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Fig. 3b

(57) Abrégé/Abstract:
Building panels, especially floor panels are shown, which are provided with a locking system comprising several cavities and local protrusions that provide horizontal locking of a first and a second edge of adjacent panels.

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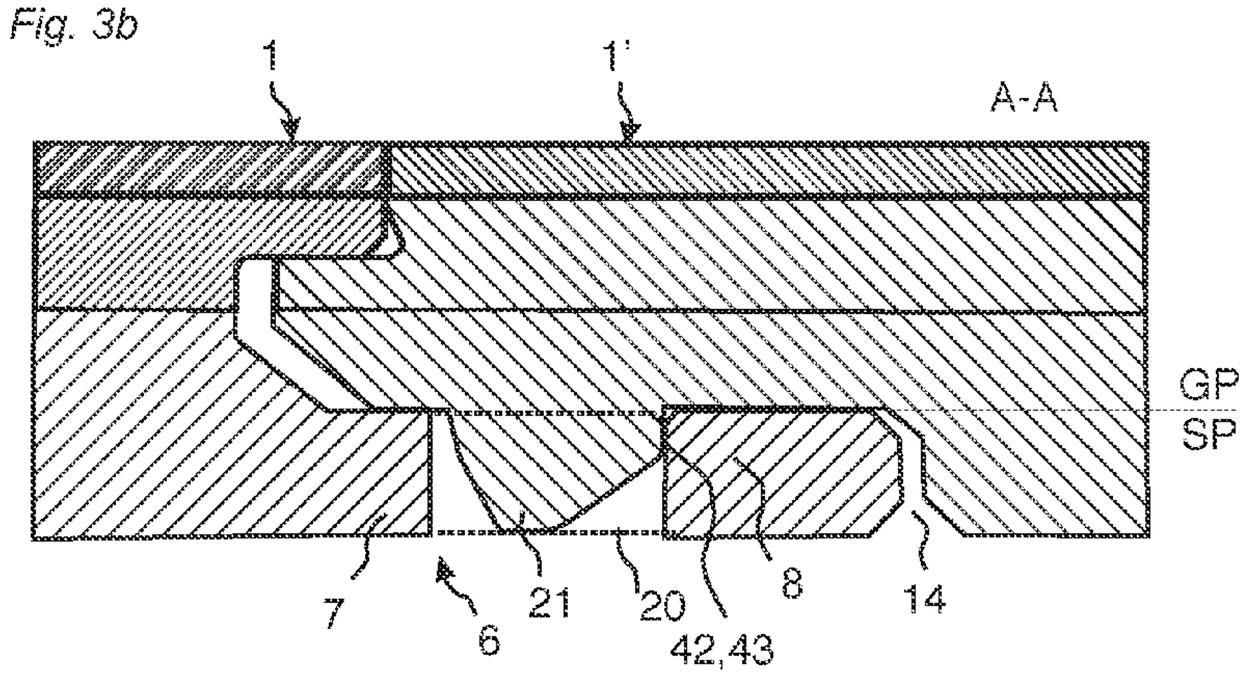
Fig. 3b



(57) **Abstract**: Building panels, especially floor panels are shown, which are provided with a locking system comprising several cavities and local protrusions that provide horizontal locking of a first and a second edge of adjacent panels.

WO 2013/032391 A1

MECHANICAL LOCKING SYSTEM FOR FLOOR PANELS

TECHNICAL FIELD

The disclosure generally relates to the field of mechanical locking systems for floor panels and building panels. The disclosure shows floorboards, locking systems and production methods.

FIELD OF APPLICATION OF THE INVENTION

Embodiments of the present invention is particularly 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 wood or wood veneer, decorative laminate, powder based surfaces 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. Floor panels with a surface layer of cork, linoleum, rubber or soft wear layers, for instance needle felt glued to a board, printed and preferably also varnished surface are included. Embodiments of the invention may also be used for joining building panels which preferably contain a board material for instance wall panels, ceilings, furniture components and similar.

The following description of known technique, problems of known systems and objects and features of embodiments the invention will, as a non-restrictive example, be aimed above all at floor panels and especially thin floor panels such a luxury vinyl tiles, generally referred to as LVT, with long and shorts edges intended to be

mechanically joined to each other on both long and short edges.

The long and short edges are mainly used to simplify the description of embodiments of the invention. The panels may be square.

BACKGROUND OF THE INVENTION

As shown in figure 1a and 1b LVT flooring usually comprise a transparent wear layer 3 which may be coated by a PU lacquer 2, preferably UV cured, a decorative plastic foil 4 and one or several core layers 5a, 5b which generally are of different density and hardness. Relevant parts of this description of known technology are also a part of the invention.

Thin LVT floors with a thickness of 2-3 mm have traditionally been installed by gluing to the sub floor. Recently LVT floors have been introduced on the market that comprises a mechanical locking system, which allows a floating installation without glue. This facilitates installation and eliminates a lot of work to prepare the sub floor for gluing.

Such LVT floors have generally a thickness of 4 - 5 mm. This thickness is mainly required in order to form the locking system. The panel itself is strong and flexible and a thickness of about 3 mm would in many applications be sufficient but may not be suitable since it's difficult to form a locking system in such thin floors.

