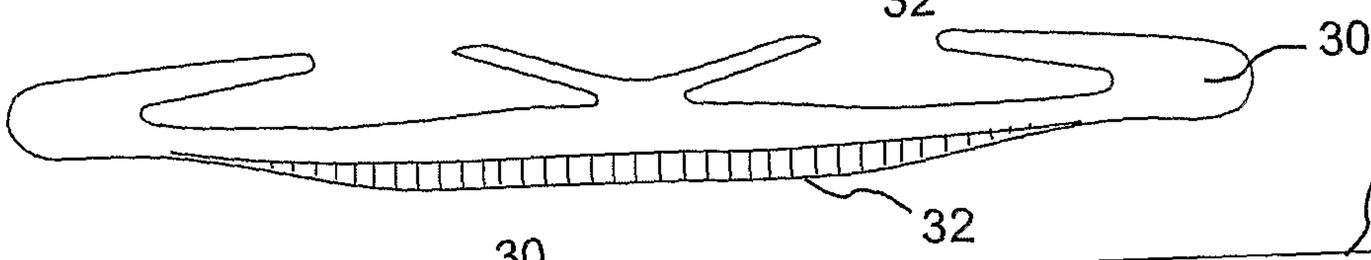


Fig. 7e

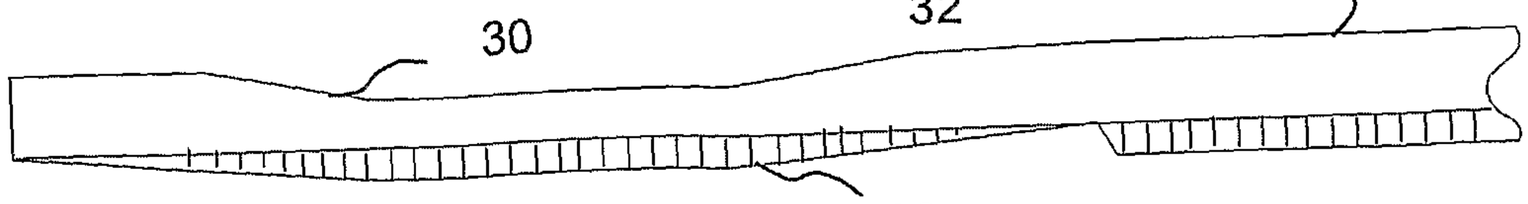


Fig. 7f

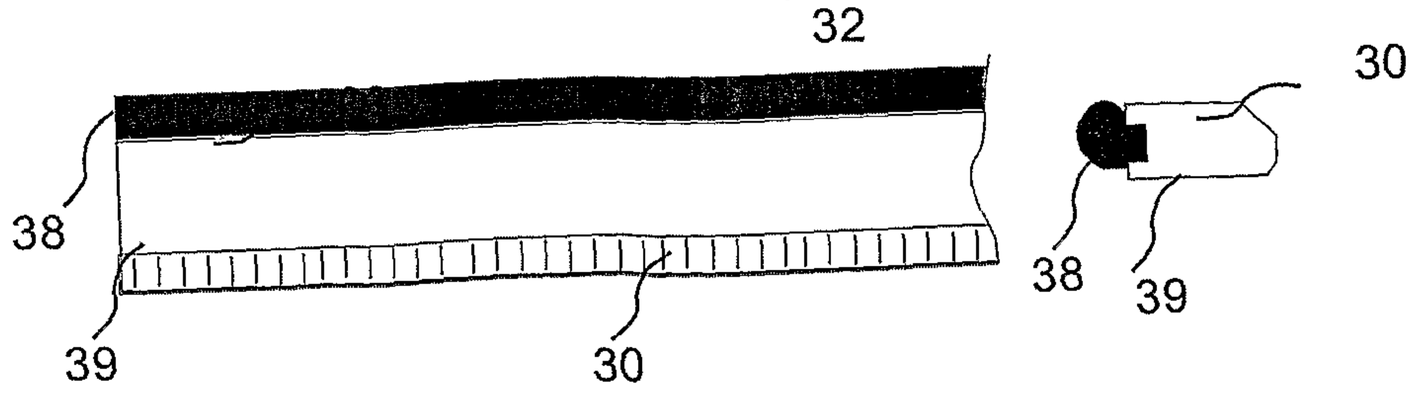


Fig. 8a

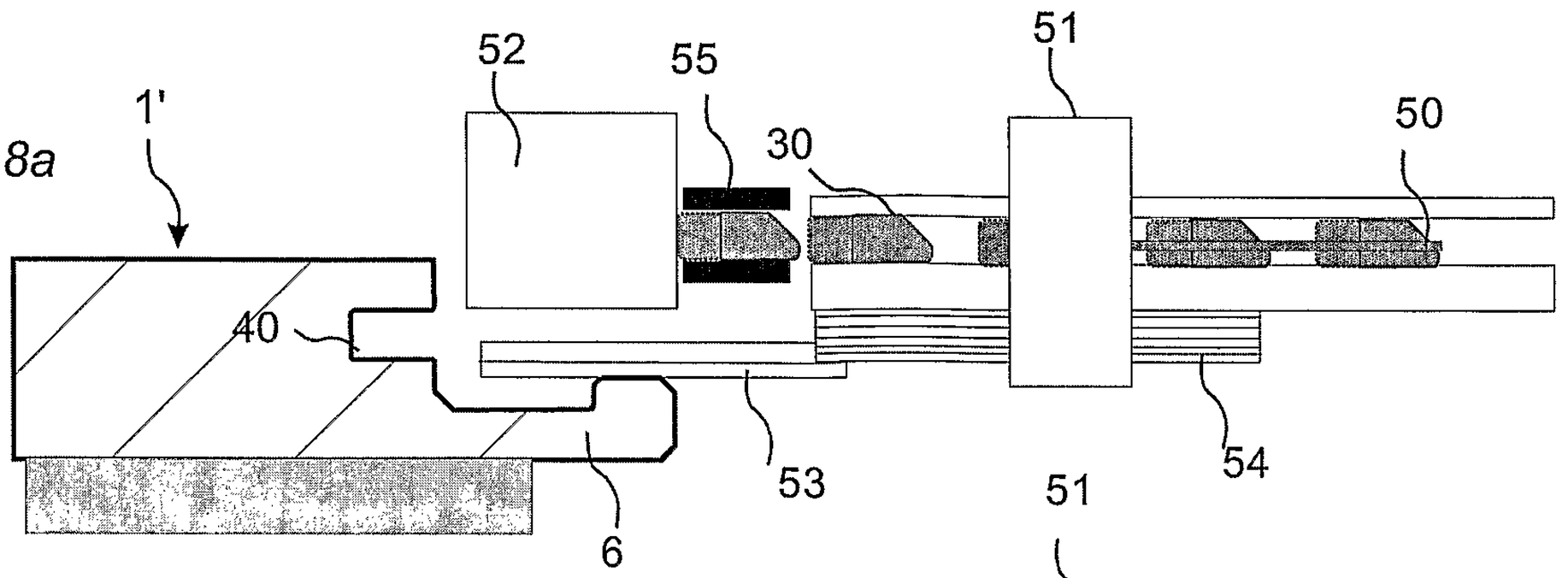


Fig. 8b

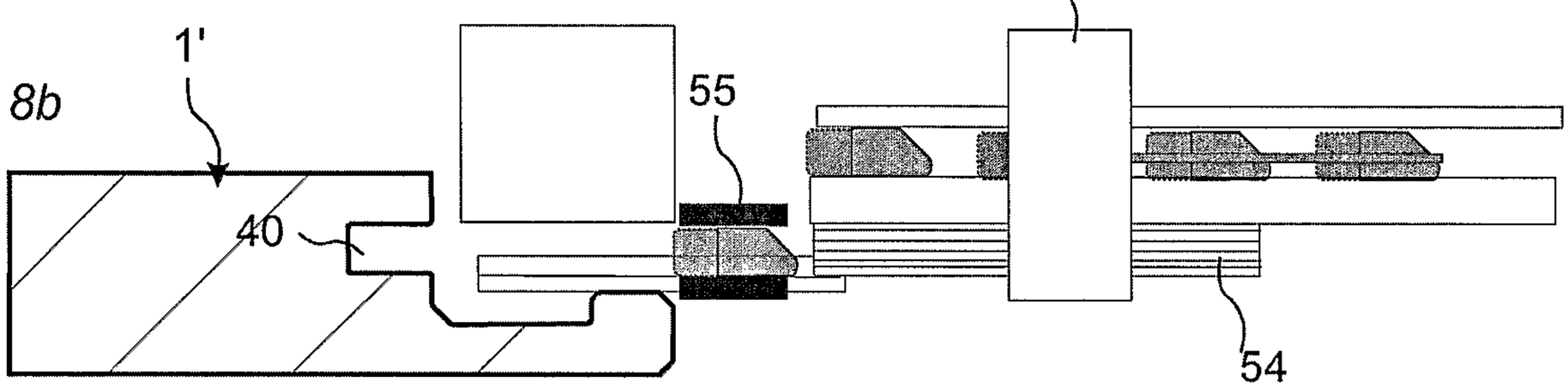


Fig. 8c

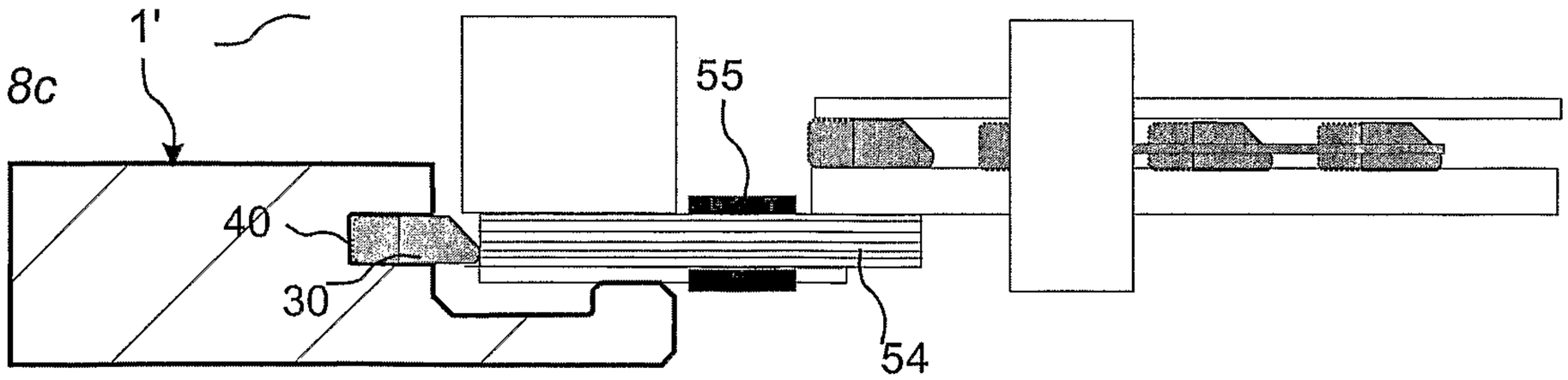


Fig. 8d

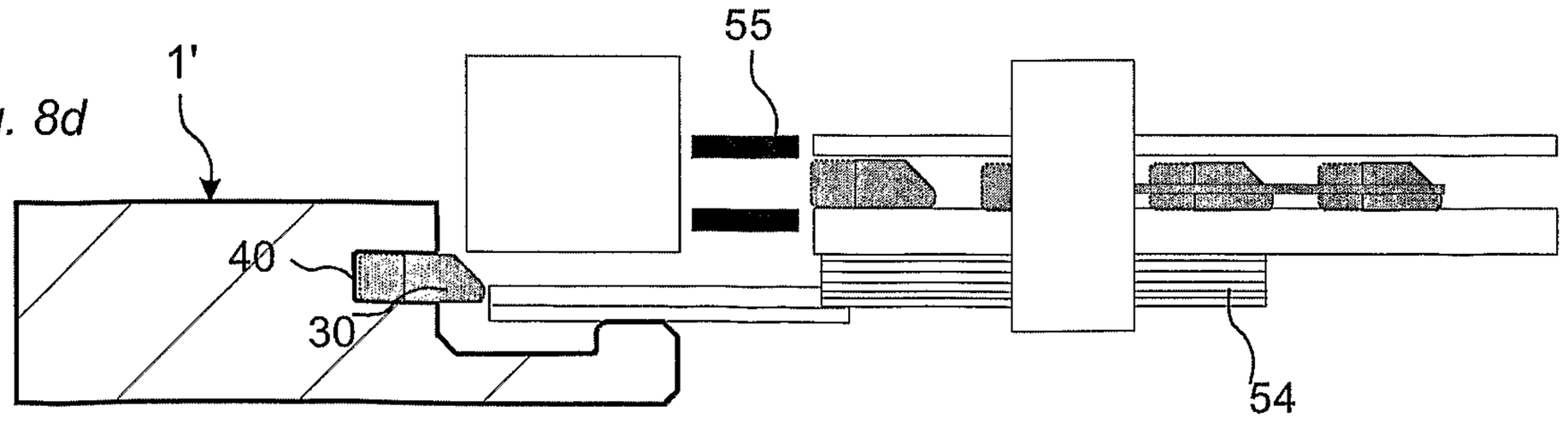


Fig. 9a

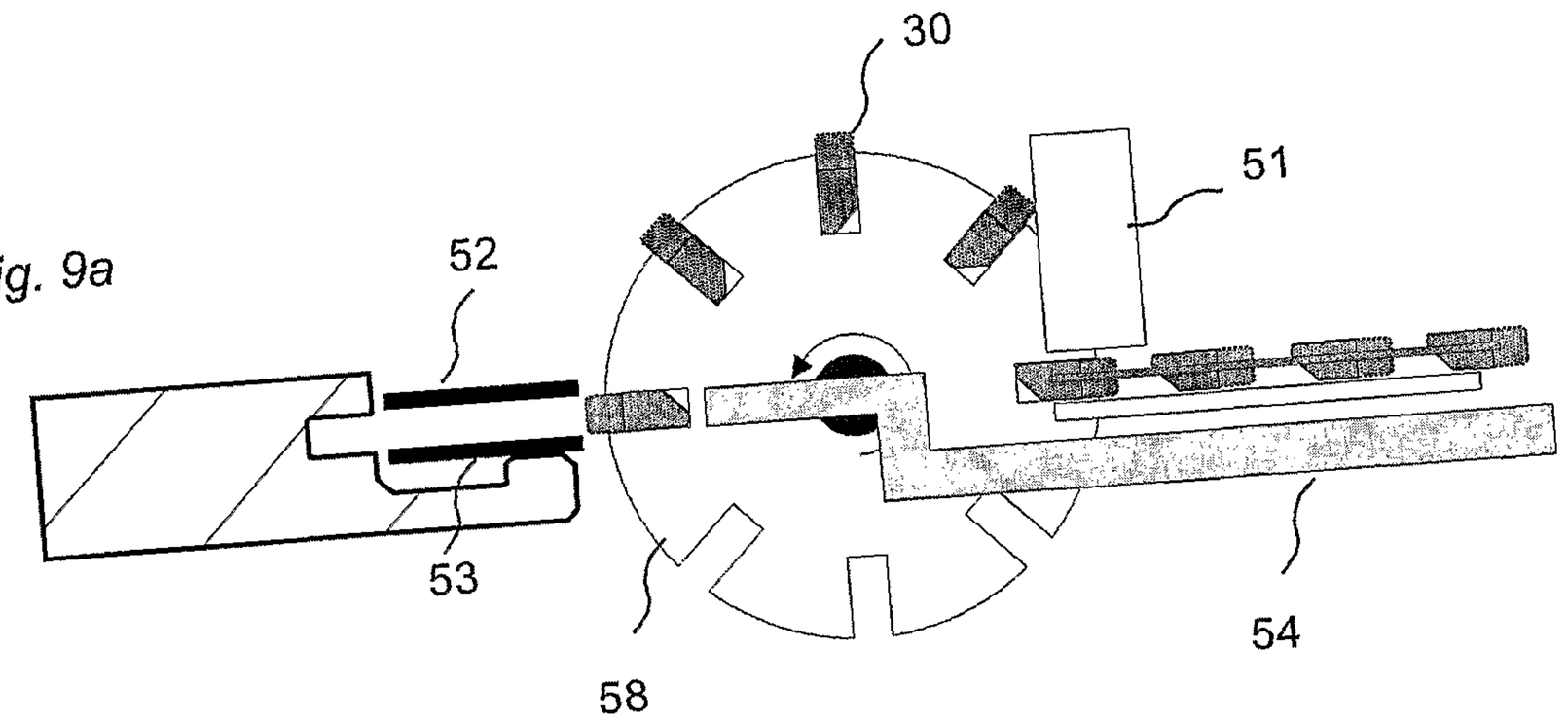


Fig.9b

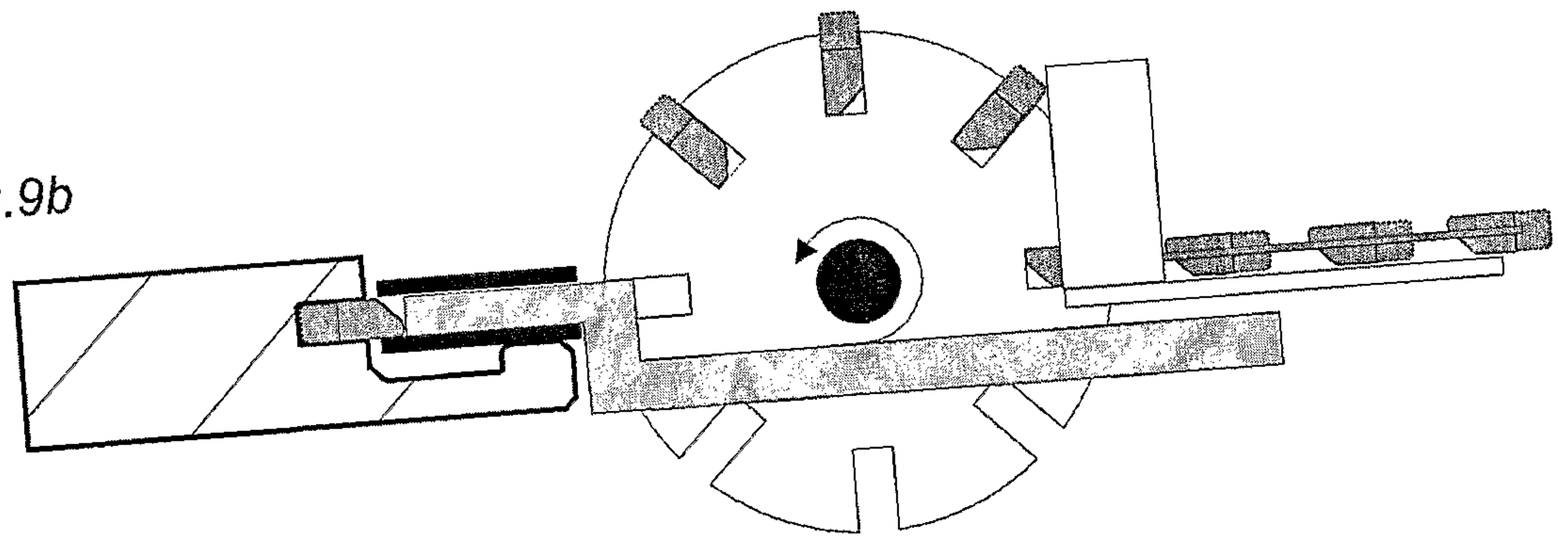


Fig. 9c

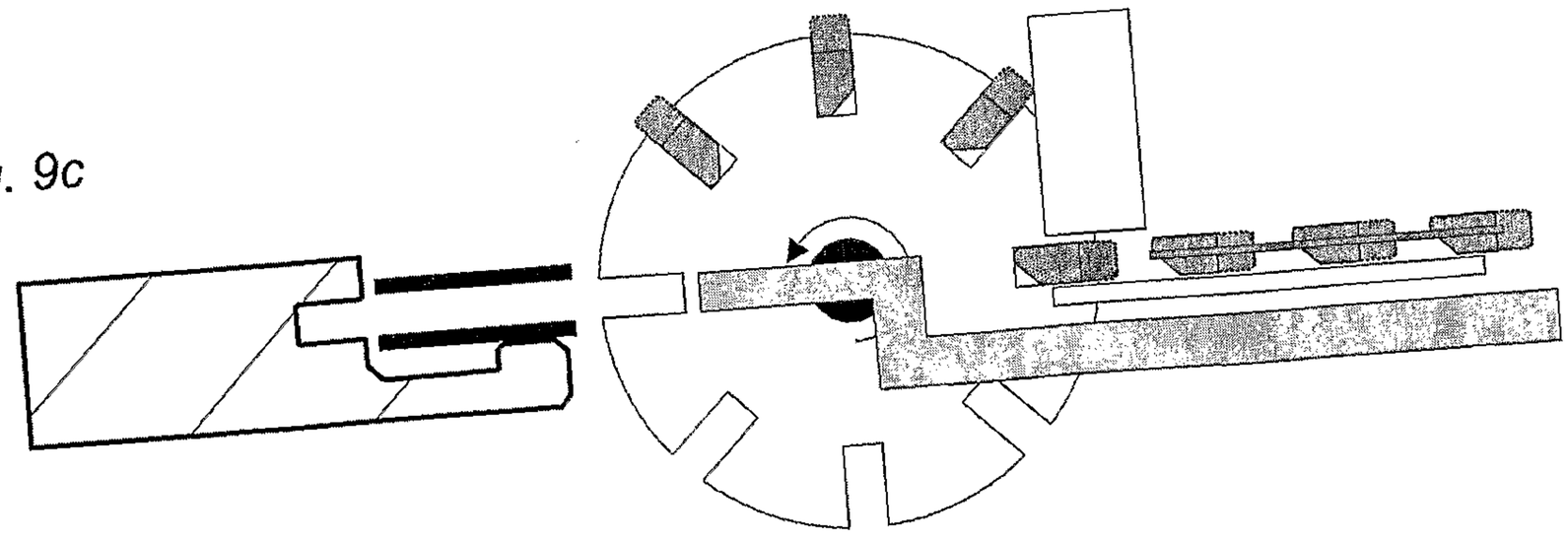