Floating LVT floors of this type have however several disadvantages. They are heavy. The density is for example about 1.6kg/dm3 compared to about 0,8kg/dm3 for laminate floors. The temperature sensitivity is more than three times higher than for laminate floors. An LVT floor may move about 2 mm/M when the temperature is changing 20 degrees Celsius.

Such problems related to thickness are also applicable in other high quality floor panels such as wood powder based floors with high density and quality. The additional cost of forming a locking system is considerable since the material content of the whole floor panel has to be increased with 25% or more.

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 “vertical locking” is meant locking parallel to the vertical plane. By “horizontal locking” is meant locking parallel to the horizontal plane.

By “up” is meant towards the front side, by “down” towards the rear side, by “inwardly” mainly horizontally towards an inner and centre part of the panel and by “outwardly” mainly horizontally away from the centre part of the panel.

By "locking systems" are meant co acting connecting elements, which connect the floor panels vertically and/or horizontally. By “strip plane” is meant a horizontal plane positioned at the lowest part of the upper strip body surface. By “groove plane” is meant a horizontal plane positioned at the upper and inner part of a locking groove.

RELATED ART AND PROBLEMS THEREOF

Figures 1a and 1b show a LVT floor panel with a locking system that is locked with angling. The horizontal locking is obtained by a locking strip 6 having a strip body 7 and a locking element 8 formed at one panel edge 1 that locks into a locking groove 14 formed in another adjacent panel edge 1'.

The strip body 7 has a strip surface 7a. A strip plane SP is positioned at the lowest part of the strip surface 7a. The locking groove 14 has a vertical extension that is needed to house the locking element 8. A groove plane GP is positioned at the upper part of the locking groove 14. The floor panel thickness must be adapted to this required vertical distance between the strip plane SP and the groove plane GP. The thickness of the floor panel may be decreased by 25% and more if it would be possible to use a locking system where the vertical distance between the strip plane SP and the groove plane GP may be reduced or even completely eliminated.

It would be a major advantage if thin panels may be locked with a locking system that do not require deep vertical locking grooves and locking elements that extend vertically from the main strip body. It would also be an advantage if the weight may be decreased and if problems related to temperature changes, especially in installations with floor heating, may be eliminated.

SUMMARY OF THE INVENTION

An overall objective embodiments of the present invention is to provide an improved and more cost efficient locking system that may be used in primarily thin floorings and floorings with soft flexible core layers.

A specific objective is to decrease weight of LVT floors and adapt the panel such that it is suitable to be

installed in areas, which are subjected to considerable temperature changes. Another specific objective is to provide cost efficient production methods to produce locking systems in especially thin floor panels.

The above objects of embodiments of the invention are achieved wholly or partly by locking systems and floor panels according to embodiments of the invention.

A first aspect of the invention is building panels provided with a locking system for vertical and horizontal locking of a first and a second edge of adjacent panels. Said locking system comprising a tongue and a tongue groove for vertical locking. A strip at the first edge is provided with a locking element, which cooperates for horizontal locking with a downwardly open locking groove formed in the second adjacent edge. The strip comprises a strip body with a cavity and the second edge comprises a local protrusion that extends downwards. The protrusion is located in the cavity when the panels are locked vertically and horizontally.

The locking element may be a part of the cavity and the strip body may comprise several cavities.

The cavity preferably extends entirely through the strip body.

The second edge may comprise several local protrusions.

The locking element and/or the protrusions may discontinuous along the edge.

The strip body may comprise a horizontal strip plane that is positioned at the lowest part of the upper strip surface and a locking groove that comprise a horizontal groove plane that is positioned at the upper and inner part of the locking groove, such that the strip plane and

the groove plane are closer to each other vertically than the vertical extension of the locking element.

The locking system may comprise a strip plane and groove plane that are located essentially on the same horizontal plane.

A second aspect of the invention is a method to produce a panel with a locking system. The method comprises the steps of:

a) forming a part of the cavities with punching; and

b) forming a part of the protrusions by a screw cutter.

The locking system may be formed on long and/or short edges and may be locked with angling and/or horizontal snapping and/or vertical folding.

A third aspect of the invention is a building panel according to the first aspect produced by the method according to the second aspect.

A fourth aspect of the invention is building panels provided with a locking system for vertical and horizontal locking of a first and a second edge of adjacent panels. Said system is configured to lock the edges by a vertical displacement of the adjacent edges relative each other. The locking system comprises a separate tongue fixed into a fixation groove. Said tongue cooperates with a tongue groove for vertical locking. A strip at the first edge is provided with a locking element, which cooperates for horizontal locking with a downwardly open locking groove formed in the second adjacent edge.

The strip comprises a strip body with a cavity and the second edge comprises a local protrusion that extends downwards. The protrusion is located in the cavity when the panels are locked vertically and horizontally. A

lower part of the tongue groove is in locked position located essentially on the same horizontal plane as an upper part of the strip surface.

The locking element may be a part of the cavity.

The cavity preferably extends entirely through the strip body.