Fig. 9d

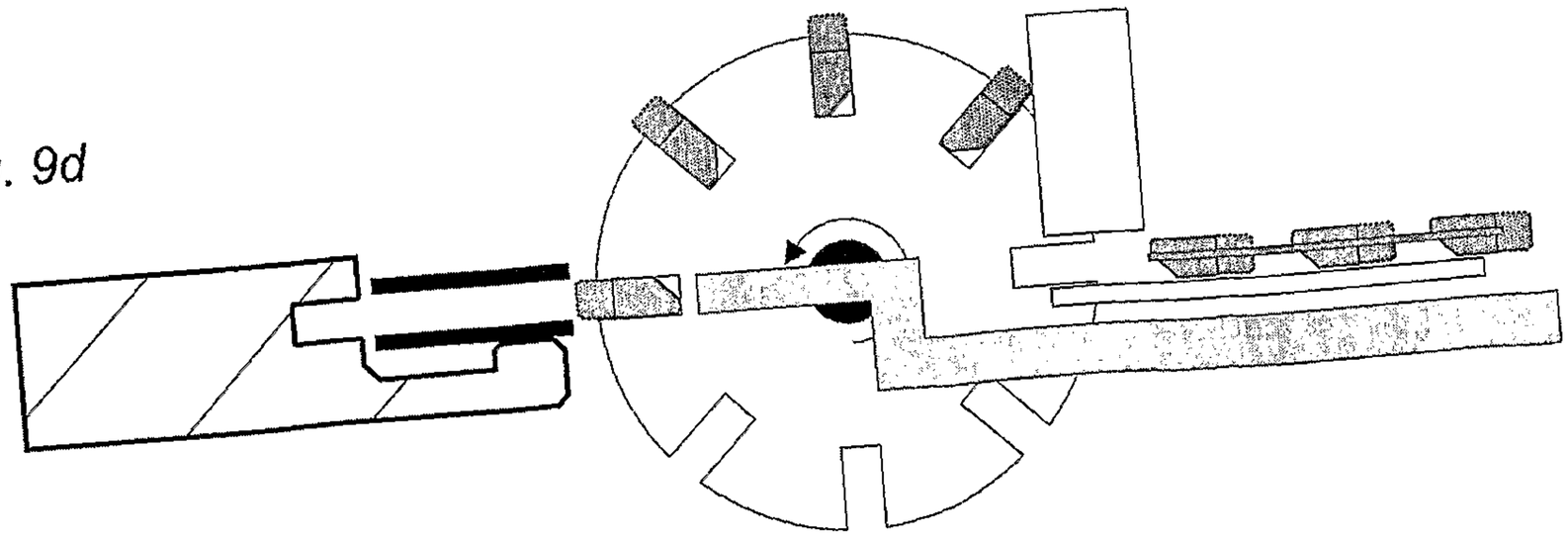


Fig. 10a

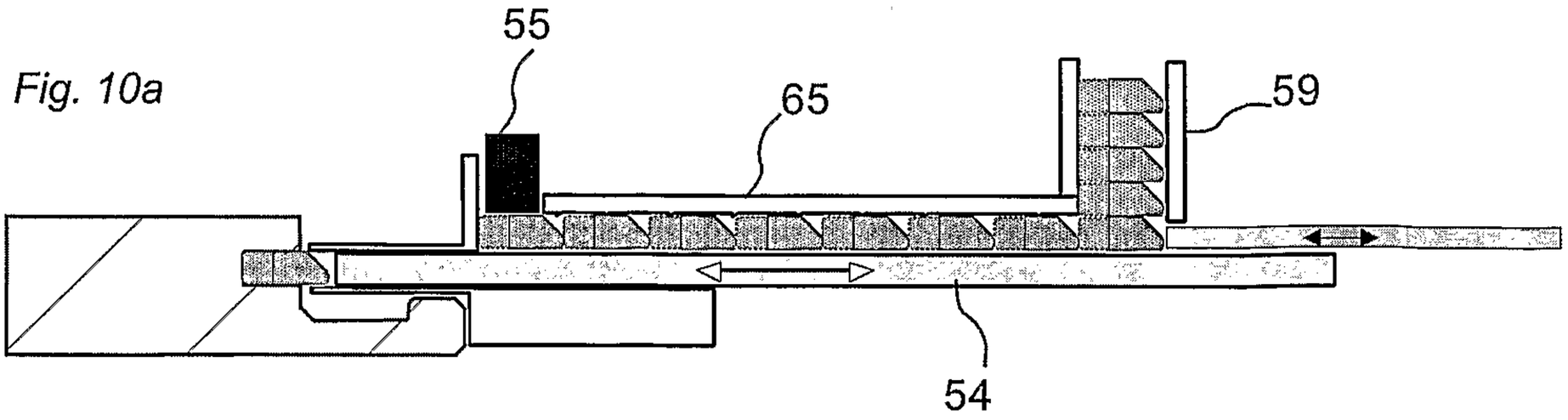


Fig.10b

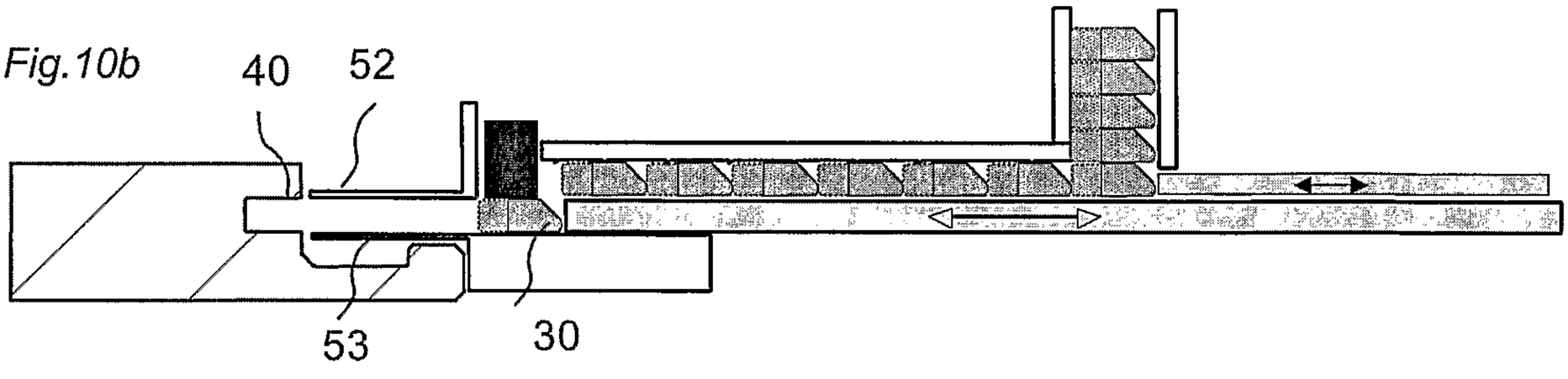


Fig. 10c

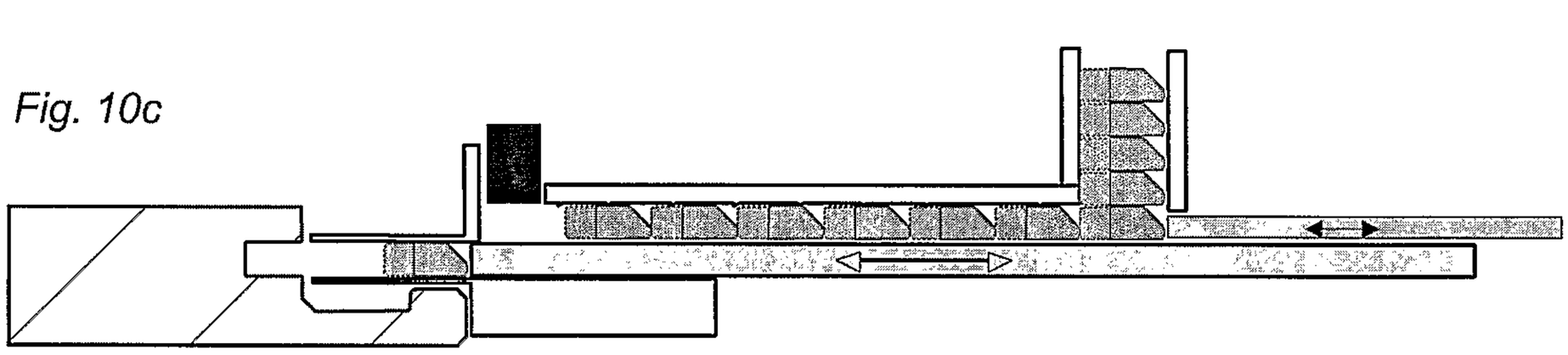


Fig. 10d

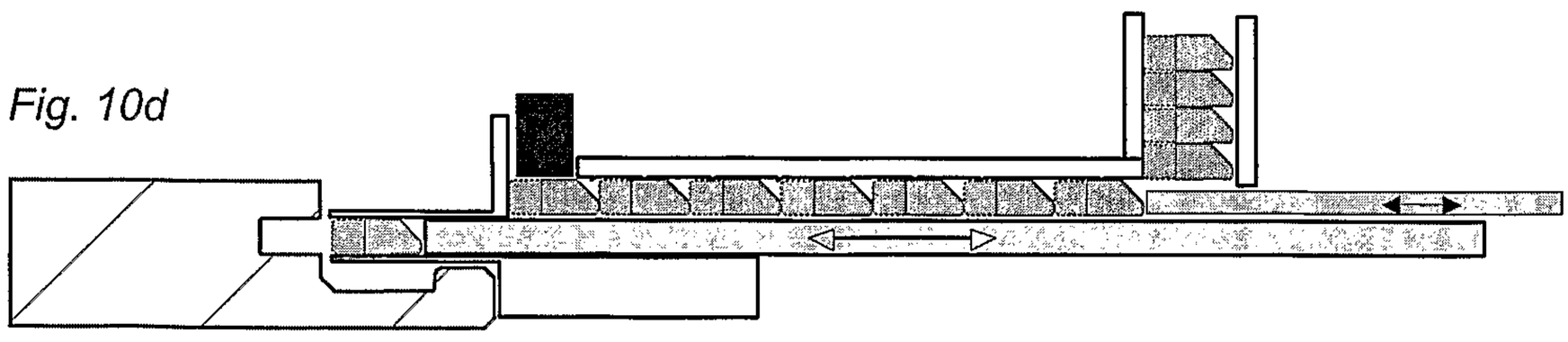


Fig. 10e

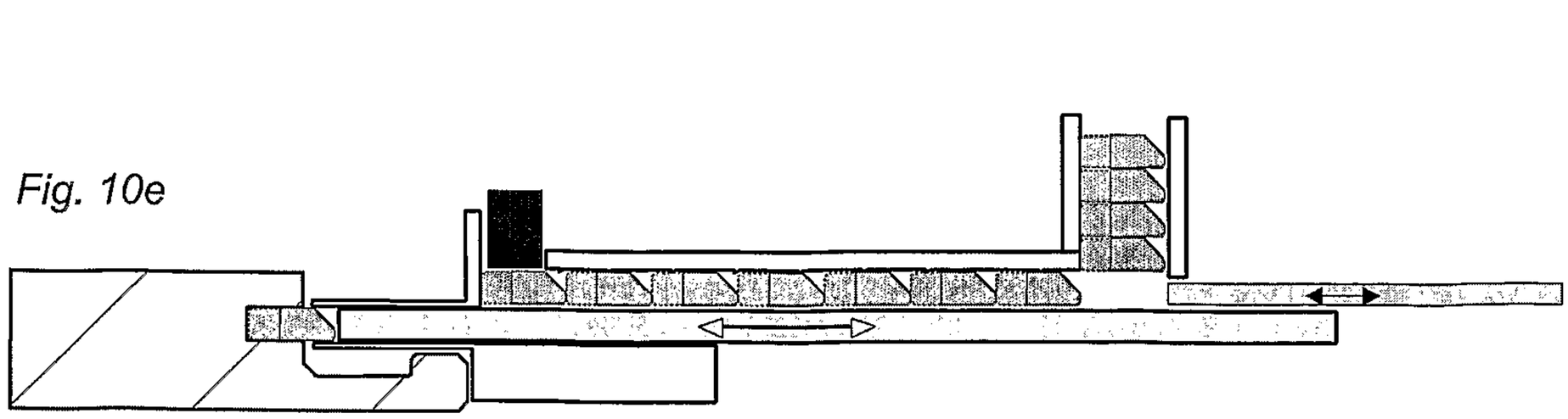


Fig. 11a

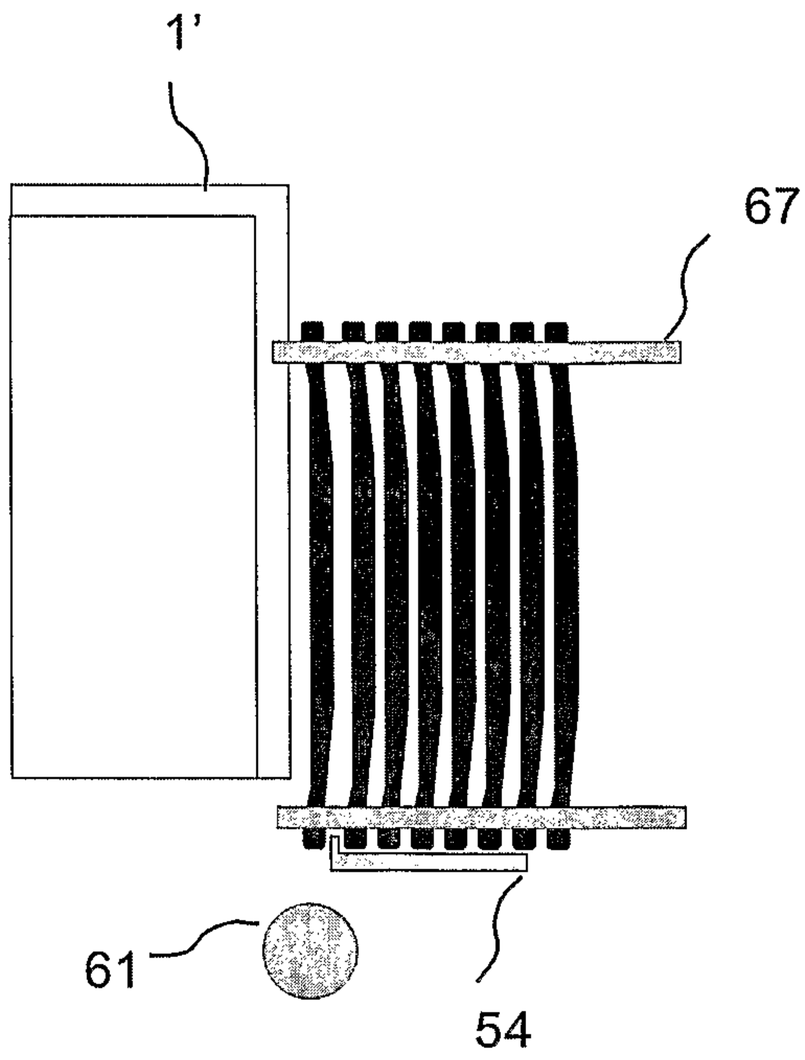


Fig. 11b

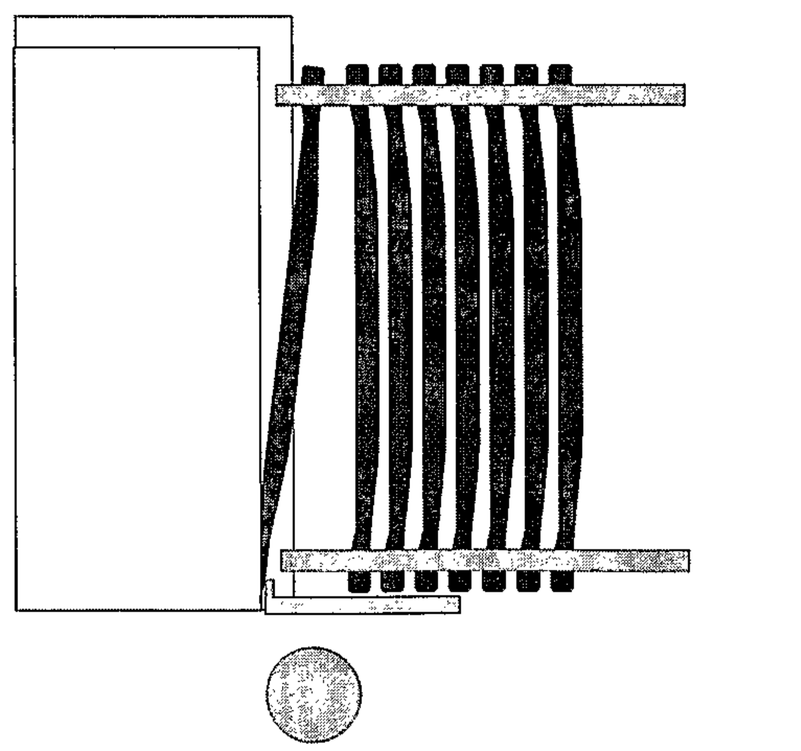


Fig. 11c

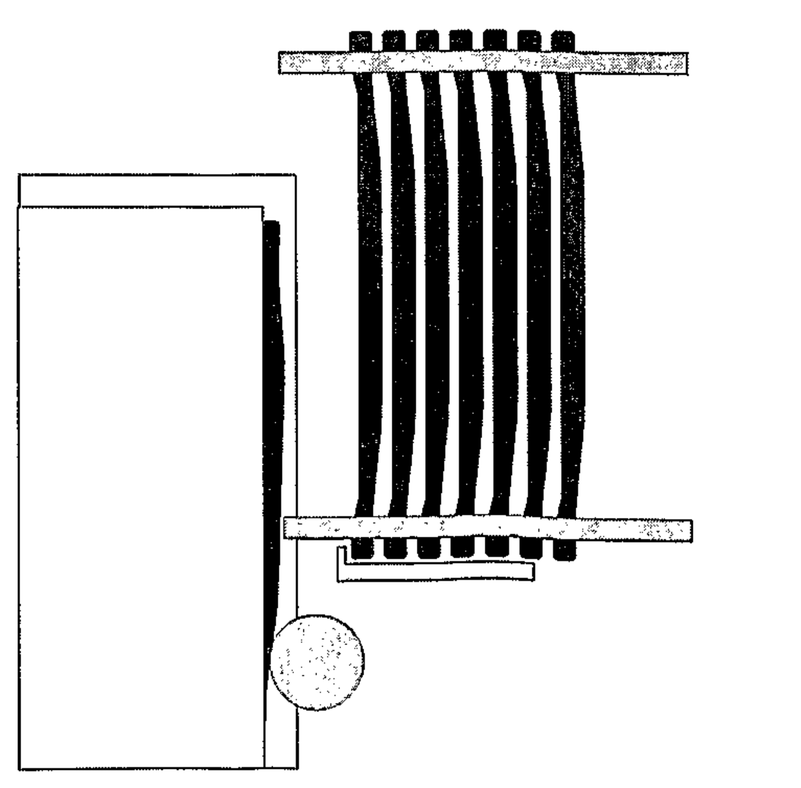


Fig. 12a

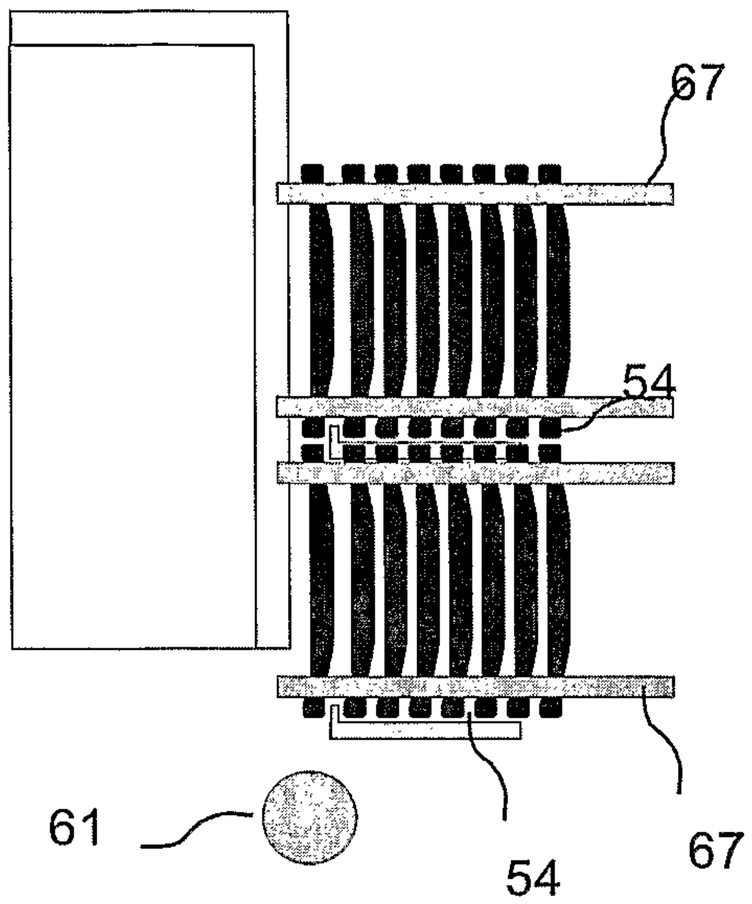


Fig. 12b

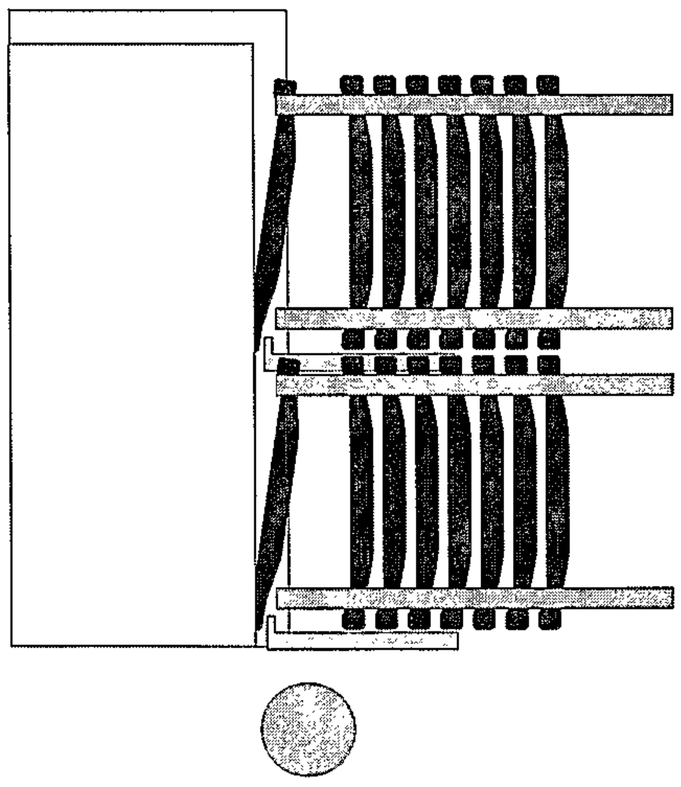


Fig. 12c

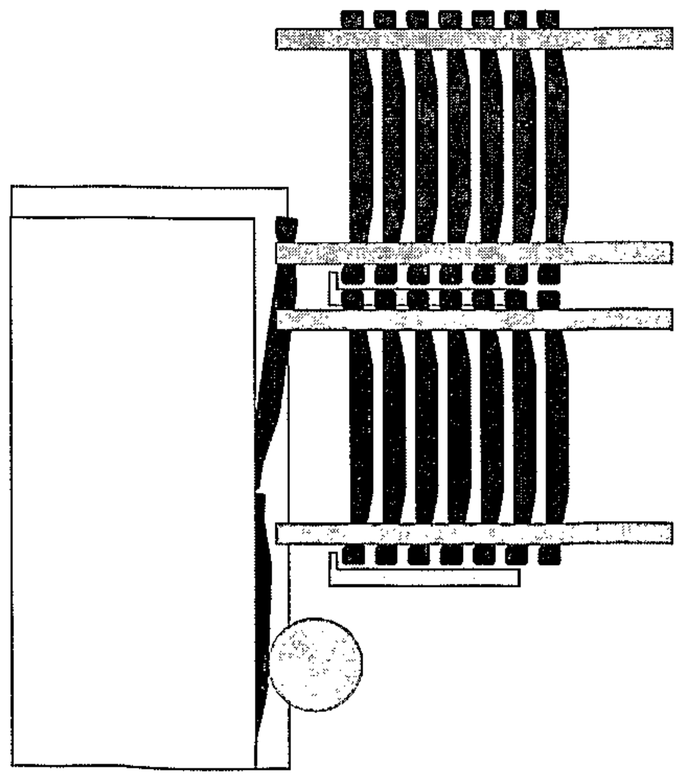


Fig.13a

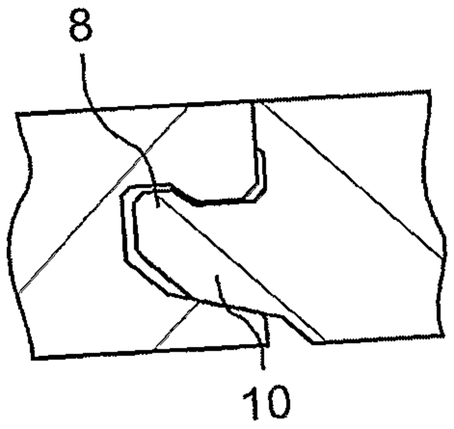


Fig. 13b

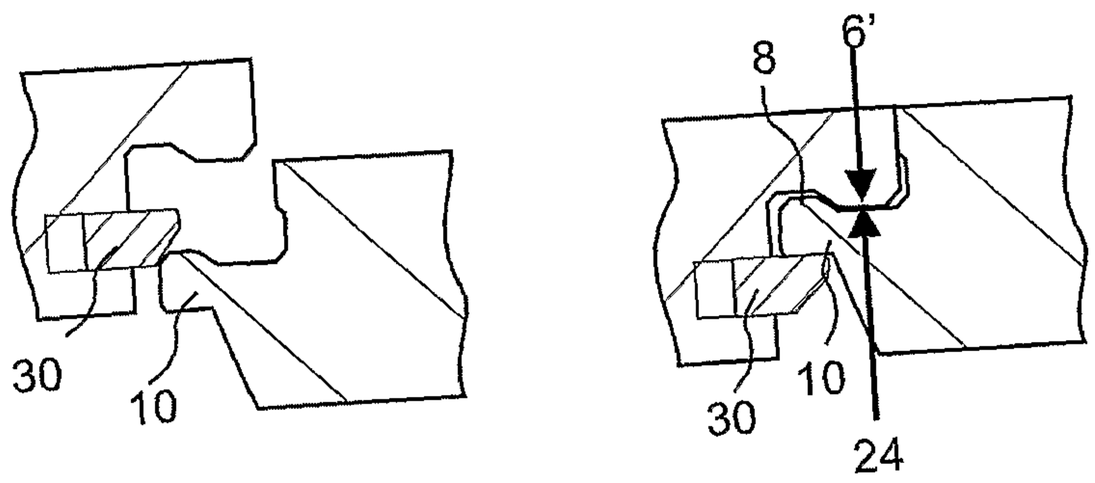


Fig.13c

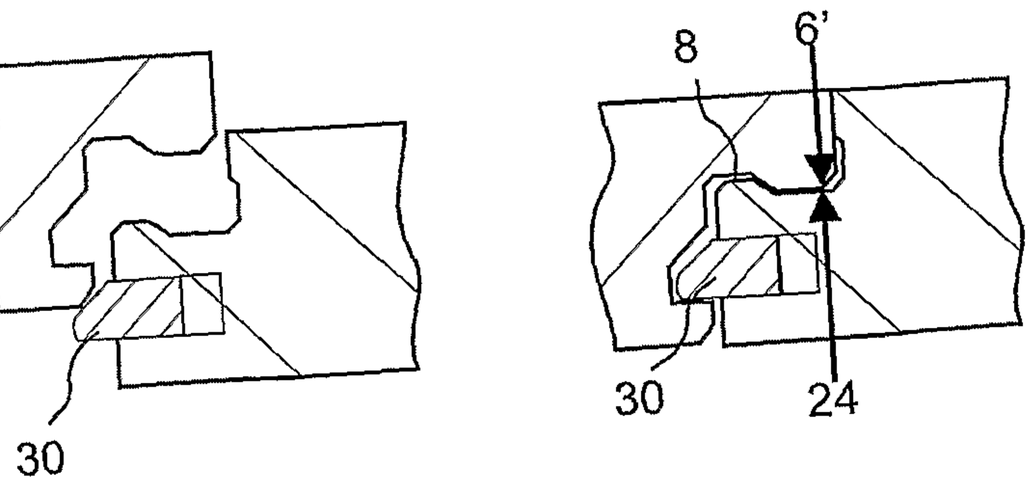


Fig. 13d

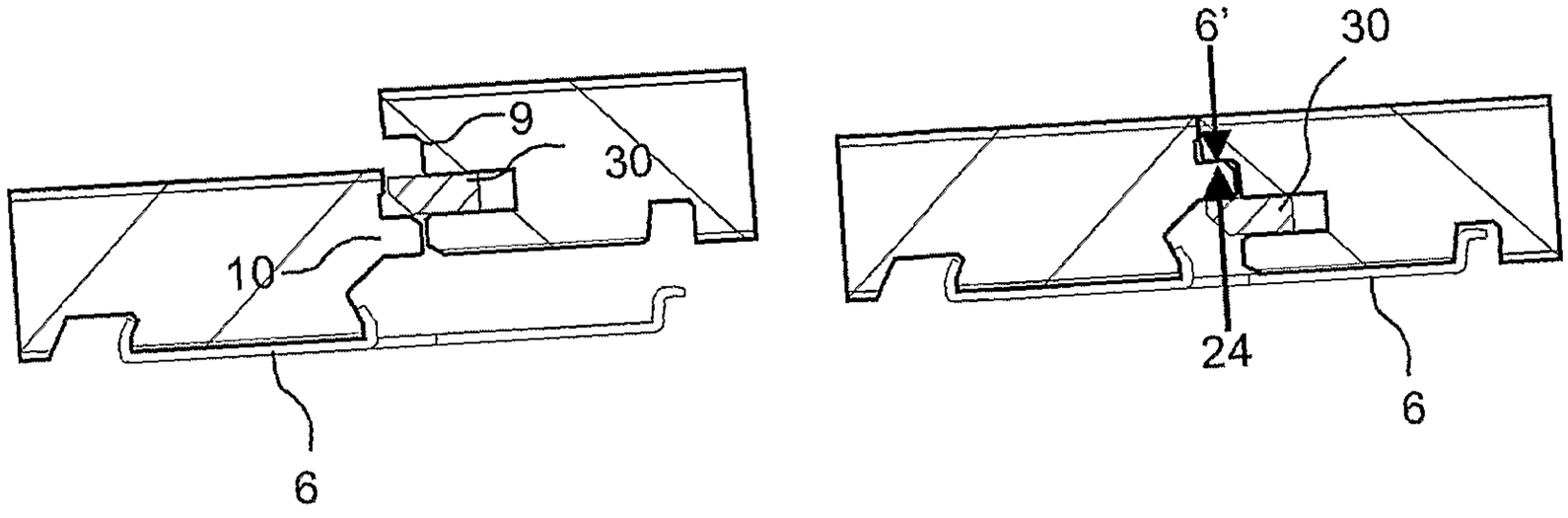


Fig.13e

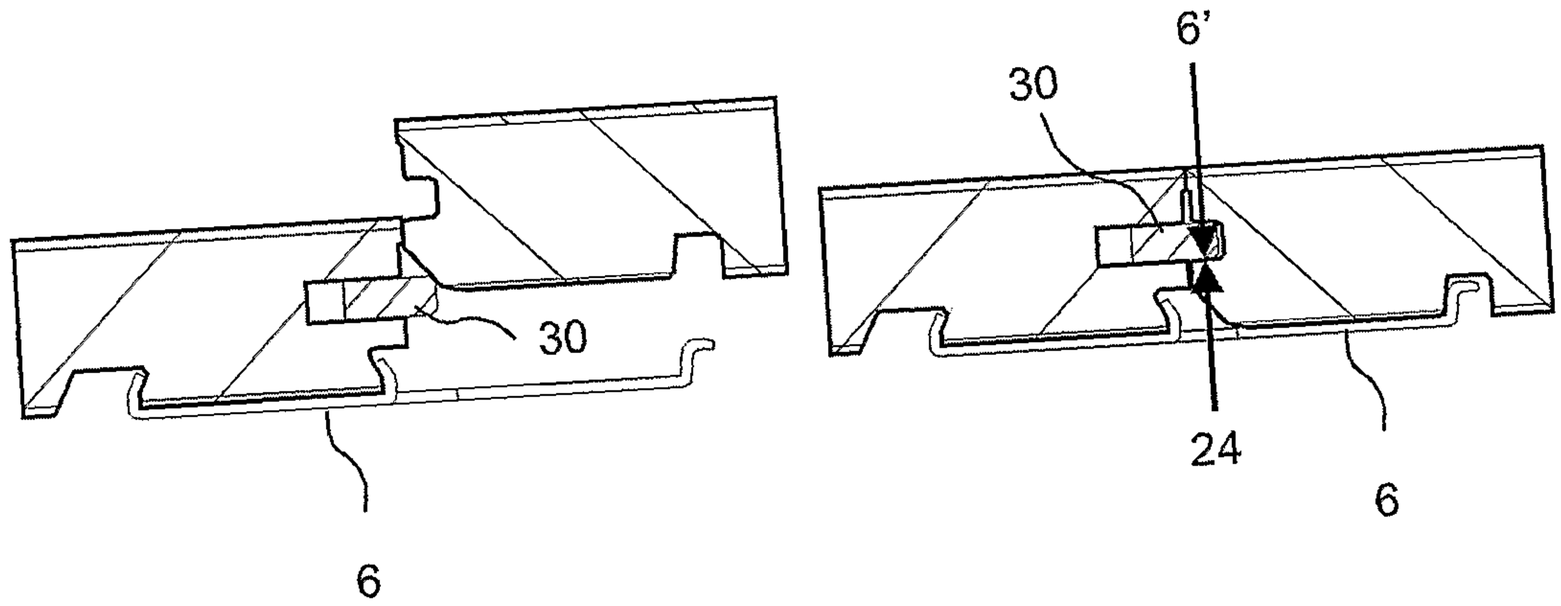


Fig.13f

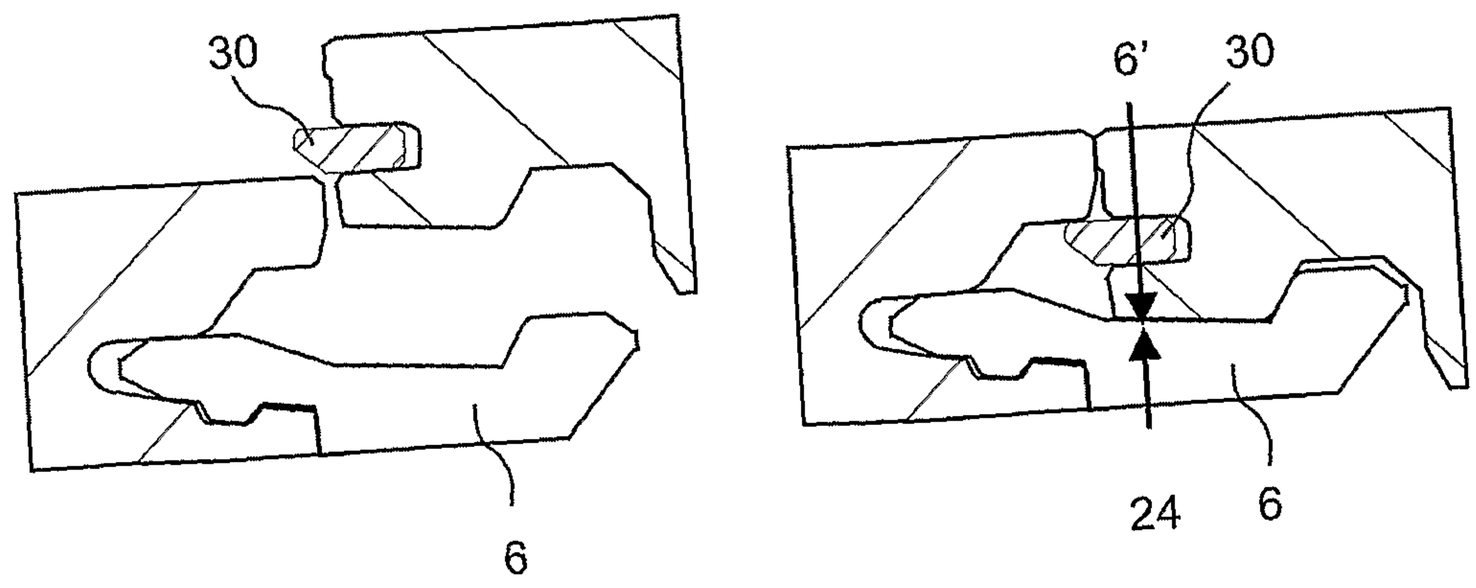


Fig.14a