The strip body may comprise several cavities.

The second edge may comprise several local protrusions.

A fifth aspect of the invention is building panels provided with a locking system for vertical and horizontal locking of a first and a second edge of adjacent panels. Said system is configured to lock the edges by a vertical displacement of the adjacent edges relative each other. The locking system comprises a tongue, which cooperates with a tongue groove or an undercut for vertical locking. A strip at the first edge is provided with a locking element, which cooperates for horizontal locking with a downwardly open locking groove formed in the second adjacent edge. The strip comprises a strip body with a cavity. The second edge comprises a local protrusion that extends downwards. The protrusion is located in the cavity when the panels are locked vertically and horizontally.

The tongue may be located at a lower part of the protrusion.

The cavity preferably extends entirely through the strip body.

A sixth aspect of the invention is a method to produce a panel comprising a locking system that locks vertically and/or horizontally. The method comprises the steps of:

- forming a part of the locking system with knives that comprise an essentially V or U shaped open cutting edge; and

- displacing cut-off material such that it flows in the inner part of the open cutting edge during cutting.

A seventh aspect of the invention is a method to separate a sheet into a first and a second floor panel and to form two adjacent edges comprising a locking system that locks vertically and /or horizontally. The first edge comprises a lower part that protrudes horizontally beyond an upper part and the second edge comprises an upper part that protrudes horizontally beyond a lower part. The method comprises the step of:

- cutting the sheet and separating the panels by cutting knives that cuts horizontally and vertically; and

- forming the lower part on the first panel and the upper part on the second panel by said cutting.

An eight aspect of the invention are floor panels, provided with a locking system for vertical and/or horizontal locking of a first and a second edge of adjacent panels, comprising a plastic wear layer and one or several plastic core layers with several essentially vertical flexing grooves that have a vertical extension of at least about one third of the core thickness.

The flexing grooves may be covered with an underlay.

The flexing grooves may be essentially parallel with the long edges and have a length that is smaller than the distance between the locking systems on the short edges.

A ninth aspect of the invention is resilient floor panels with long and short edges provided with a locking system for vertical and/or horizontal locking of a first and a second edge of adjacent panels. The panels comprise a resilient material that allows a bending with overlapping short edges. One of the long edges is provided with a plastic locking strip extending along the edge and protruding horizontally from the edge. The locking strip comprises at least one vertically extending protrusion configured to be inserted into a locking groove formed at the adjacent edge.

The locking strip may be a thermoplastic extruded section.

The floor panel may have a length that is at least 15 times larger than the width.

BRIEF DESCRIPTION OF THE DRAWINGS

The disclosure will in the following be described in connection to exemplary embodiments and in greater detail with reference to the appended exemplary drawings, wherein:

Figs 1a-b illustrate floor panels and locking systems according to known technology.

Figs 2a-c illustrate two edge sections with a locking system according to an embodiment of the invention.

Figs 3a-3c illustrate locking with a locking system according to an embodiment of the invention.

Figs 4a-d illustrate production methods to form a locking system according to embodiments of the invention.

Figs 5a-d illustrate a locking system according an embodiment of the invention.

Figs 6a-d illustrate a separate strip part connected to an edge according to an embodiment of the invention.

Figs 7a-b illustrate embodiments of the invention.

Figs 8a-d illustrate a fold down locking system with a separate tongue according to an embodiment of the invention.

Figs 9a-d illustrate an embodiment with a fold down locking system with a tongue made in one piece with the panel.

Figs 10a-e illustrate embodiments of the invention.

Figs 11a-f illustrate separation of panels according to embodiments of the invention.

Figs 12a-b illustrate an embodiment comprising cutting with a screw cutter.

Figs 13a-d illustrate an embodiment comprising forming of a locking system with several knives.

Figs 14a-d illustrate an embodiment comprising a LVT panel with reduced weight and improved temperature properties.

Figs 15a-d illustrate a locking system installed with a vertical motion.

Figs 16a-d illustrate a locking system installed with a vertical motion.

Figs 17a-c illustrate a locking system installed with a vertical motion.

Figs 18a-d illustrate a locking system installed with angling.

Fig 19 illustrates grooves formed at the rear side.

Figs 20a-b illustrate grooves formed at the rear side .

Figs 21a-d illustrate installation of a roll-formed resilient floor.

Figs 22a-d illustrate a locking system comprising extruded profiles.

DESCRIPTION OF EMBODIMENTS OF THE INVENTION

To facilitate understanding, several locking systems in the figures are shown schematically. It should be emphasised that improved or different functions may be achieved using combinations of the embodiments.

All embodiments may be used separately or in combinations. Angles, dimensions, rounded parts, spaces between surfaces etc. are only examples and may be adjusted within the basic principles of the invention.

Figure 2a shows from above an edge section of a first 1 and a second panel 1' according to one embodiment of the invention. Several cavities 20 are formed in the strip body 7 from the strip surface 7a to the rear side of the panel 1. The cavities extend horizontally to the locking element 8. Cooperating vertically extending protrusions 21 are formed on the second panel 1' between the locking groove 14 and the tongue 10. The locking element 8 is in this embodiment continues along the joint. The cooperation locking surfaces 42, 43 of the locking element and the locking groove are discontinuous.