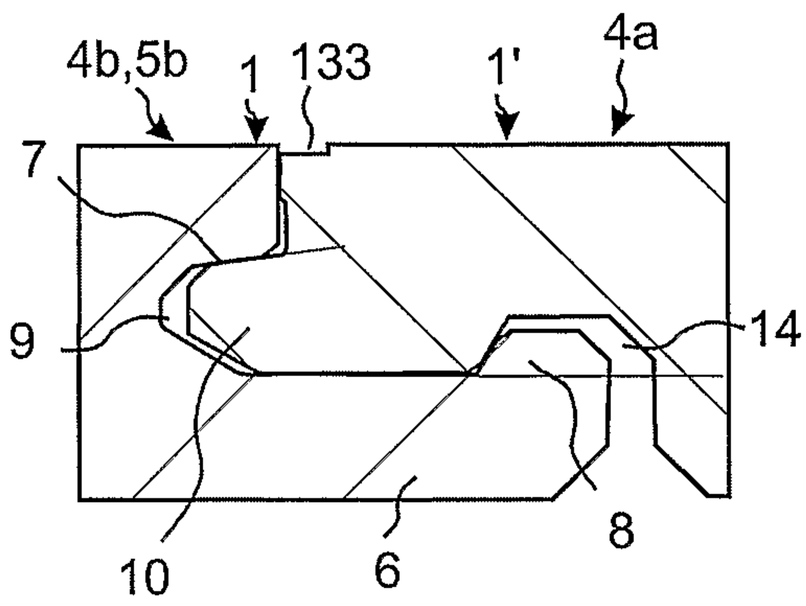


Fig14b

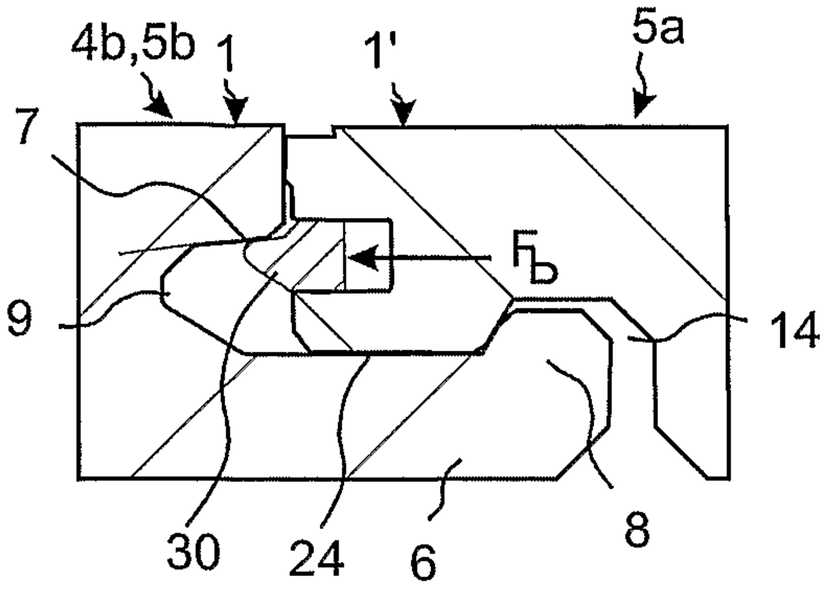


Fig14c

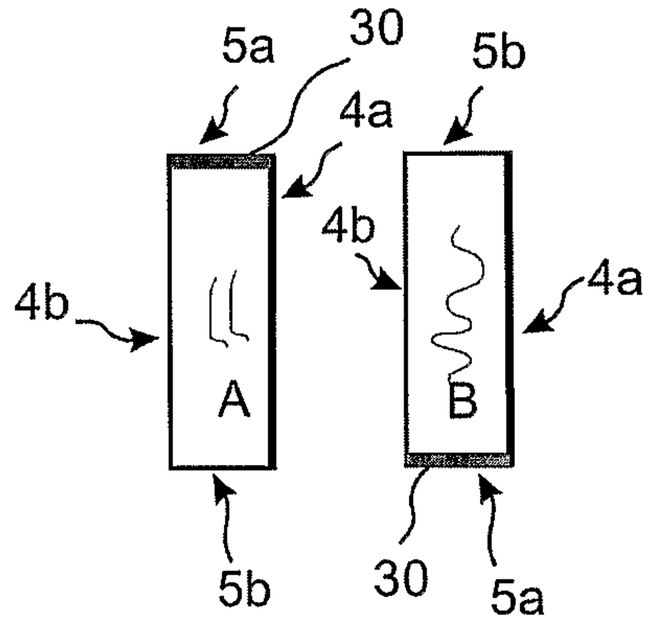


Fig14d

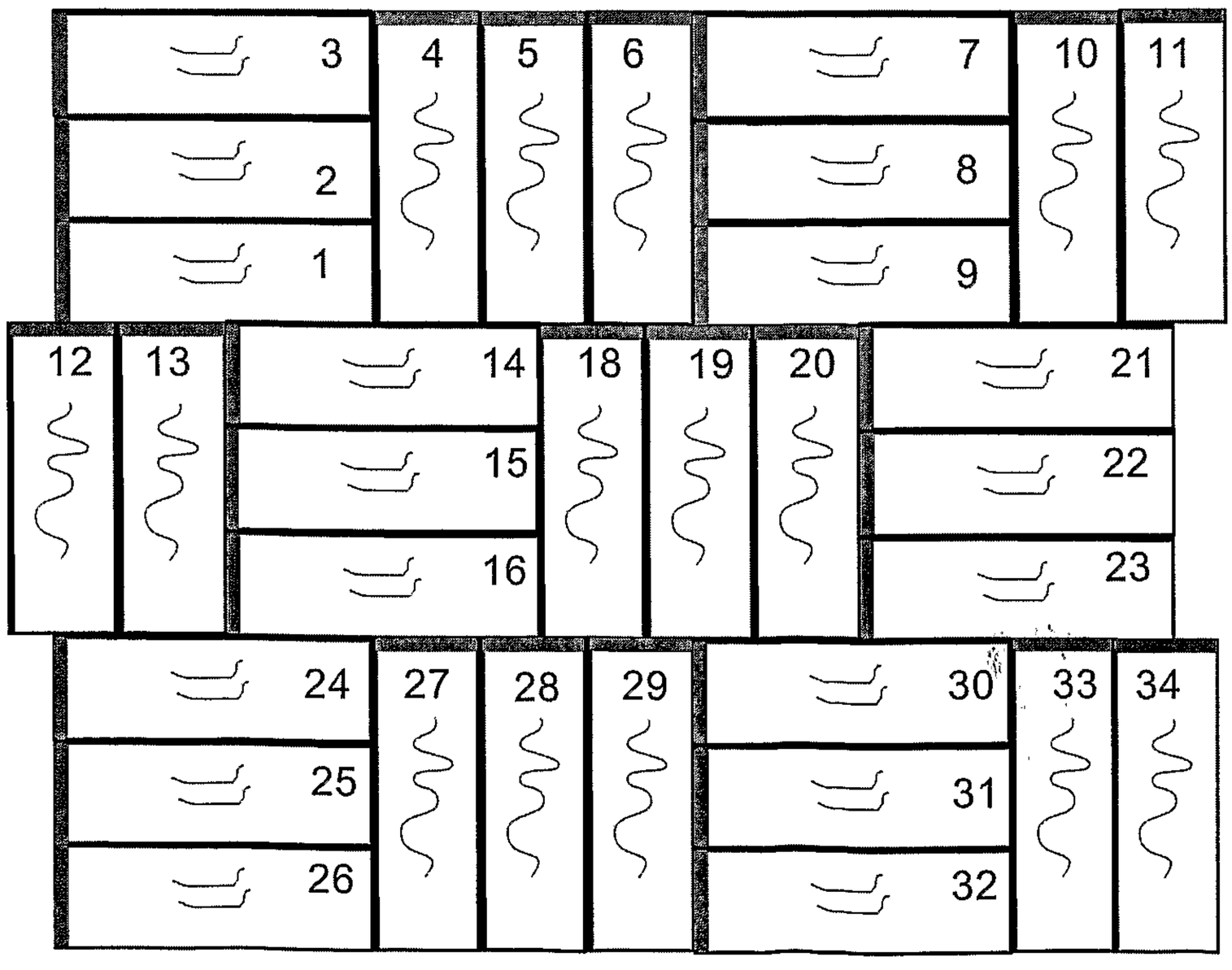


Fig. 15a

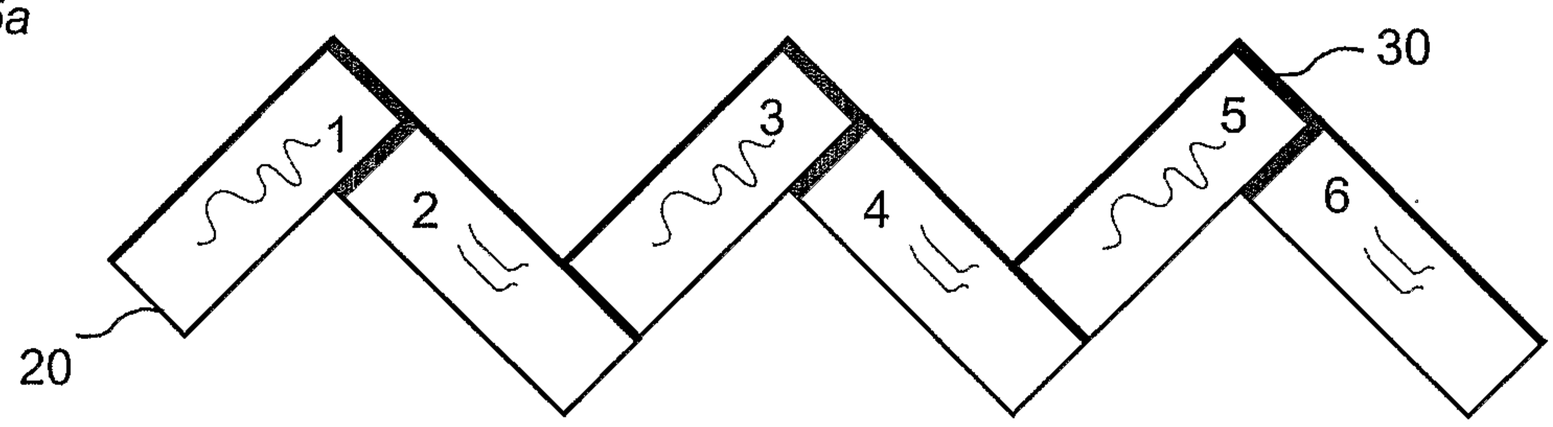


Fig. 15b

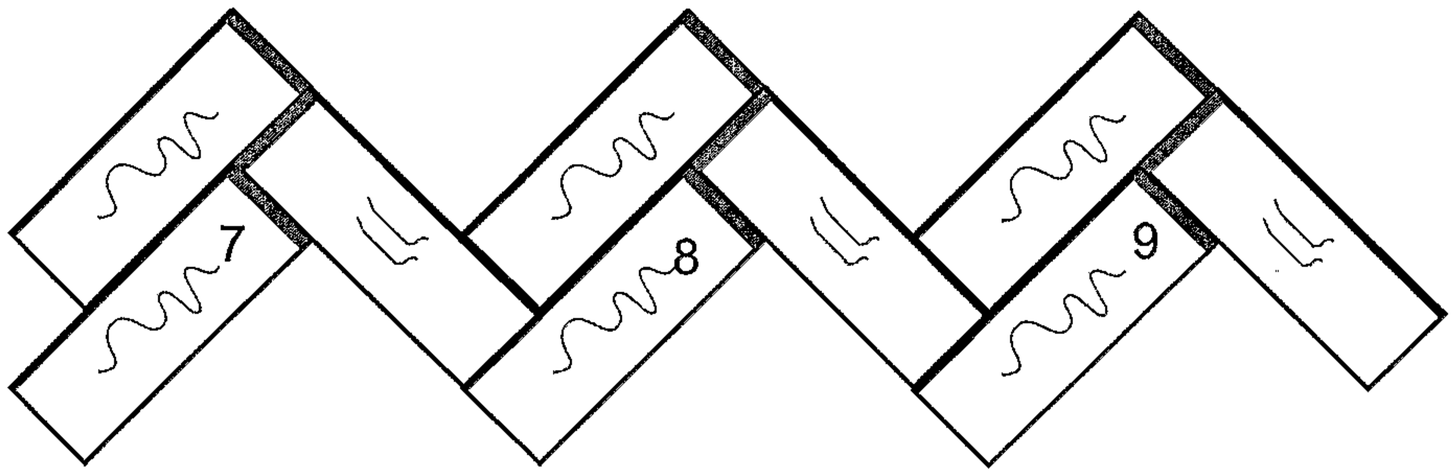


Fig. 15c

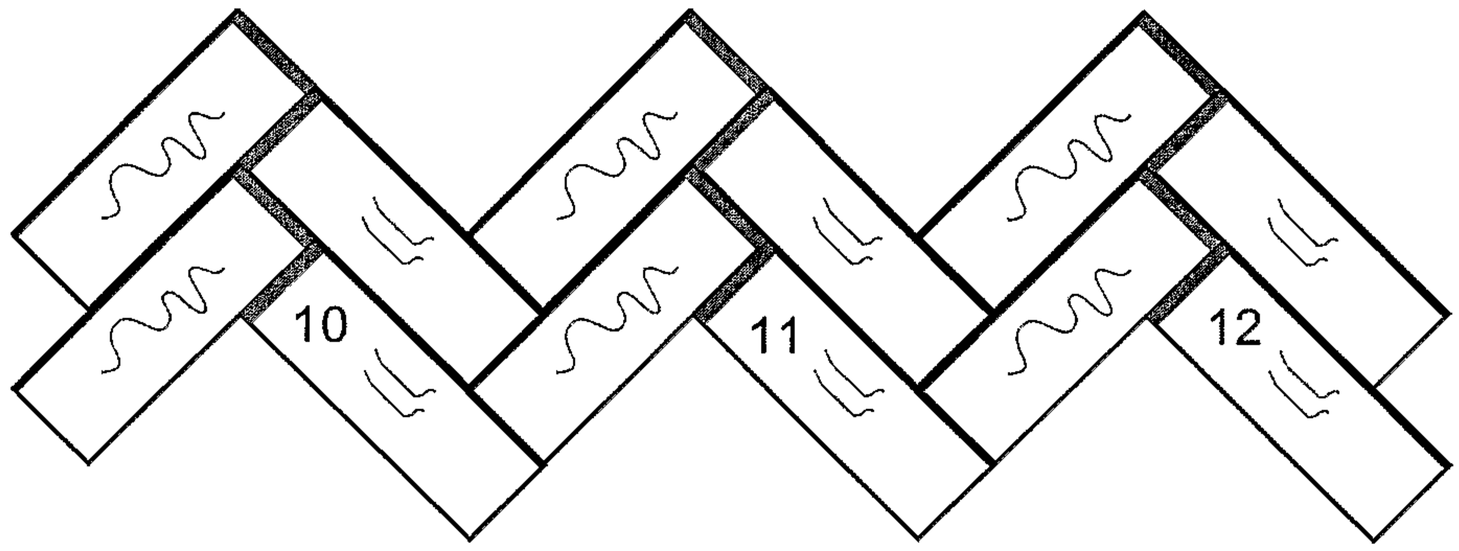


Fig. 15d

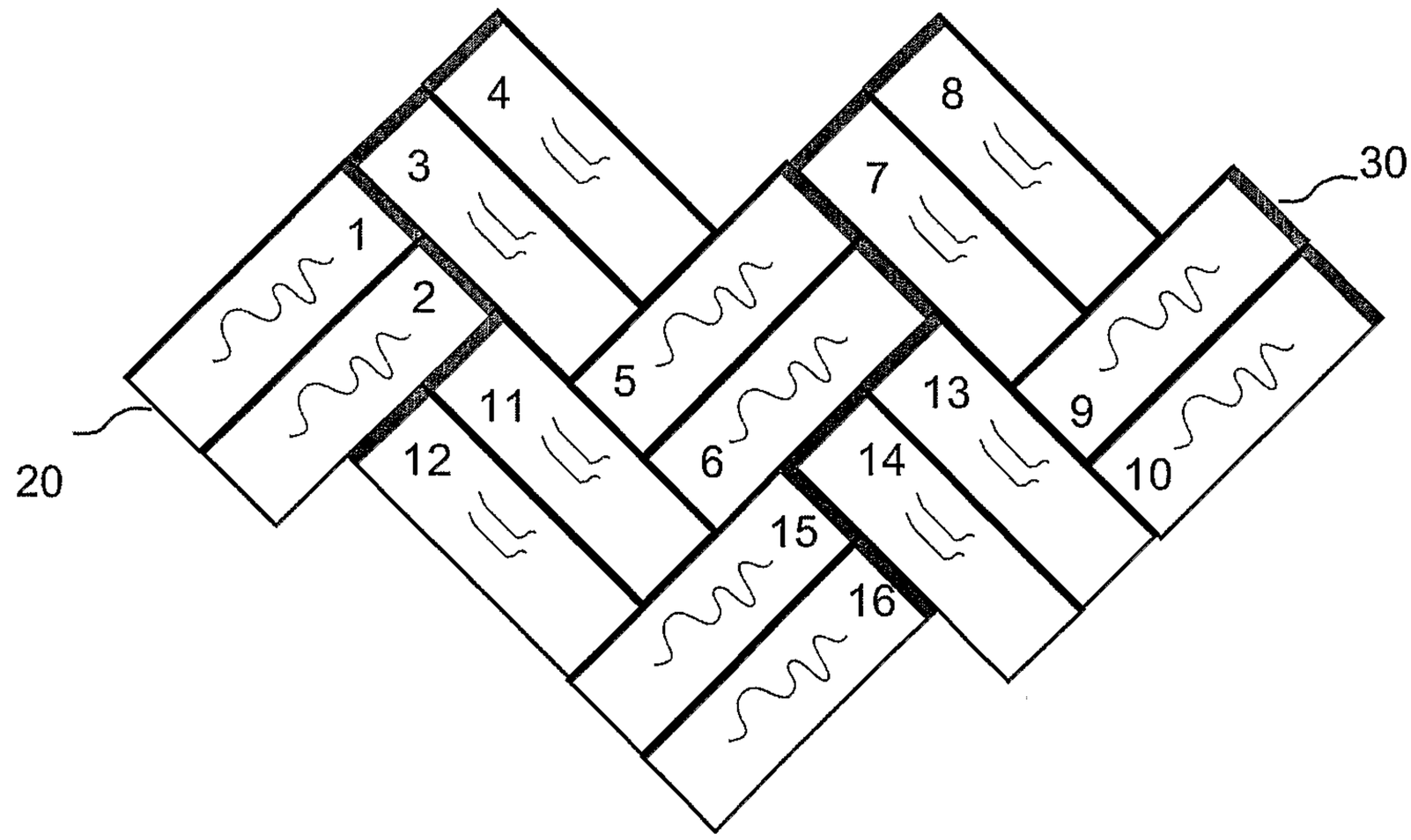


Fig. 16a

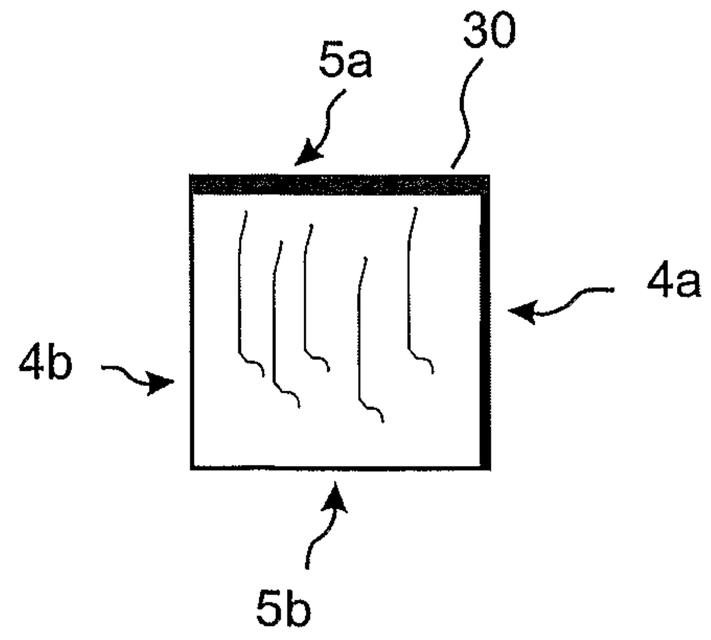


Fig. 16b

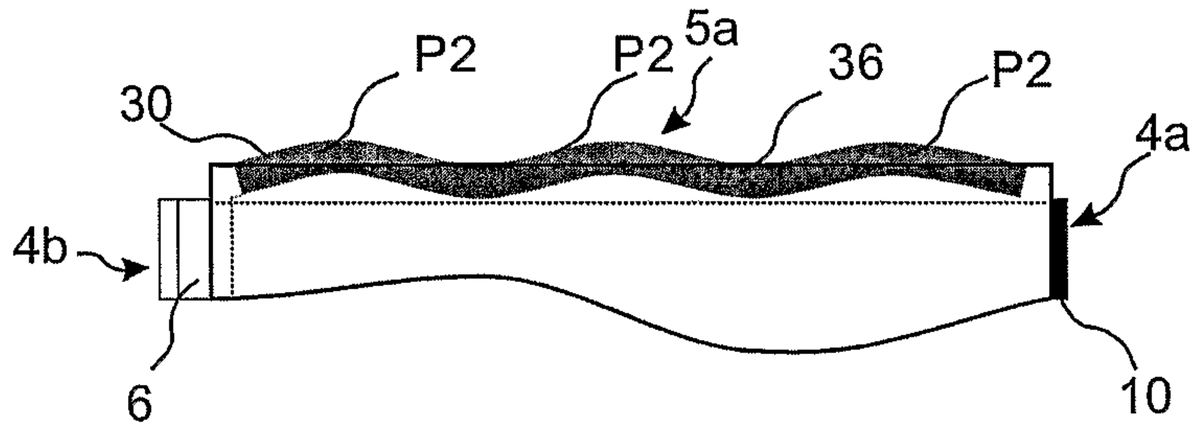


Fig. 16c

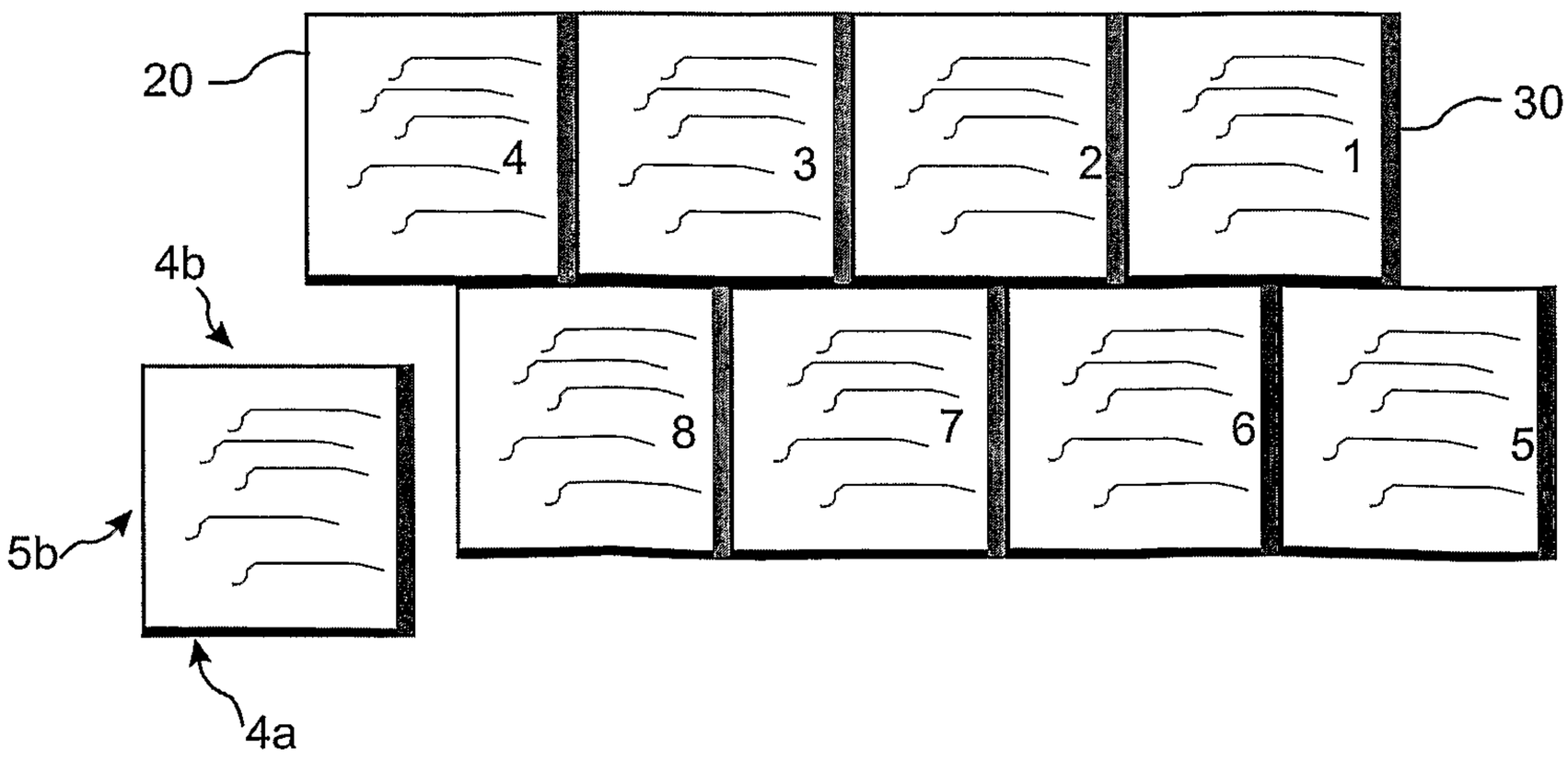


Fig. 16d

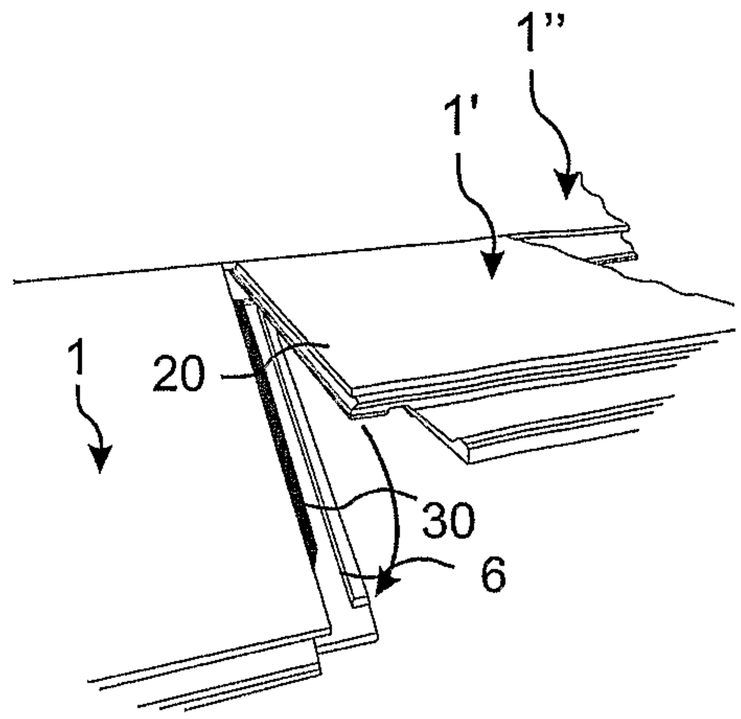


Fig. 16e

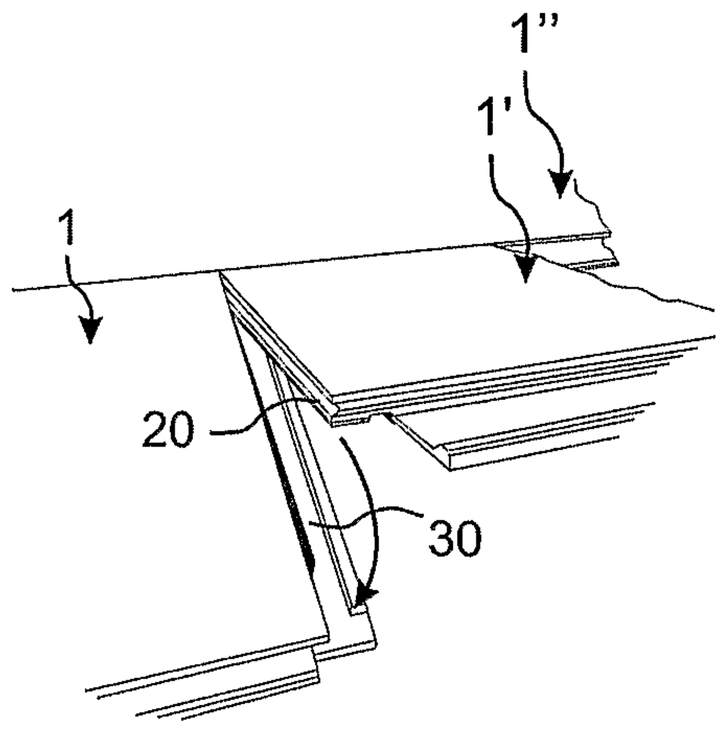


Fig. 16f

Fig. 17a

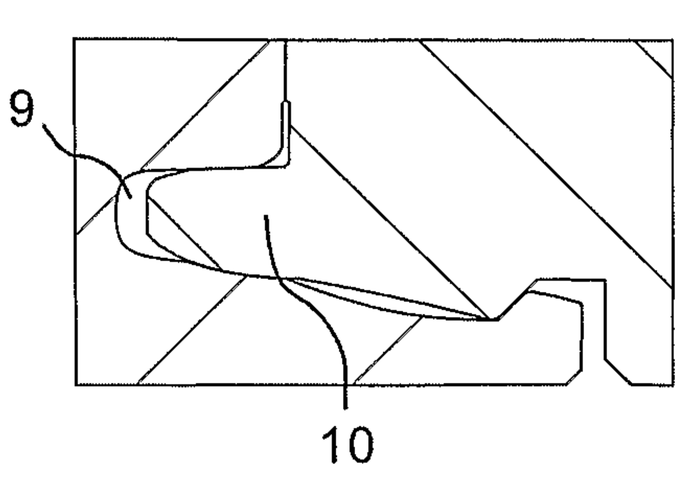


Fig. 17b

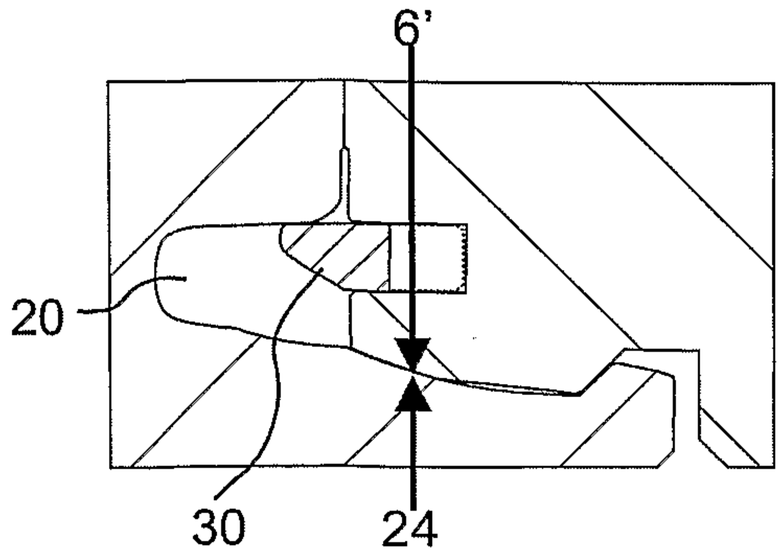


Fig. 17c

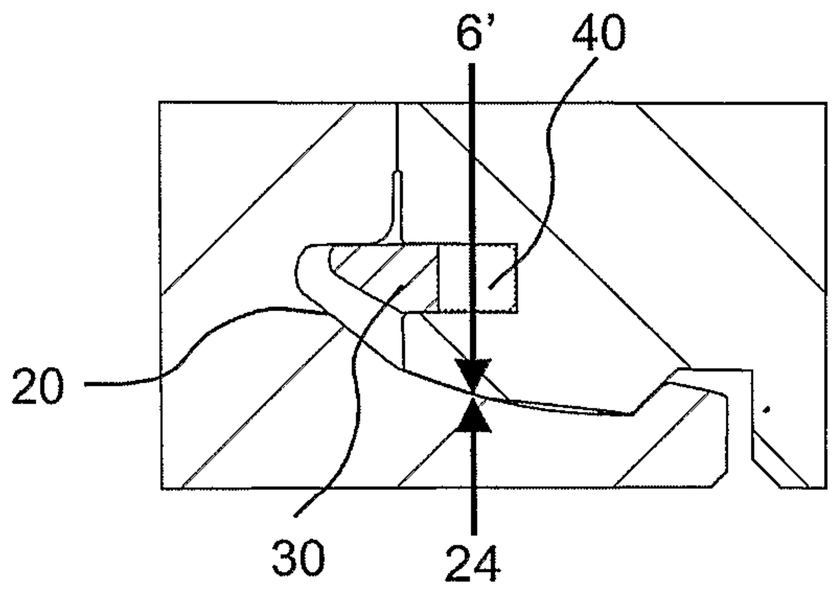


Fig. 17d

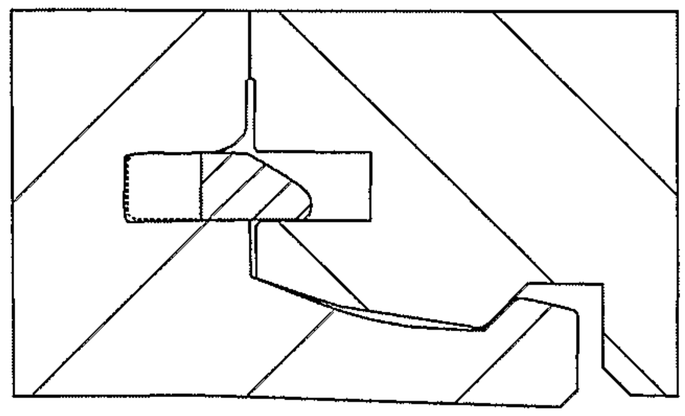


Fig. 18

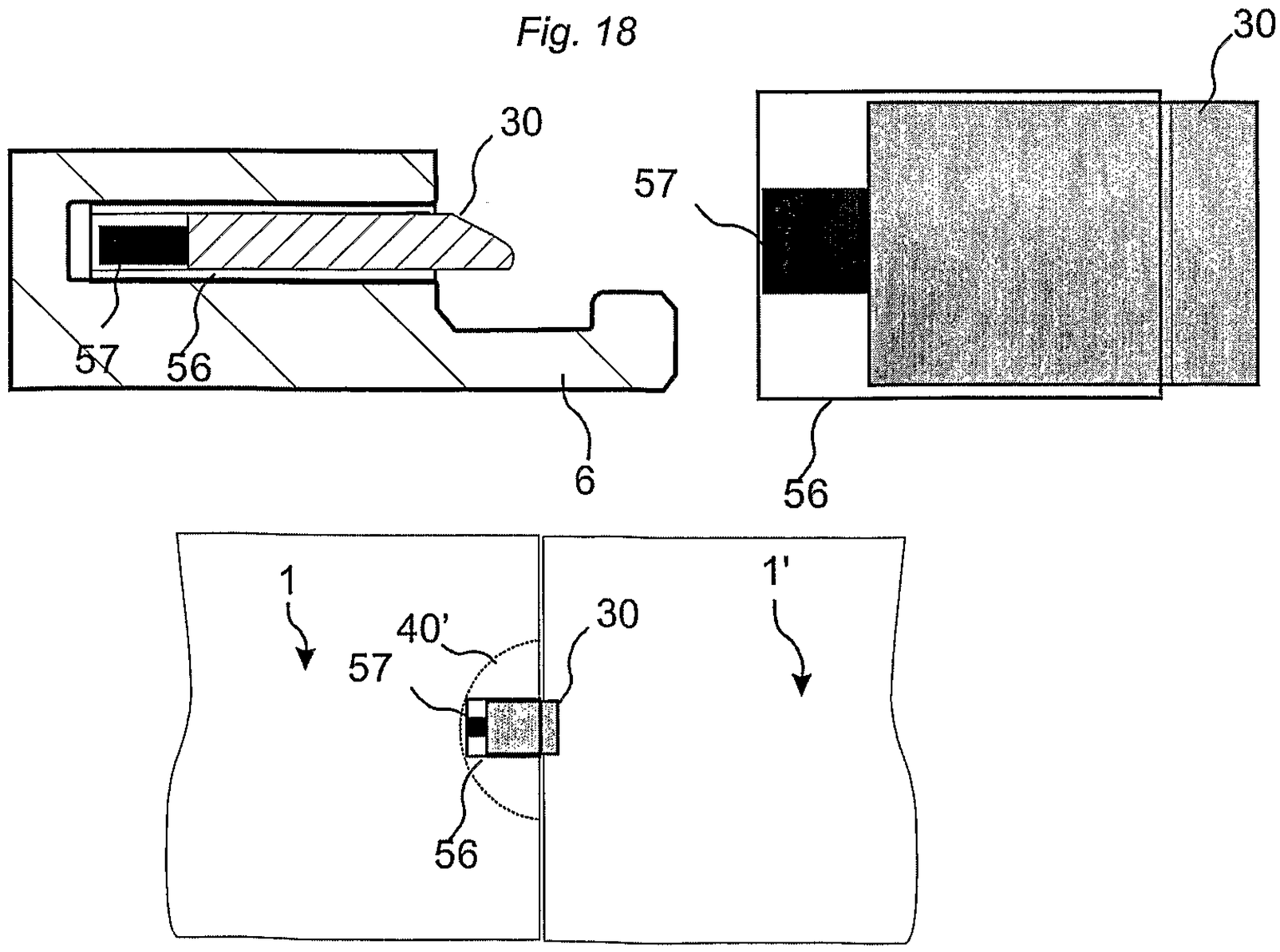
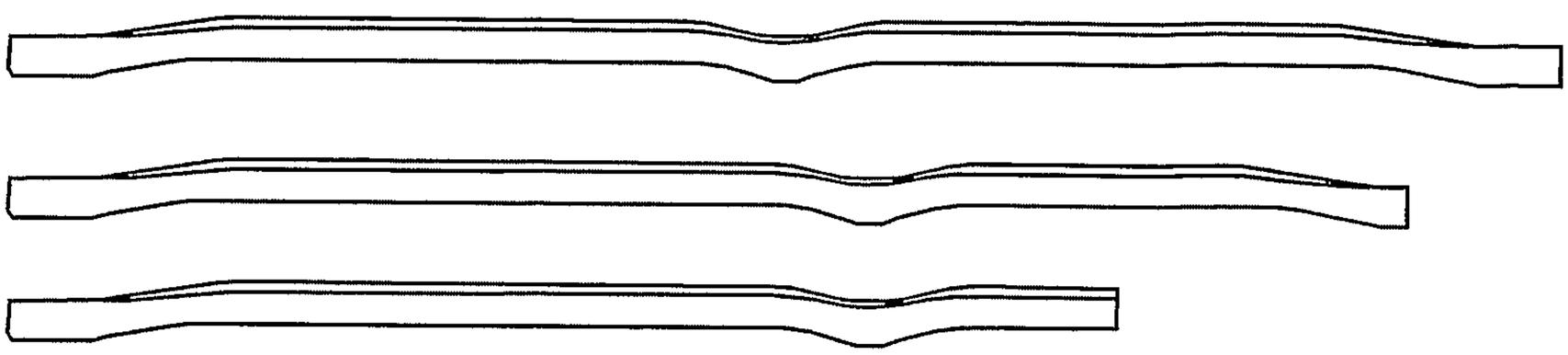