Figure 2b shows a cross section A-A that intersects a cavity 20 and a protrusion 21. The strip plane SP and the groove plane GP are located essentially in the same

horizontal plane. The protrusion 21 is formed such that it may be inserted in the cavity 20. The extension of the protrusion in the length direction of the joint is smaller than the corresponding extension of the cavity.

It is preferred that the protrusion is 2-5 mm smaller such that a precise positioning during locking is not required when a first panel in a row is installed.

The locking element 8 is located completely below the strip surface 7a and the strip plane SP. This makes it possible to decrease the floor thickness since no locking groove 14 is needed that extends above the strip plane SP.

Figure 2c shows a cross section B-B that intersects a part of the strip 6 where no cavity is formed. This unbroken strip body is connected to the locking element 8. The adjacent second edge 1' has no protrusion and no locking groove. The lower part of the edge 23 is essentially flat and extends essentially horizontally.

Figures 3a and 3b shows the cross sections B-B and A-A in locked position. Figure 3c shows locking by angling. The locking system may also be designed such that it may be locked by horizontal and/or vertical snapping where a strip bends backwards or a small tongue 10 is pressed into a tongue groove.

Figure 4a shows a method to form the cavity 20 with punching. The panel is machined with the surface layer pointing downwards. A punching wheel 30 may be used to form cavities 20 in line with the machining of the locking system when the panel is displaced in relation to rotating cutting tools. The cavities may be formed as an intermediate step, when a part of the locking system is formed, or as a last step when the whole edge is formed - in line or as a separate operation. A rotating cutting

tool 31 may be used, preferably after punching, to form small guiding surfaces on the locking element.

Figure 4b shows a method to form local protrusions 21 with a screw cutter 32 that cuts perpendicularly along the joint. Moving saw blades may also be used.

Figures 4c and 4d shows adjacent edges in locked position. Figure 4d shows that the embodiments of the invention may be combined with a preferably small locking element 8' that preferably comprises upper guiding surfaces, and a small locking groove 14'.

Figure 4c shows that the building panel may comprise a third core layer 5c, preferably positioned vertically within the strip 7, such that the strip 7 is reinforced. The third layer is in a preferred embodiment positioned at the cooperating surfaces of the locking element 8 and the locking groove 14. Such a layer increases the locking strength and makes it easier to position the locking element 8 into the locking groove 14. The core may comprise several such layers.

Figures 5a -5c shows that the horizontal locking according to an embodiment of the invention may be combined with a flexible and displaceable tongue 11 that is fixed into a horizontally extending fixation groove 12 and that snaps during vertical folding. The invention may be used in combination with all known so called fold down systems that are locked with vertical snapping during folding or a side push action after folding when the panels are laying flat on the sub floor. The separate tongue 11 may be fixed to the first 1 or second panel 1' edge. Figure 5d shows a flexible bristle tongue that comprises flexible protrusions 13. The tongue is displaced in the fixation groove 12 during folding. A separate tongue may also be fixed into a groove and may comprise an outer part that is flexible.

Figures 6a - 6d shows that the principles of embodiments of the invention may be combined with a separate strip part 6 that is attached to the panel edge and that comprises cavities 20, 20'. The strip part 6 comprises fixing element 33 and strip legs 34 that may be inserted in grooves or pressed into the plastic core. The strip part 6 may be formed such that it may be connected to the panel edge with essentially a horizontal snapping.

Figure 7a and 7b show cavities that are formed such that the locking element 8 is discontinuous along the joint.

Embodiments of the invention make it possible to form a strong locking in in 3 mm floor panels or even thinner. The floor panel may be formed with an upper lip 24, as shown in figure 2c, of about 1 mm, a tongue 10 and a tongue groove 9 of about 1 mm and a strip body of about 1 mm. The locking element 8 and the locking groove 14 need no material and this means that considerable cost savings may be reached by decreasing the panel thickness.

Figures 8a -8d shows a fold down locking system suitable for very thin floor panels. A separate and preferably flexible and/or displaceable tongue 11 may be inserted into a fixation groove 12 that is formed such that its lower part is located essentially on the same horizontal plane HP as the upper part of the strip 6. The strip 6 is an extension of the lower part of the fixation groove 12. The lower part 9a of the tongue groove 9 is in locked position located essentially on the same horizontal plane HP as the upper part of the strip surface 7a. Figure 8b shows the second panel 1' turned upside down with the surface pointing downwards. The separate tongue 11 overlaps vertically an inner part of the cavity 20. An advantage is that the locking system may be formed in a thinner panel since the protrusions 21 are located in the cavities 20 below the upper part of the strip surface 7a.

Figures 9a -9d show a locking system that may be locked with a vertical motion and that comprises a tongue 10a on the lower part of the protrusion 21. The tongue is in this embodiment formed in one piece with the panel. Figure 9b show that the locking element 8 comprises a flexing part 22 that bends essentially horizontally and outwardly. The tongue 10a locks against an undercut 15 formed on the lower part of the cavity 20. It is an advantage if the protrusion 21 is smaller in the length direction of the joint than the corresponding opening of the cavity 20. This facilitates flexing of the flexible part 22 that will be pushed outwardly during locking. The panel may comprise a reinforcement layer 5c of for example glass fibre or a strong plastic layer that may increase the strength and flexibility of the locking element. The reinforcement layer is preferably unbroken around the whole cavity 20. One or several tongues may be formed on the protrusion at the outer 10a or inner part 10c or on one or both edges 10b, 10d along the joint.

Figures 10a – 10e shows different embodiments of the locking system shown in figure 9. Figure 10a shows a tongue 10c formed at an inner part of the protrusion that may comprise a bending groove 16. Figures 10b and 10c show two tongues 10a, 10c with corresponding undercuts 15, 15a. Figures 10c and 10d show a tongue and groove connection 10,9 formed at an upper edge above the strip and figure 10e shows a hook connection that only locks horizontally.

All embodiments shown in this description may be partly or completely combined and may be used optionally on long and/or short edges.

LVT panels are produced in sheets that are cut vertically into several individual floor panels 1,1. The forming of the locking system creates a waste W, as shown in figure 11a. Figures 11b-11f show that cutting the individual

panels vertically and horizontally may reduce the waste W. A cutting groove 36 is preferably formed with knifes, carving tool or rotating cutting tools and various combinations of such tools. The panels are thereafter separated by a knife 35a that cuts essentially horizontally and a knife or carving tool 35b that cuts essentially vertically. Figure 11e shows that the first edge 1 is formed with a lower part 40 that protrudes horizontally beyond the upper part and the second edge 1' is formed with an upper part 41 that protrudes horizontally beyond the lower part. A non-linear cut with knives or scraping tool may be formed and this may give considerable material savings. Figure 11f shows that the whole cut may be formed with one knife 35c that cuts vertically and horizontally.

Figures 12a and 12b show forming of the panel edges by a screw cutter 32 that cuts perpendicularly to the displacement direction of the panel 1' and forms the protrusions 21.

A locking system in a plastic based LVT flooring may be formed with traditional rotating cutting tools that cut as a saw blade but also partly or completely with cutting knives that may be fixed or rotating. Carving tools may also be used. Figures 13a-13d show that all parts of a mechanical locking system may be formed by cutting knifes which have a straight cutting edge 35a, 35b, 35c or which have an irregular form 35d, 35e, 35f and 35g. Cutting knives with a straight edge are preferably rotating knives. The irregular knives are preferably formed as open V or U - shaped section that allow the cut-off material to flow in the inner part of the cutting tool 37 such that it may be removed when the tool 35 or the panel 1 is displaced in relation to each other.

The knives may be stationary and the panel may be displaced in relation to the knives. It is also possible to displace the knives in relation to a fixed panel.

Increased temperature will facilitate all type of separation and forming of the edges with for example knives, carving, punching wheels, screw cutters etc. since plastic material is considerable softer when the temperature is increased. The panel may be heated completely or only locally with for example infrared lamps, hot air etc. that heat an edge part.

Bevels or rounded edges are easily formed at increased temperature and with rollers or pressing wheels that compress and form the edges. Such forming devices may be embossed and the edges may be formed with the same structure as the panel surface. A decorative paint may be applied during forming.

Parts of the locking system may also be formed with heat and rollers that press and form the edge.

LVT floors are very moisture stable but they expand or shrink when the temperature is changing. Some LVT floors may shrink and expand about 2 mm when the temperature is changing from 10 to 40 degrees Celsius. This may cause problems when LVT floors are installed floating especially in a room with floor heating.

The major reason for the temperature sensitivity is the type of plastic (PVC) that is used in the surface and core layers. Adding special fillers into the core layers may decrease the temperature sensitivity.

The expansion and shrinking may be compensated by the flexibility of the panel. This flexibility must be such that the locking system is able to keep the floor together in low temperature and such that the panels will

not warp or bend upwards when they expand in high temperature.

Figures 14a, 14b and 14d show that the flexibility may be increased considerably if several flexing grooves 19 are formed at the rear side of the core 5b. Such grooves may preferably be formed with knives along and/or across the board. The cut-off material may be recycled completely and used to produce a new core. The grooves may also be formed when the panel is pressed. Such a production method is suitable when the sheets are pressed in a discontinuous press. Knives may preferably be used when the sheets are produced in continuous presses. The material is very easy to remove when the material is hot.

Figures 14b,d show that the flexing grooves may be covered with an underlay 18 that may be foam or any other plastic material similar to the material used in the core. It is preferred that the flexing grooves 19 have a vertical extension of at least about one third of the core thickness.

The grooves 19 may be used to decrease the weight of the panel.

Figure 14c show that including layers that are more stable, for example one or several layers of glass fibre or a sub core 17 that preferably comprises wood fibres, may increase the temperature stability. The sub core 17 may be a high quality HDF board or wood powder based board with high moisture resistance.