Fig. 18a



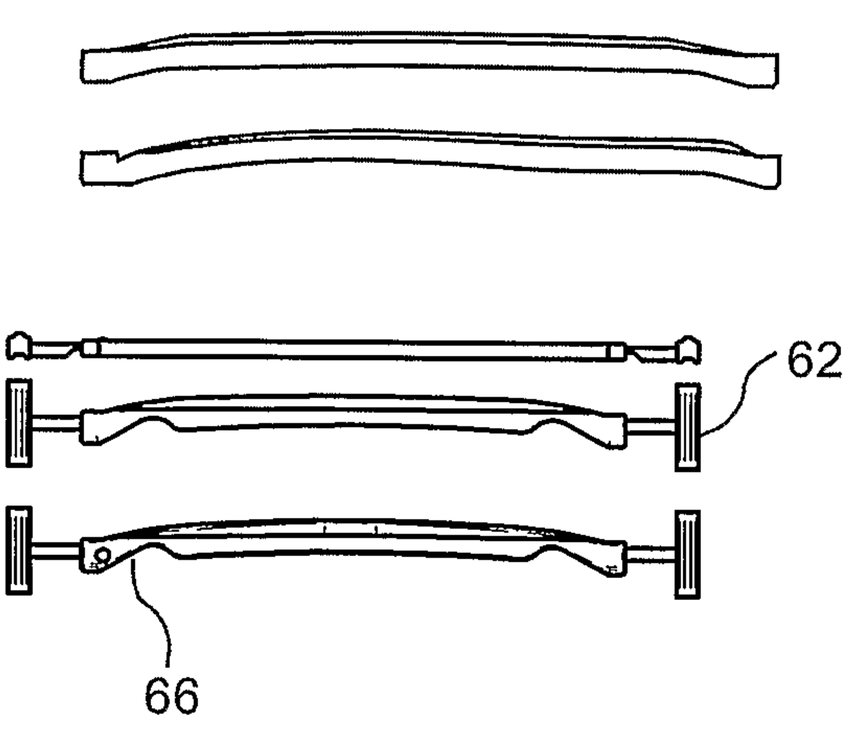


Fig. 18b

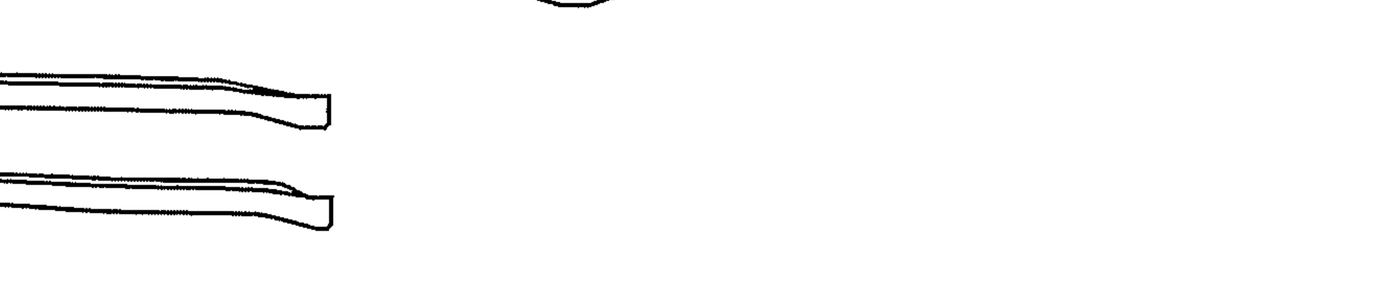


Fig. 18c

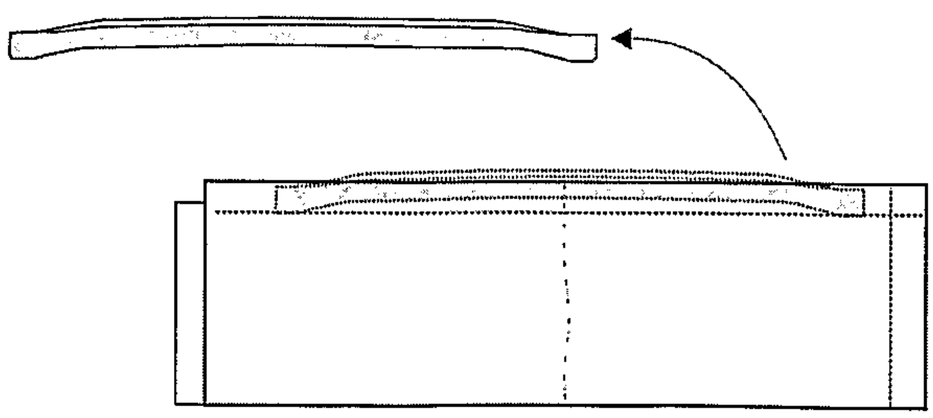


Fig. 18d

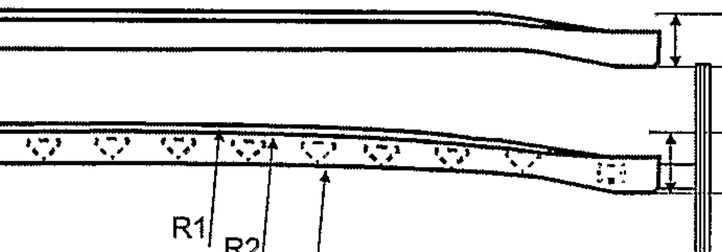


Fig. 18e

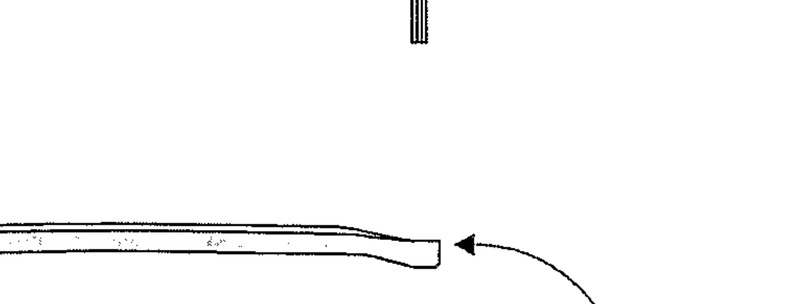


Fig. 18f

Fig. 19a

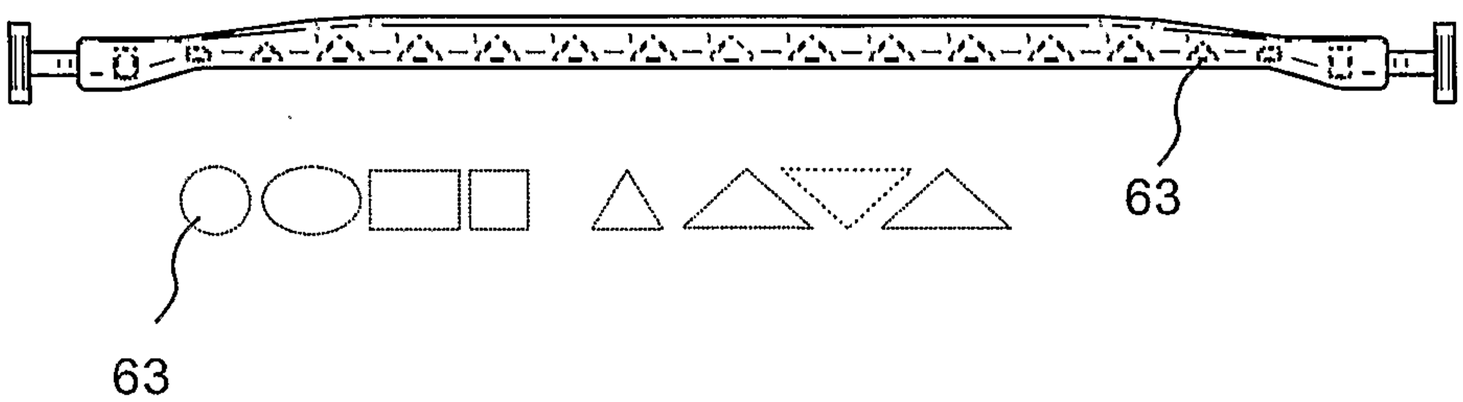
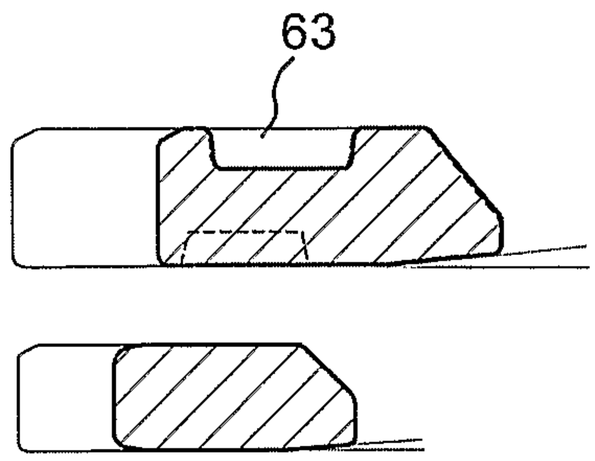


Fig. 19b



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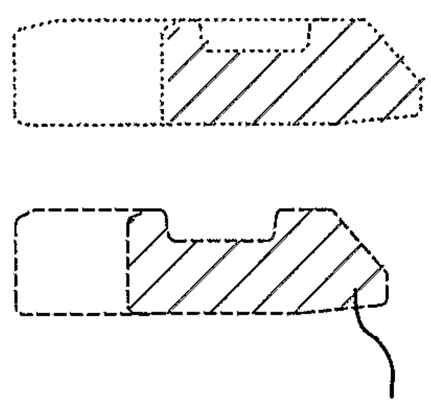
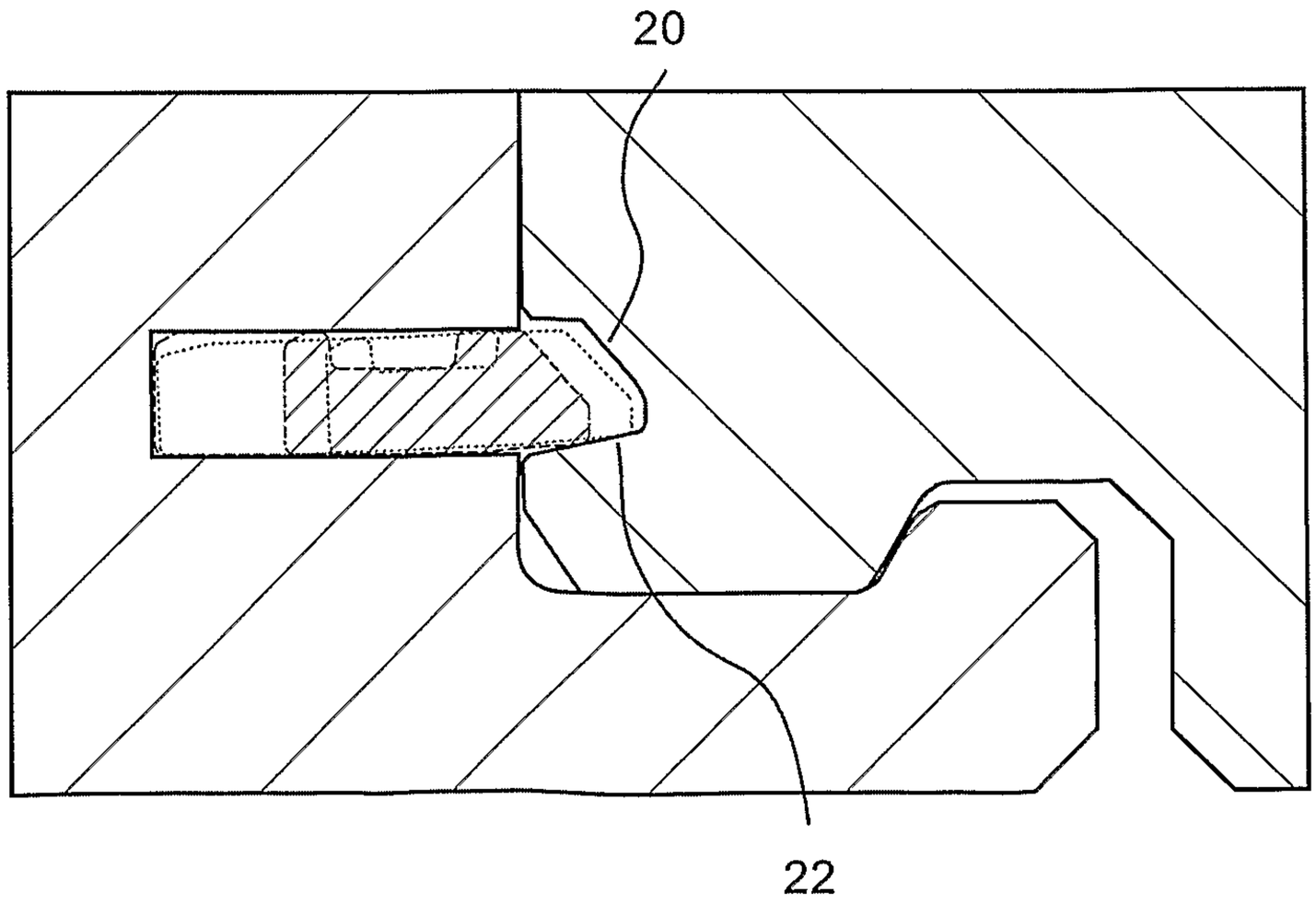


Fig. 19d



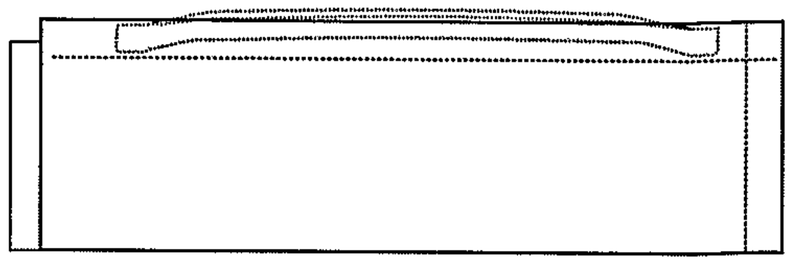


Fig. 20a

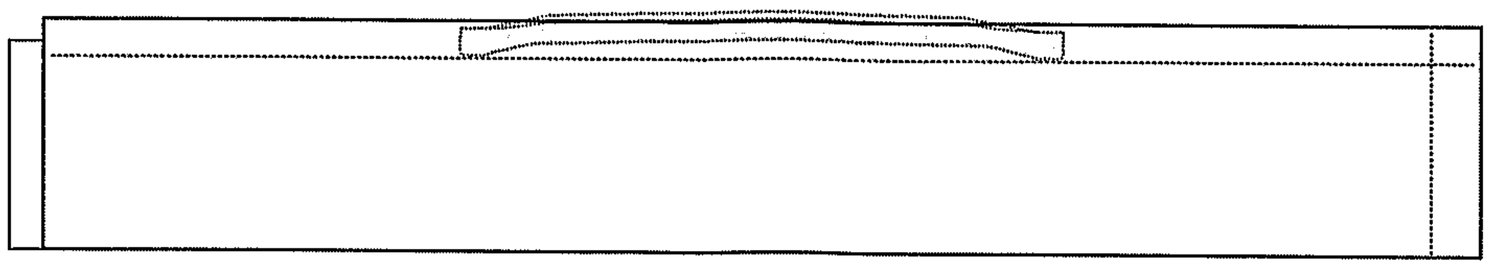


Fig. 20b

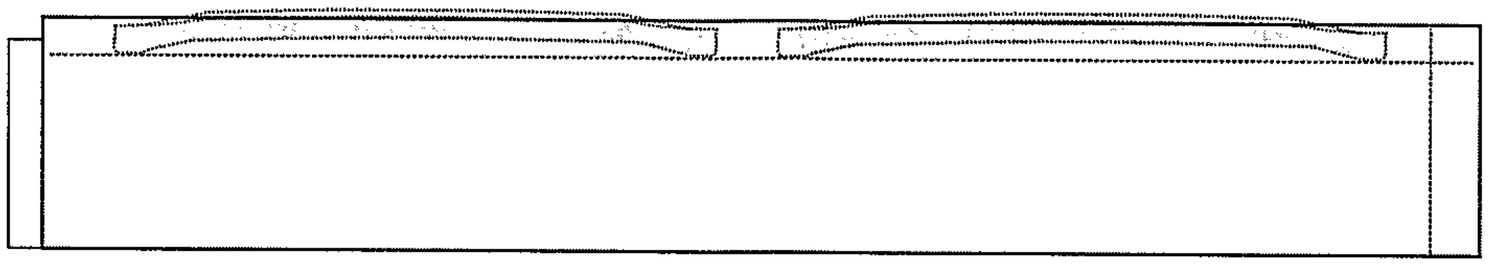


Fig. 20c

Fig. 20d

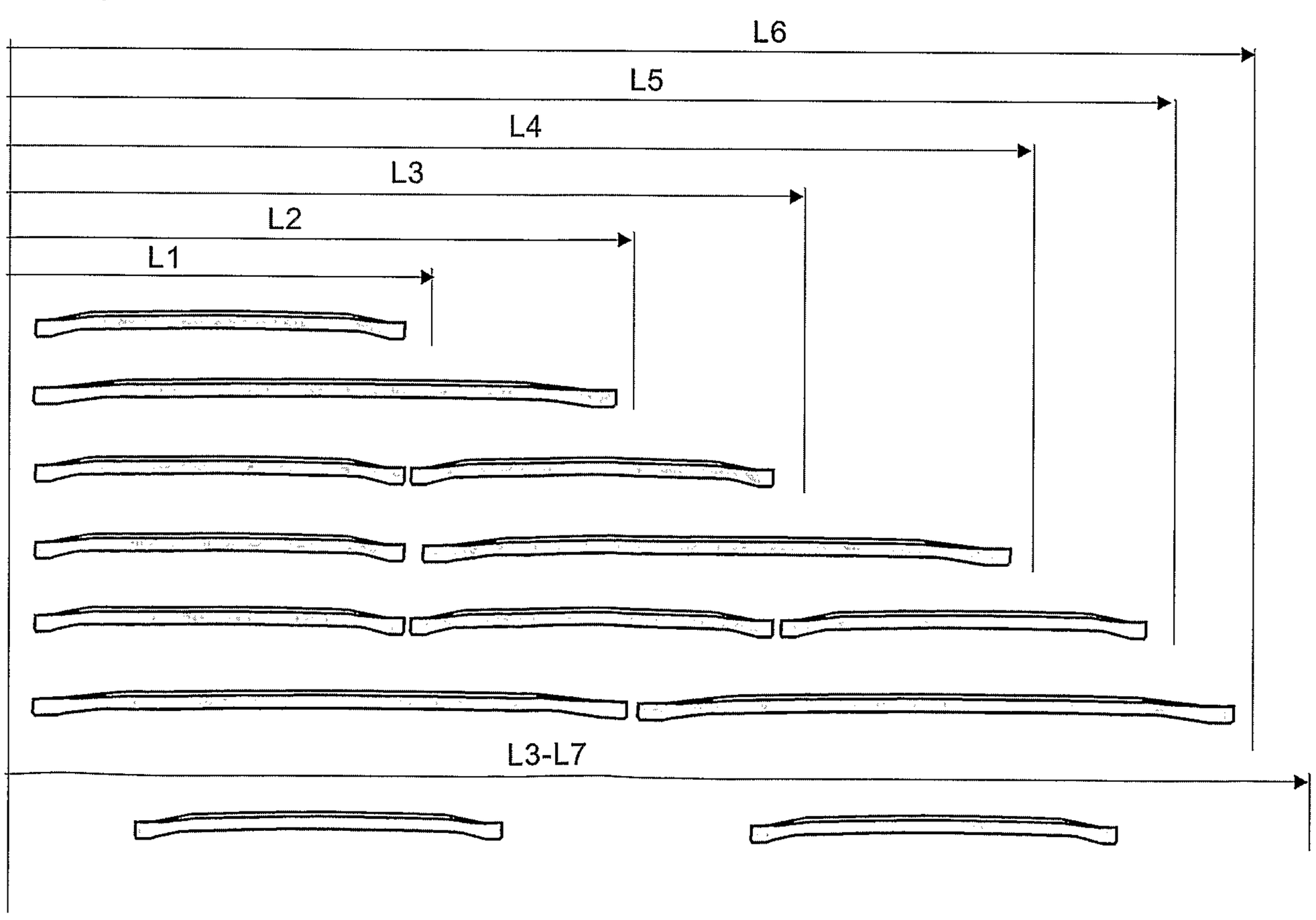
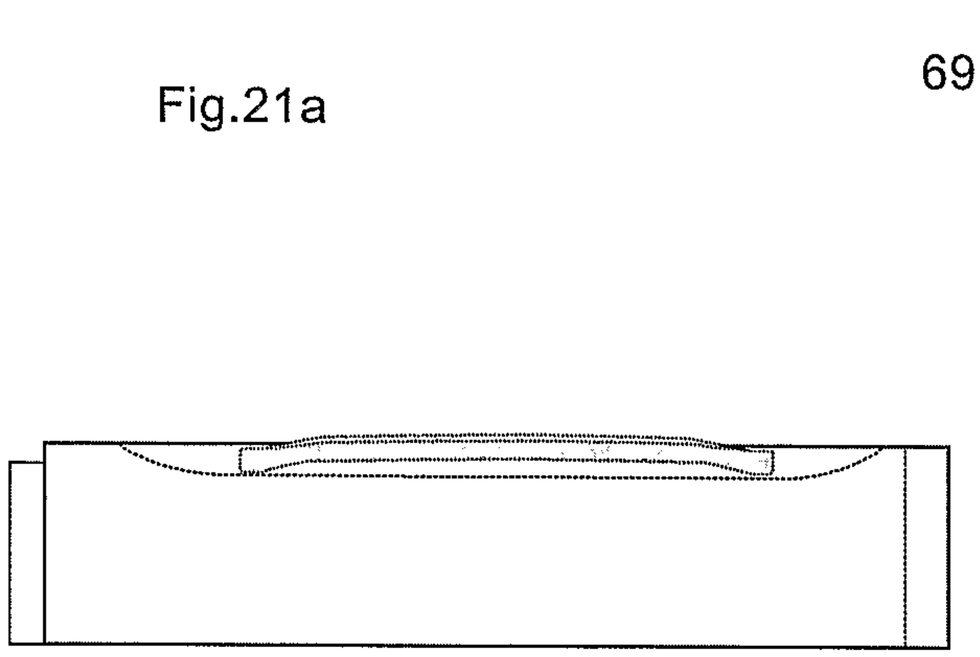


Fig.21a



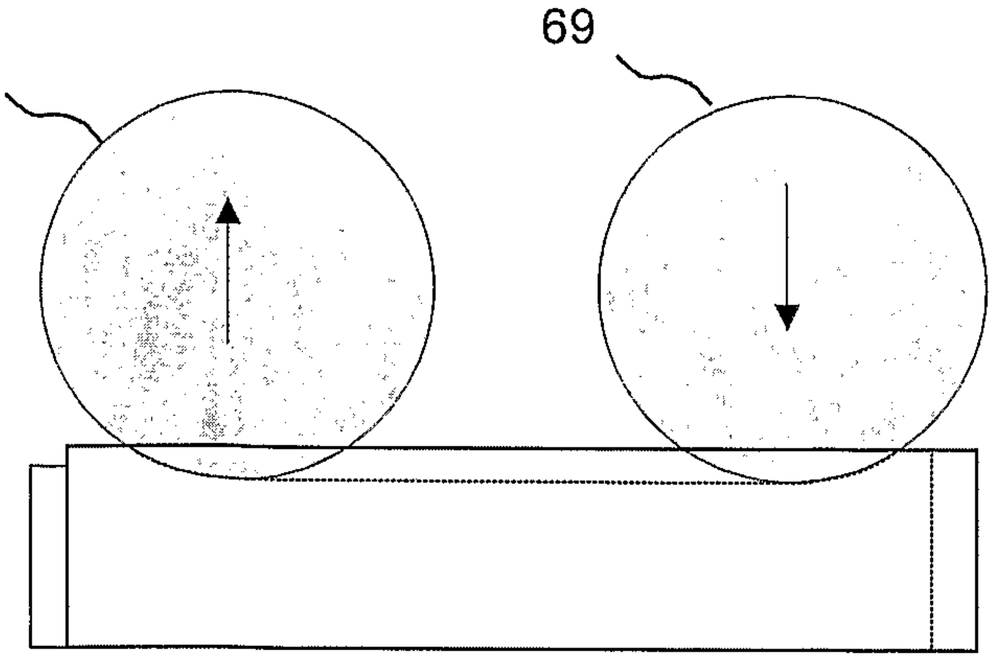
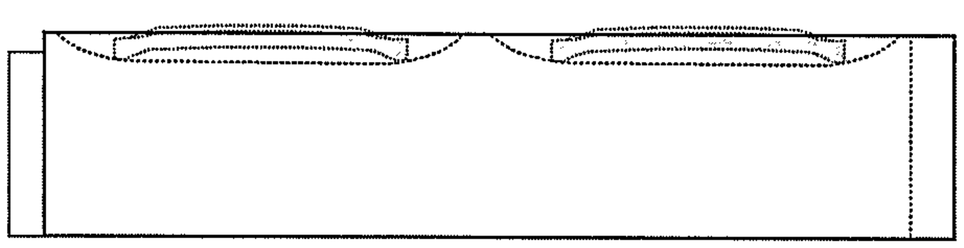