Figure 15a-d show a locking system that is locked with vertical snapping. The protrusion 21 comprises a tongue 10a that cooperates with an undercut 15a formed at the rear side of the locking element. The tongue 10 may be formed at an inner part of the protrusion 21. The protrusion 21 and the locking element are bent and displaced horizontally during the vertical motion, as

shown in figures 15b and 15c. Figure 15d shows a cross section where no protrusion and cavity are formed. Such cross section has only a horizontal locking. This embodiment is characterized in that the locking system comprises a first set of sections along the joint that locks only horizontally and a second set of sections that locks horizontally and vertically. The locking system is also characterized in that the protrusion 21 and the locking element 8 are displaced horizontally during the vertical motion.

Figures 16a - 16d shows a locking system similar to the system shown in figures 15a - d. The tongue 10a is however formed at an outer part of the protrusion 21. The locking element 8 may also be discontinuous as shown in figures 16c-d. Such geometry facilitates the forming of the cavities 20 that may be formed with rotation tools. This embodiment is characterized in that the locking system comprises a first set of sections along the joint (A-A) that locks only vertically and a second set of sections (B-B) that only locks horizontally.

Figures 17a-c shows the locking of the locking system according to figures 16a-d. A first set of sections A and the second set of sections B are displaced vertically wherein the protrusion 21 is displaced horizontally and inwardly during locking.

Figures 18a-c shows a locking system where the cavities 21 and protrusions 20 are mainly used to guide the floor panels during the angling action. The horizontal locking is accomplished with cooperating locking surfaces 42,43 on the locking element 8 and the locking groove 14 that are located above and below the strip plane SP. A strong locking may be obtained in plastic material with vertically extending locking surfaces that are only about 0,2 - 0,5 mm, especially if the locking angle 44 on a part of the locking surfaces is high, for example about

90 degrees as shown in figure 18b. The locking is only possible if a protrusion is positioned above a cavity. The locking may be accomplished in several steps. In case the protrusion 21 is not above the cavity 20 as shown in figure 18c, the panels will stay in an angled position. A displacement along the joint may thereafter take place and the protrusion 21 will automatically fall into the cavity 20 as shown in figure 18c. Figure 18 shows that the tongue 10 may be formed on the edge comprising a cavity 20. This embodiment may be used to save material.

Figure 19 shows that flexing grooves 19 may be formed at the rear side with a length that is smaller than the length of the rear side. Such forming may be made with rotating jumping tools or with knives. The advantage is that the flexing grooves 19 are not formed in the edge sections where the locking system is formed. The flexing grooves 19 may be essentially parallel with the long edges and may have a length that is smaller than the distance between the locking systems on the short edges.

Figure 20a-b show that position marks 45 may be formed by mechanical forming or with colour spots on the tongue 10 such that they are visible from the front side. They may be used to position the protrusions 21 above the cavities 20. Figure 20b shows that the flexing grooves 19 may be discontinues and arranged in various patterns.

Figure 21a-d show that resilient floors may be delivered in rolls with overlapping short edges where each roll corresponds to one row. The rolls have preferably a width of 0,1 - 0,5 m and may comprise floor material that in installed position has a length of several metres. A preferred embodiment is a roll comprising a resilient flooring material, preferably PVC material, which in an unrolled and installed position has a length that is larger than 15 times the width. An even more preferred embodiment is a roll with an installed length that is

larger than about 50 times the width. Such a roll may be about 0,2 m wide and about 10 m long and may comprise 2 m2 of flooring material. An extruded locking strip 46 comprising a first 47 and second 48 upwardly extending protrusions may be attached in a holding groove 49 in one edge of the roll. The first upwardly extending protrusion 47 is attached in a holding groove 49 of a first edge 1 and the second upwardly extending protrusion 48 is rolled and pressed during installation into a locking groove 14 formed in the adjacent edge 1' of a second roll. Such a combined pressing and rolling action facilitates the insertion of the protrusion 48 into the locking groove 14 since the protrusion is gradually inserted into the locking groove when the floor is unrolled.

Figures 22a-22d shows that all the above described embodiments may be used to form locking strips 46a, 46b that may be attached on adjacent panel edges or roll edges as separate strips in order to provide a vertical and/or horizontal locking. Figure 22b and 22c shows that punching of an extruded plastic section may form locking strips comprising cavities 20 and protrusions 21. Figure 22d shows the locking strips in a locked position. The locking system is locked by vertical displacement where the protrusions 21 are inserted into the cavities 20 with a rolling motion. The first upwardly extending protrusion 47 may be combined or replaced by glue or thermal bonding. The locking strips may comprise several upwardly extending protrusions 48', 48 as shown in figure 22d.

The methods above may also be used to lock linoleum floors and other resilient floors.

CLAIMS

1. Building panels provided with a locking system for vertical and horizontal locking of a first edge (1) and a second edge (1′) of adjacent panels, said locking system comprises a tongue (10) and a tongue groove (9), for vertical locking, and at the first edge (1) a strip (6) provided with a locking element (8), which cooperates for horizontal locking with a downwardly open locking groove (14) formed in the second edge (1′)
c h a r a c t e r i s e d in

that the strip (6) comprises a strip body (7) with a cavity (20),

that the second edge (1′) comprises a local protrusion (21) that extends downwards, and

that the protrusion (21) is located in the cavity (20) when the panels are locked vertically and horizontally.