Fig. 21b



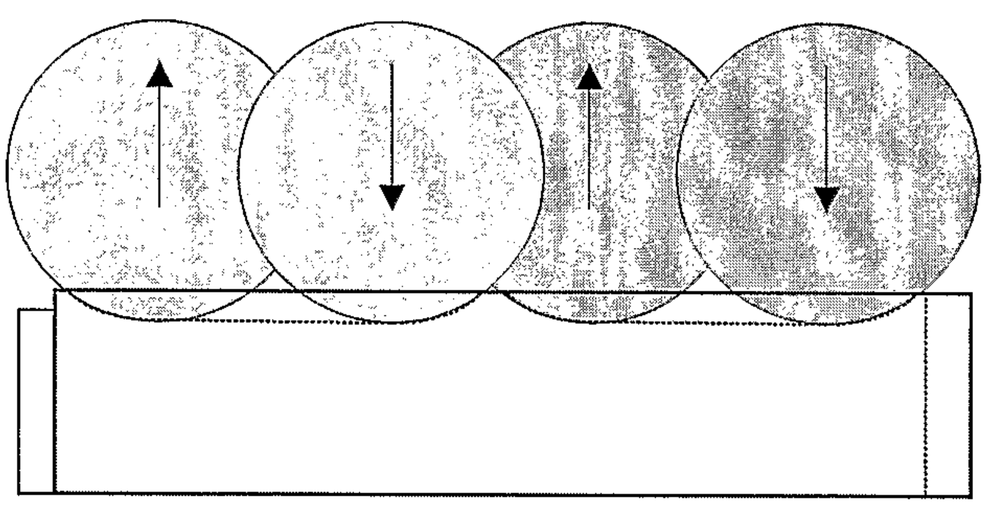
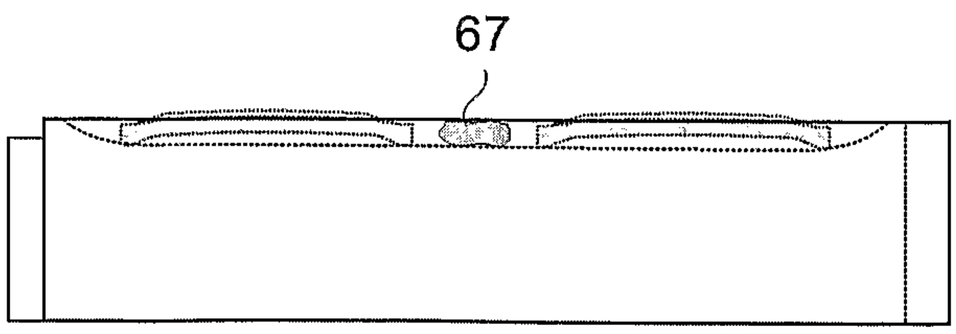


Fig. 21c



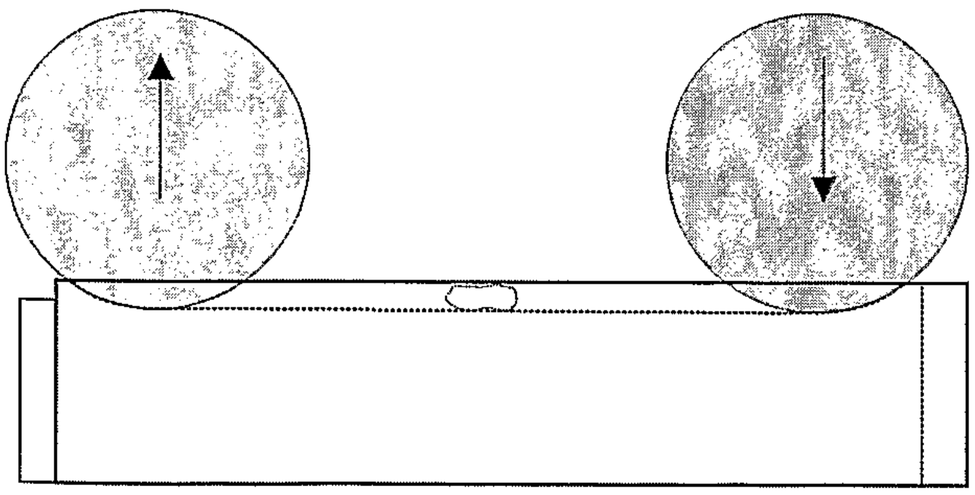
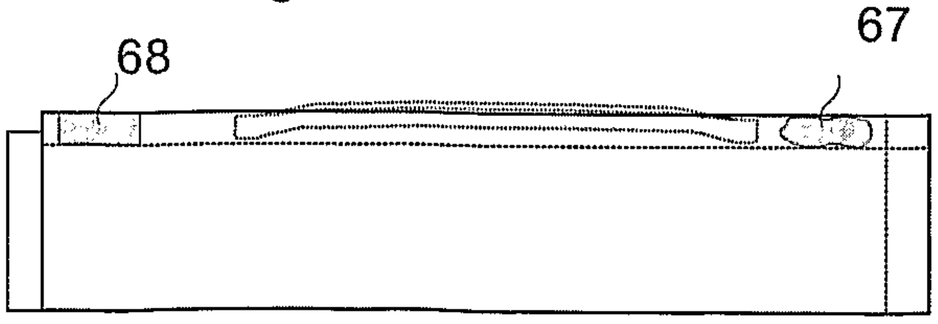


Fig. 21d



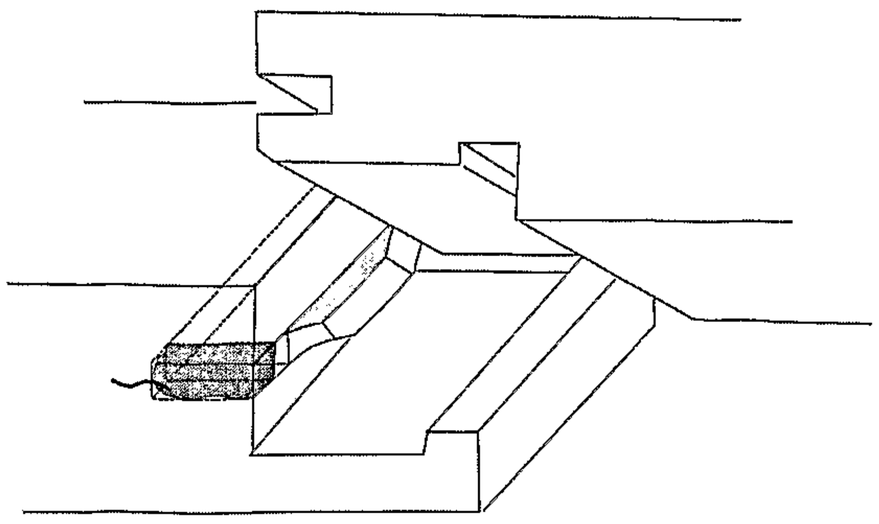


Fig. 22a

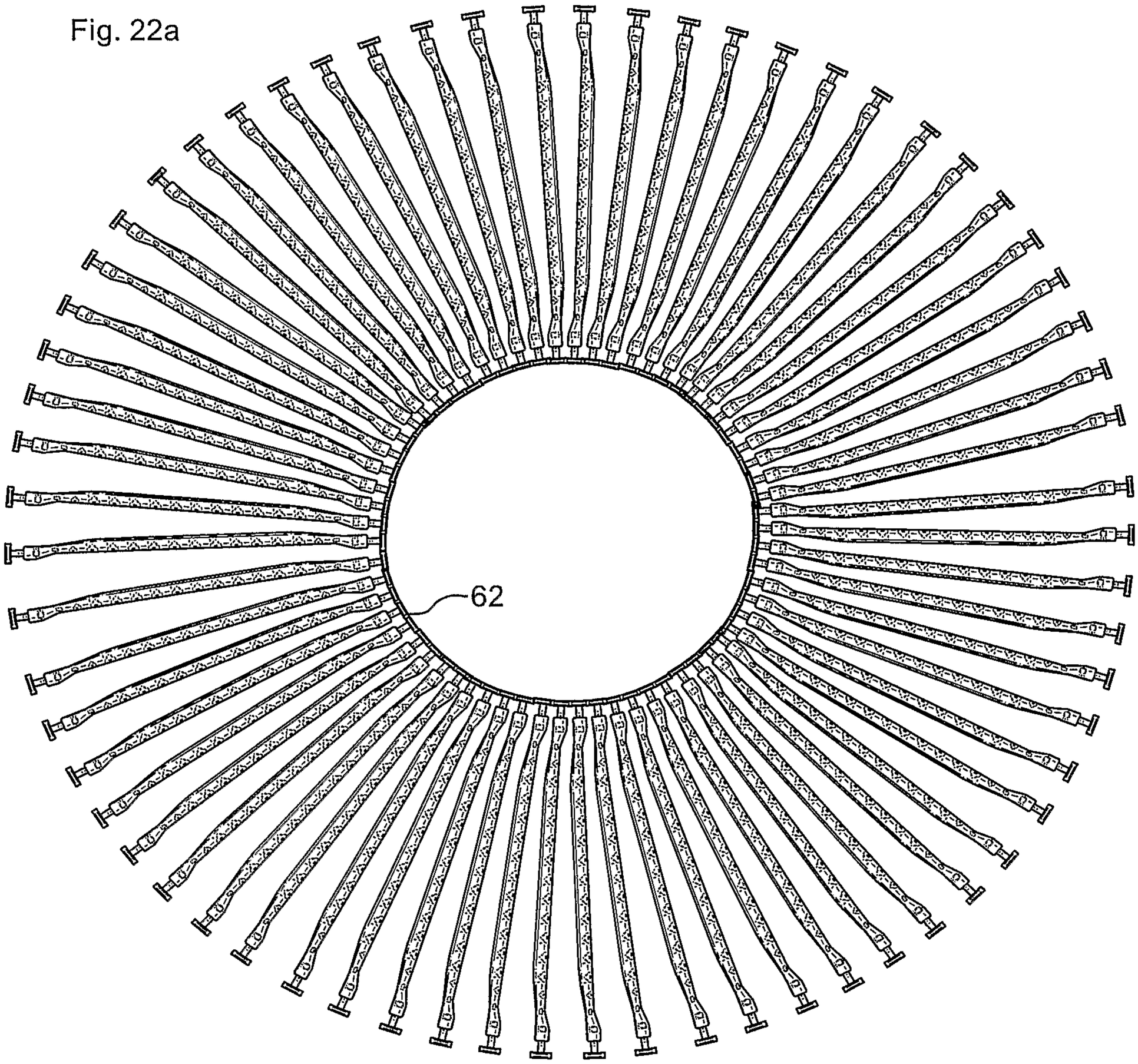


Fig. 22b

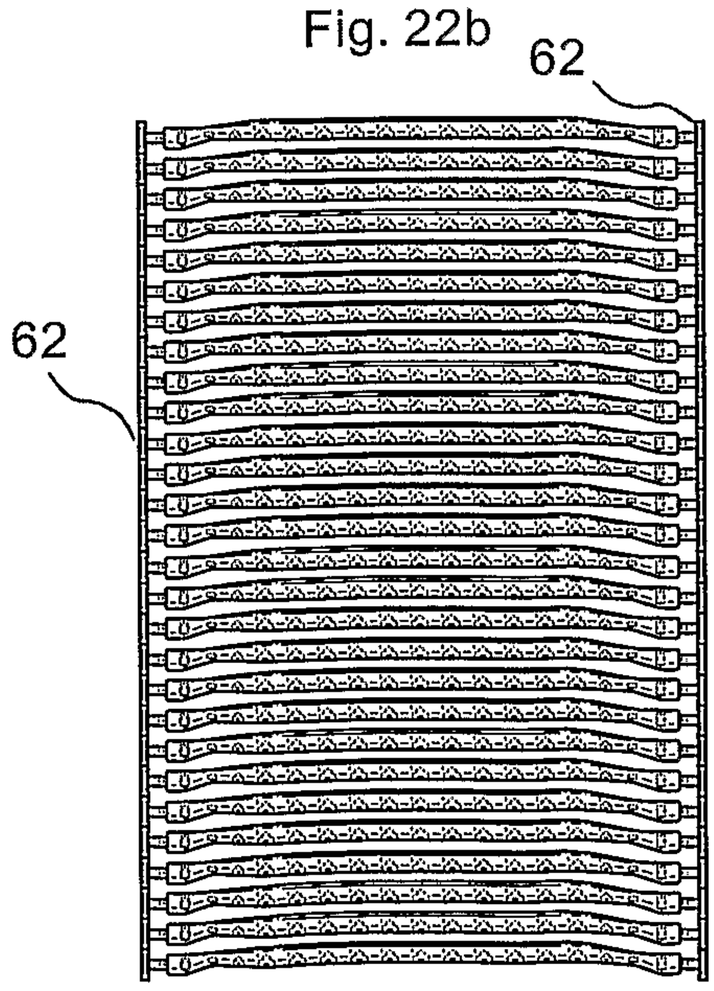


Fig. 22c

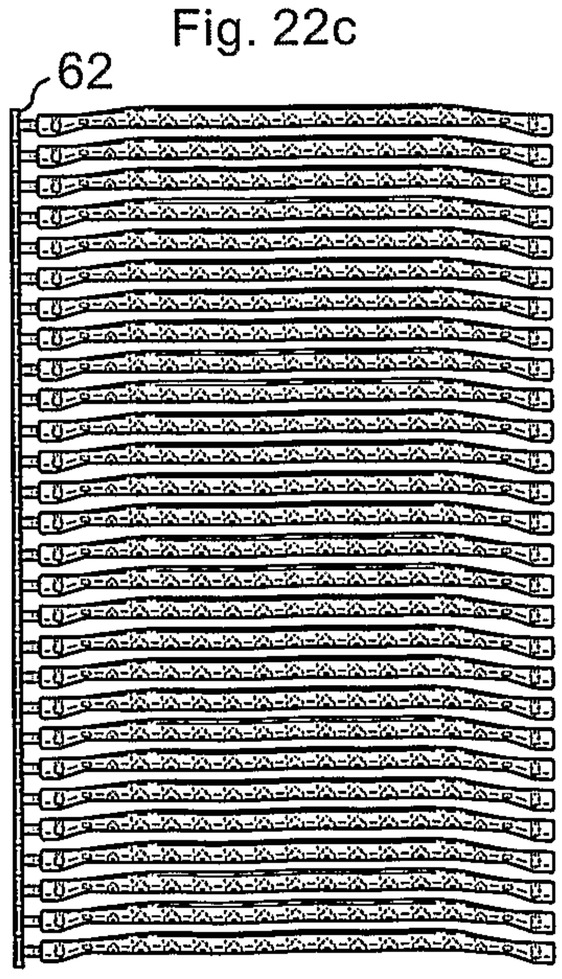
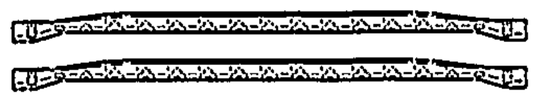