2. The building panels as claimed in claim 1, wherein the locking element (8) is a part of the cavity (20).

3. The building panels as claimed in claim 1 or 2, wherein the cavity (20) extends entirely through the strip body (7).

4. The building panels as claimed in claim any one of the preceding claims, wherein the locking element (8) is discontinuous along the first edge (1).

5. The building panels as claimed in any one of the preceding claims, wherein the protrusion (21) is discontinuous along the second edge (1′).

6. The building panels as claimed in any one of the preceding claims, wherein the strip body (7) comprises several cavities (20).

7. The building panels as claimed in any one of the preceding claims, wherein the second edge (1') comprises several local protrusions (21).

8. The building panels as claimed in any one of the preceding claims, wherein the strip body (7) comprises a horizontal strip plane (SP), positioned at the lowest part of the upper strip surface (7a), wherein the locking groove (14) comprises a horizontal groove plane (GP), positioned at the upper and inner part of the locking groove (14), and wherein the strip plane (SP) and the groove plane (GP) are closer to each other vertically than the vertical extension of the locking element (8).

9. The building panels as claimed in claim 8, wherein said strip plane (SP) and groove plane (GP) are located essentially at the same vertical level.

10. A method to produce a panel with a locking system according to any one of the claims 1-9 wherein the method comprises the steps of:

forming at least a part of the cavity with punching; and

forming at least a part of the protrusions by a screw cutter.

11. Building panels provided with a locking system for vertical and horizontal locking of a first edge (1) and a second edge (1') of adjacent panels, said locking system is configured to lock the edges by a vertical displacement of the first edge (1) and the second edge (1') relative each other, the locking system comprising a separate tongue (11) fixed into a fixation groove (12),

said tongue cooperates with a tongue groove (9) for vertical locking, and a strip (6) at the first edge (1) provided with a locking element (8), which cooperates for horizontal locking with a downwardly open locking groove (14) formed in the second edge (1'),
c h a r a c t e r i s e d in that

the strip (6) comprises a strip body (7) with a cavity (20),

that the second edge (1') comprises a local protrusion (21) that extends downwards,

that the protrusion (21) is located in the cavity (20) when the panels are locked vertically and horizontally, and

that a lower part (9a) of the tongue groove (9) is located essentially on the same horizontal plane (HP) as the upper part of the strip surface (7a) when the adjacent panels are locked vertically and horizontally.

12. The building panels as claimed in claim 11, wherein the locking element (8) is a part of the cavity (20).

13. The building panels as claimed in claim 11 or 12, wherein the cavity (20) extends entirely through the strip body (7).

14. The building panels as claimed in claim 12 or 13, wherein the strip body (7) comprises several cavities (20).

15. The building panels as claimed in any one of the preceding claims 11-14, wherein the second edge (1') comprises several local protrusions (21).

16. Building panels provided with a locking system for vertical and horizontal locking of a first (1) and a second edge (1') of adjacent panels, said system is configured to lock the edges by a vertical displacement of the first (1) and the second edge (1') relative each other, the locking system comprises a tongue (10a, 10b, 10c, 10d), which cooperates with a tongue groove (9) or an undercut (15, 15a) for vertical locking, and a strip (6) at the first edge (1) provided with a locking element (8), which cooperates for horizontal locking with a downwardly open locking groove (14) formed in the second adjacent edge (1') (1') c h a r a c t e r i s e d in

that the strip (6) comprises a strip body (7) with a cavity (20),

that the second edge (1') comprises a local protrusion (21) that extends downwards, and

that the protrusion (21) is located in the cavity (20) when the panels are locked vertically and horizontally.

17. The building panels as claimed in claim 16, wherein the locking element (8) is a part of the cavity (20).

18. The building panels as claimed in claim 16 or 17, wherein the cavity (20) extends entirely through the strip body (7).

19. The building panels as claimed in any one of the claims 16-18, wherein the tongue is located at a lower part of the protrusion (21).

20. A method to produce a panel comprising a locking system that locks vertically and/or horizontally wherein the method comprises the steps of:

forming a part of the locking system with knives (35e, 35f, 35g) that comprise an essentially V or U shaped open cutting edge; and

displacing cut-off material such that it flows in the inner part of the open cutting edge during cutting.

21. A method to separate a sheet into a first (1) and a second floor panel (1′) and to form two adjacent edges (1,1′) comprising a locking system that locks vertically and/or horizontally wherein the first edge (1) comprises a lower part (40) that protrudes horizontally beyond an upper part and the second edge (1′) comprises an upper part (41) that protrudes horizontally beyond a lower part wherein the method comprises the step of:

cutting the sheet and separating the panels by cutting knives that cuts horizontally and vertically; and

forming the lower part (40) on the first panel (1) and the upper part (41) on the second panel (1′) by said cutting.

22. Floor panels provided with a locking system for vertical and/or horizontal locking of a first edge (1) and a second edge (1′) of adjacent panels comprising a plastic wear layer (3) and one or several plastic core layers (5a, 5b) c h a r a c t e r i s e d in that

the core layer (5b) comprises several essentially vertical flexing grooves (19) with a vertical extension of at least about one third of the core thickness.