Fig. 22d



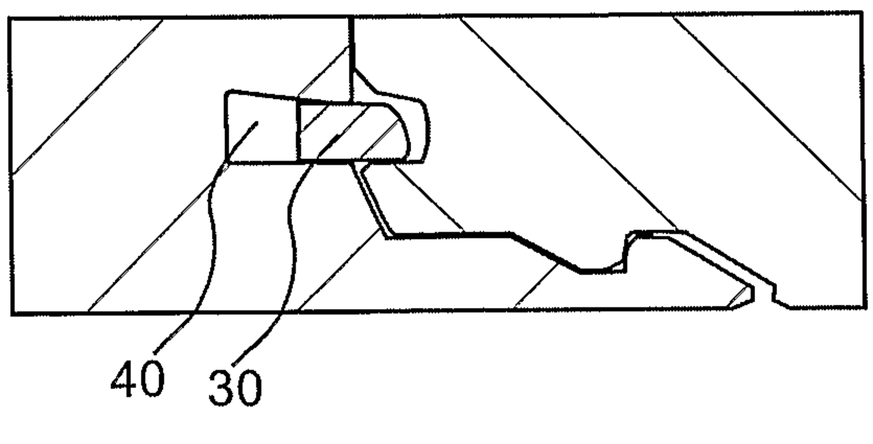


Fig. 23a

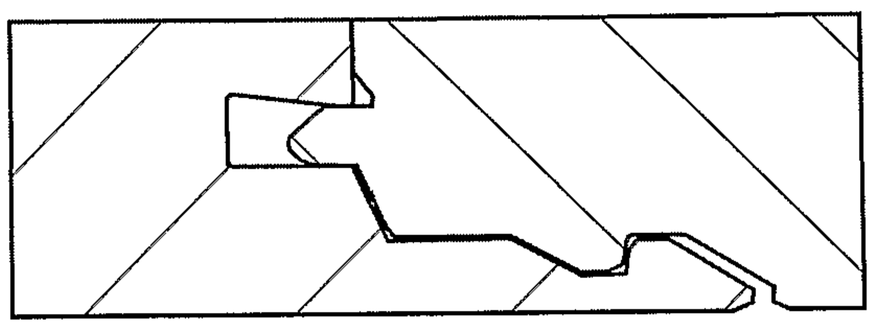


Fig. 23b

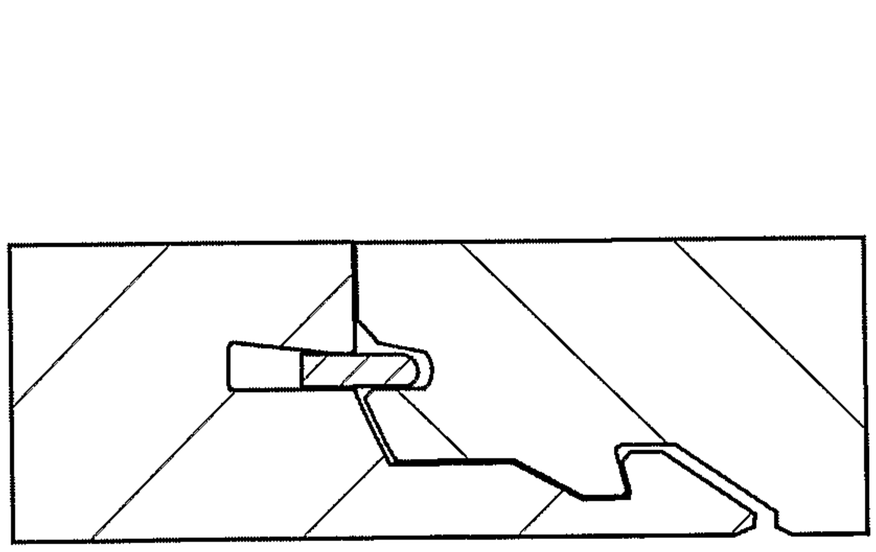


Fig. 23c

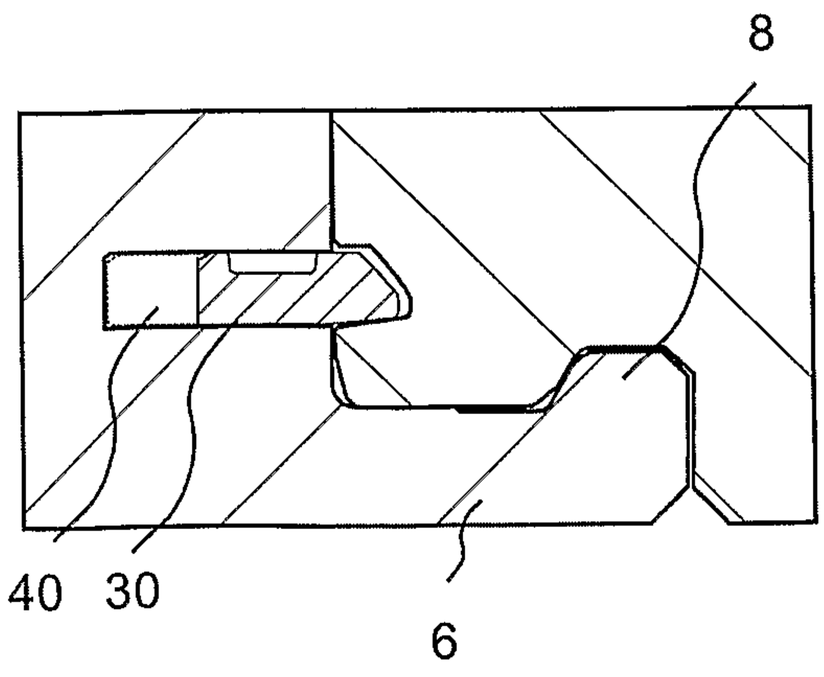


Fig. 23d

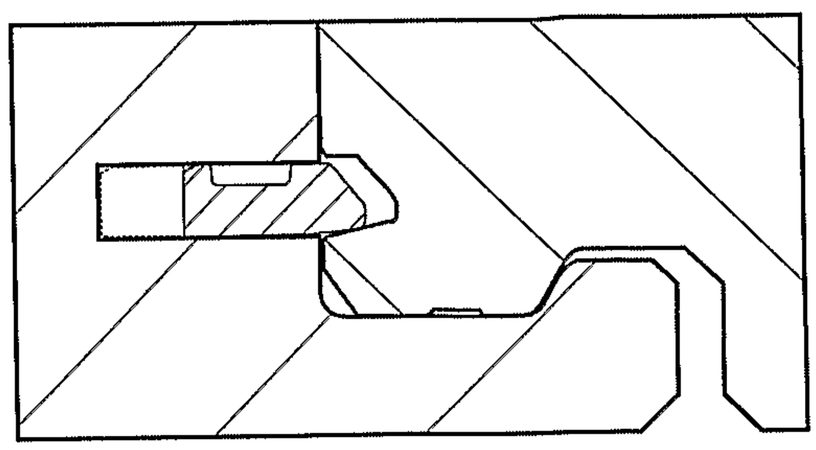


Fig. 23e

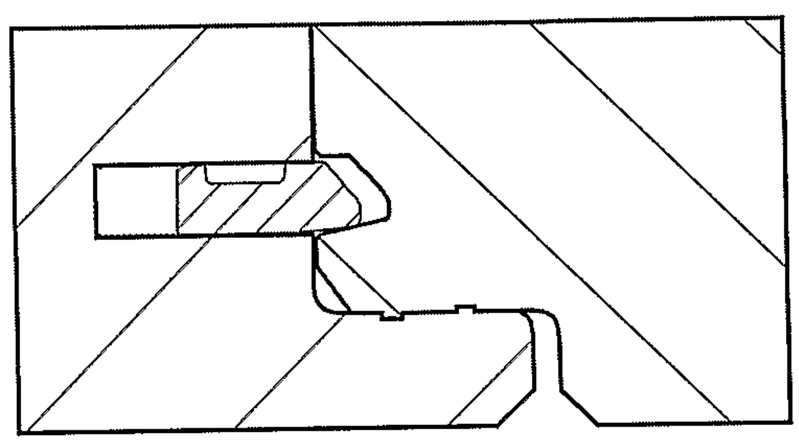


Fig. 23f

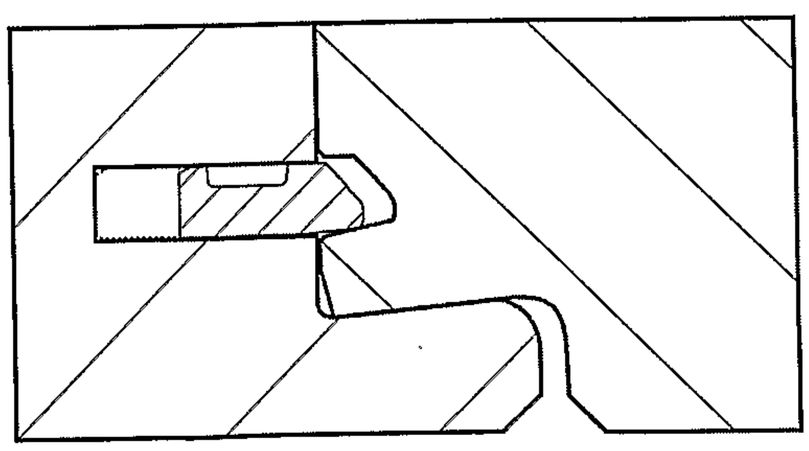


Fig. 23g

Fig. 24a

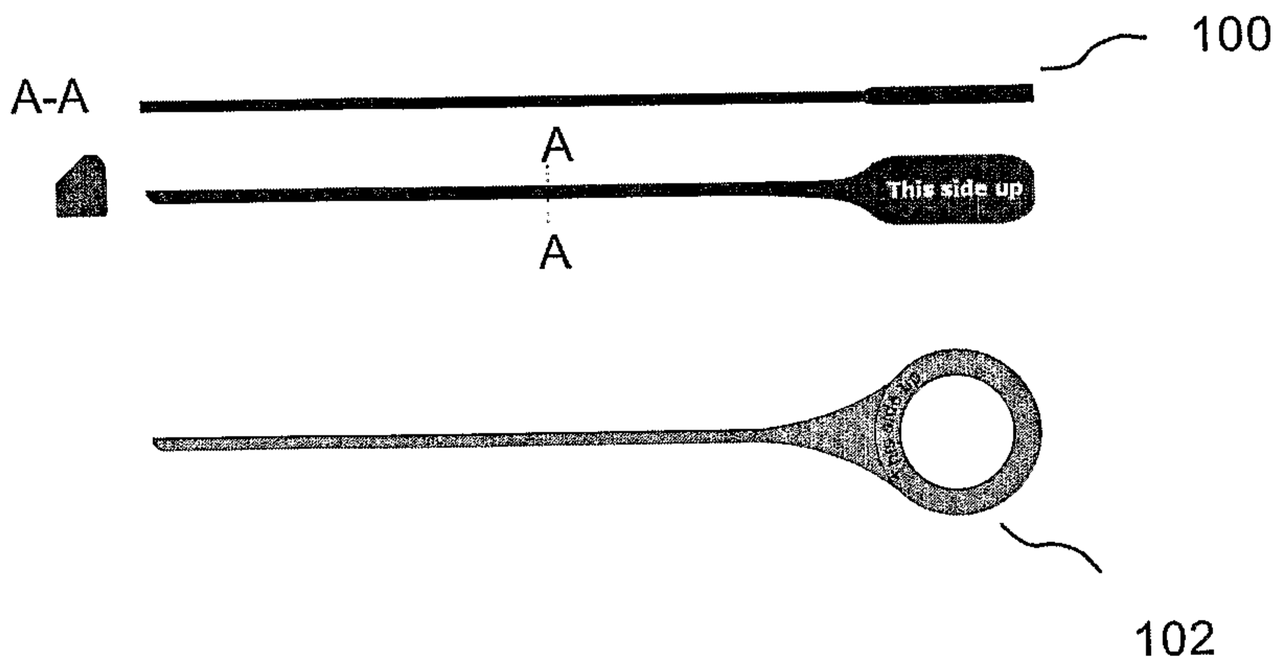


Fig. 24b

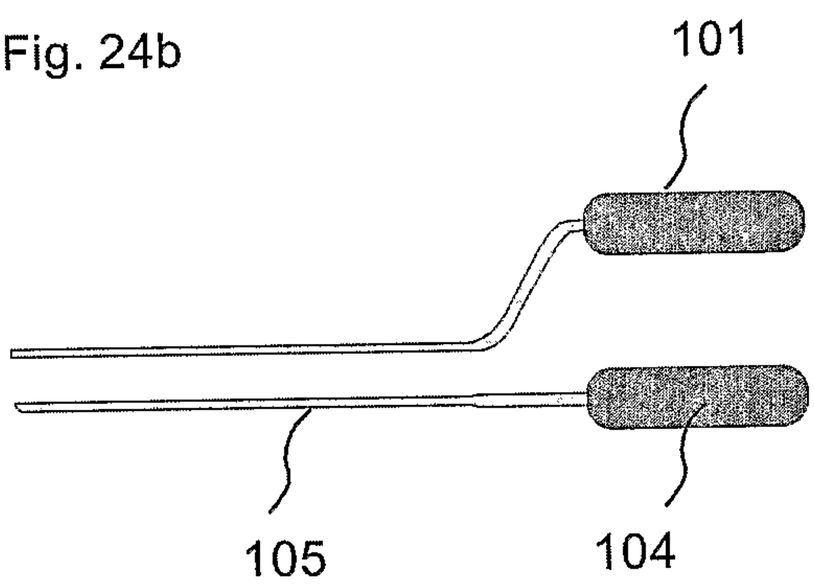


Fig. 24c

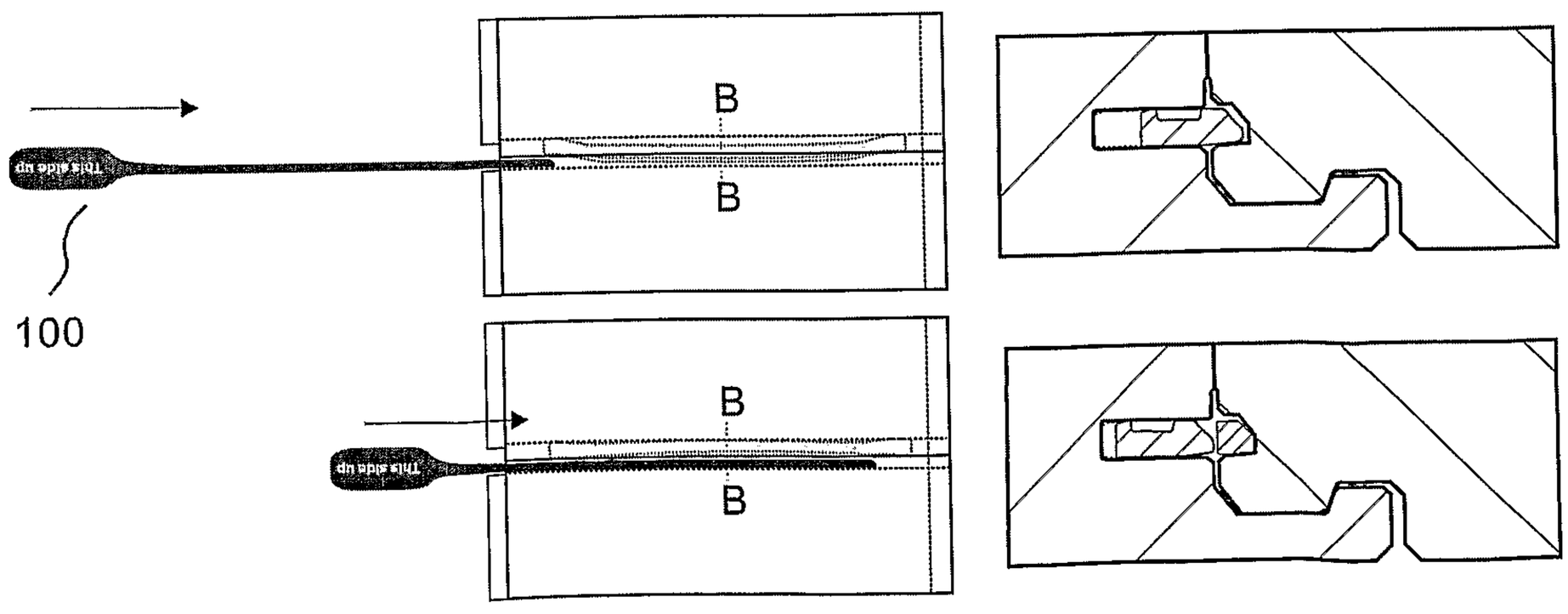


Fig. 24d

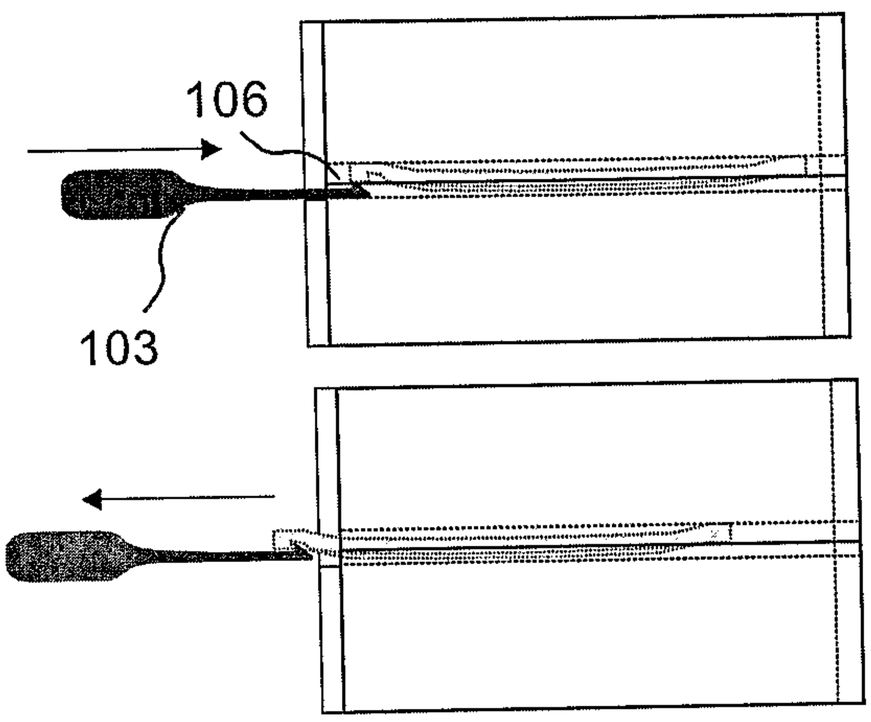
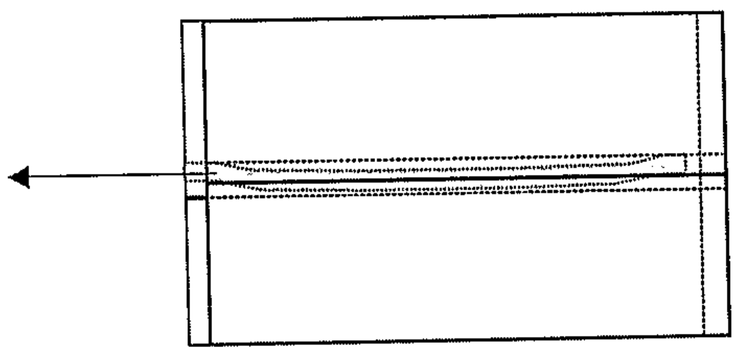


Fig. 24e



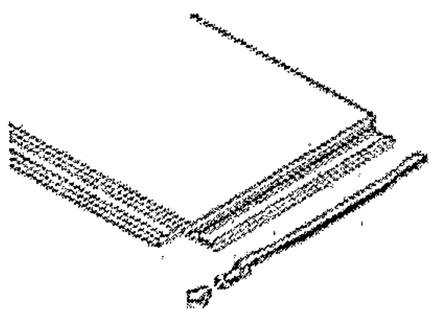
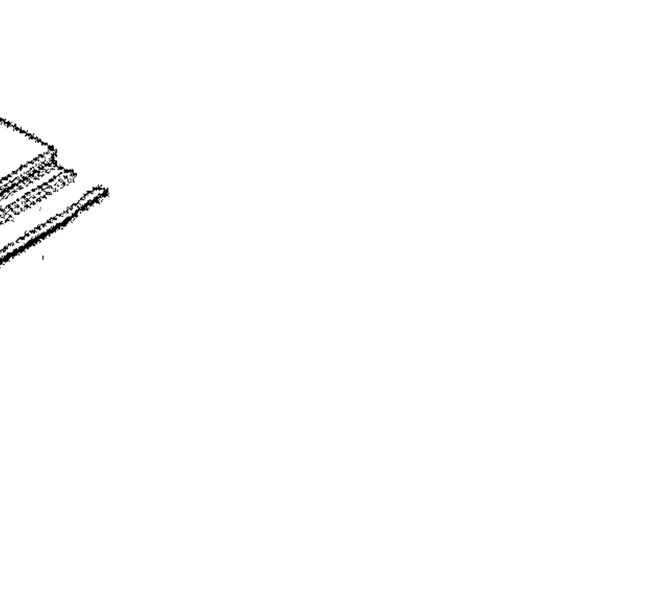
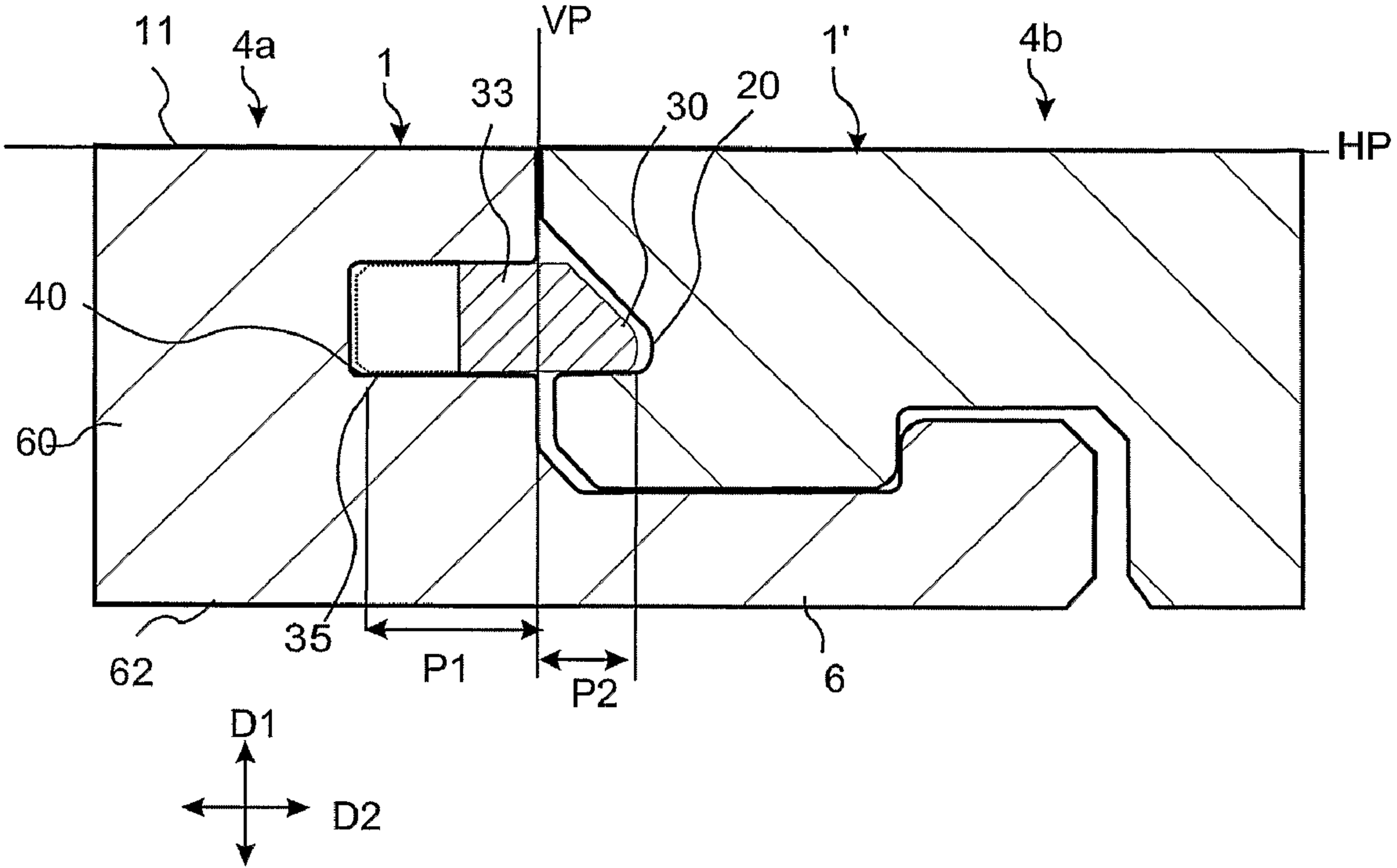


Fig. 24g

Fig. 24f




11
4a
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VP
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D2