23. The panel as claimed in claim 21, wherein the flexing grooves are covered with an underlay (18)

24. The panel as claimed in claim 22 or 23, wherein the flexing grooves (19) are essentially parallel with the long edges and have a length that is smaller than the distance between the locking systems on the short edges.

25. Resilient floor panels with long and short edges provided with a locking system for vertical and/or horizontal locking of a first edge (1) and a second edge (1′) of adjacent panels comprising a resilient material that allows a bending with overlapping short edges c h a r a c t e r i s e d in that

the first edge (1) is a long edges (1) provided with a plastic locking strip (46) extending along the first edge and protruding horizontally from the edge,

that the locking strip (46) comprises at least one vertically extending protrusion (48) configured to be inserted into a locking groove (14) formed at the second edge, which is a long edge of an adjacent panel.

26. The resilient floor panel as claimed in claim 25, wherein the locking strip (46) is a thermoplastic extruded section.

27. The resilient floor panel as claimed in claim 25 or 26, wherein the length is a least 15 times larger than the width.

Fig. 1a

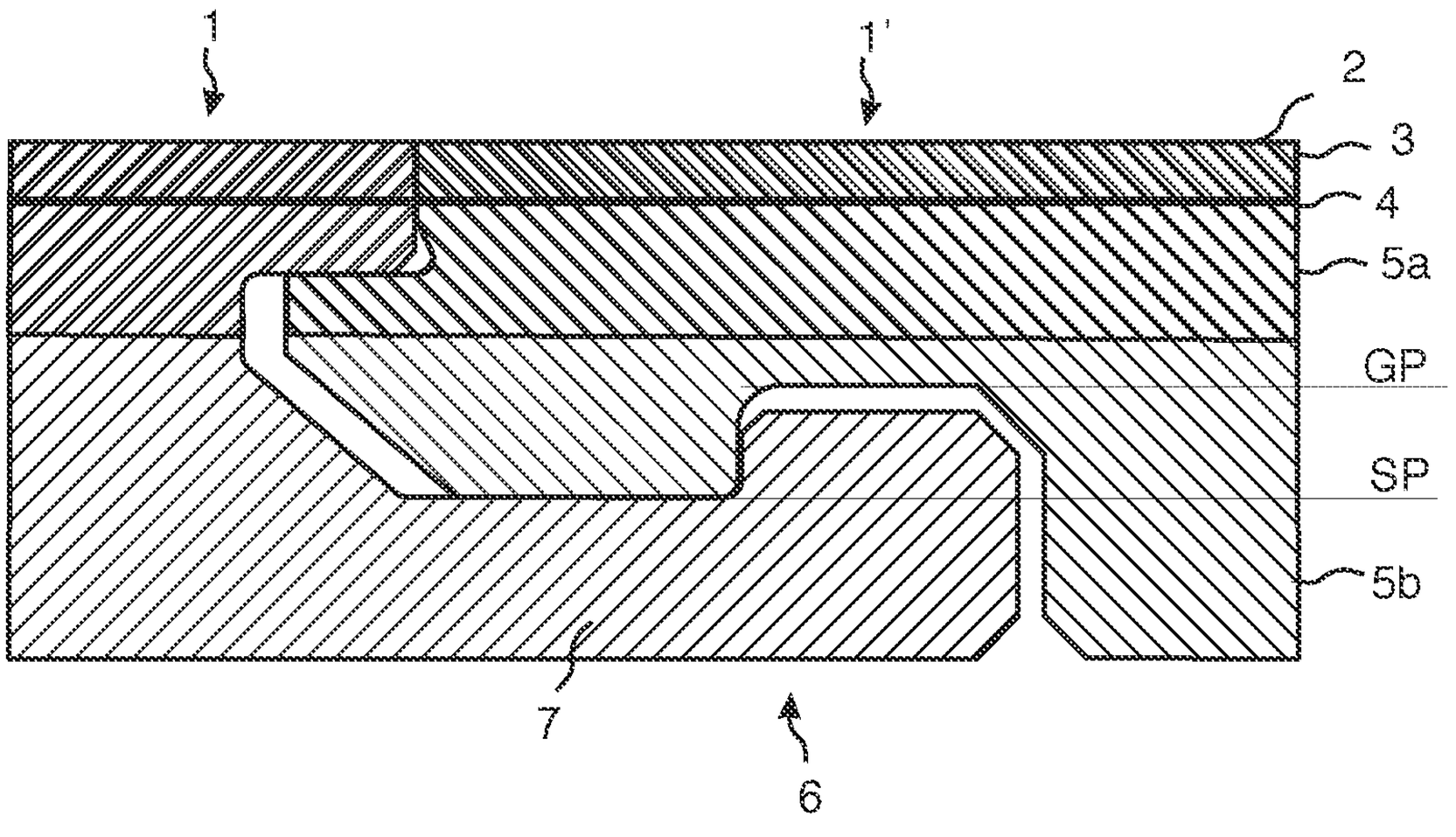
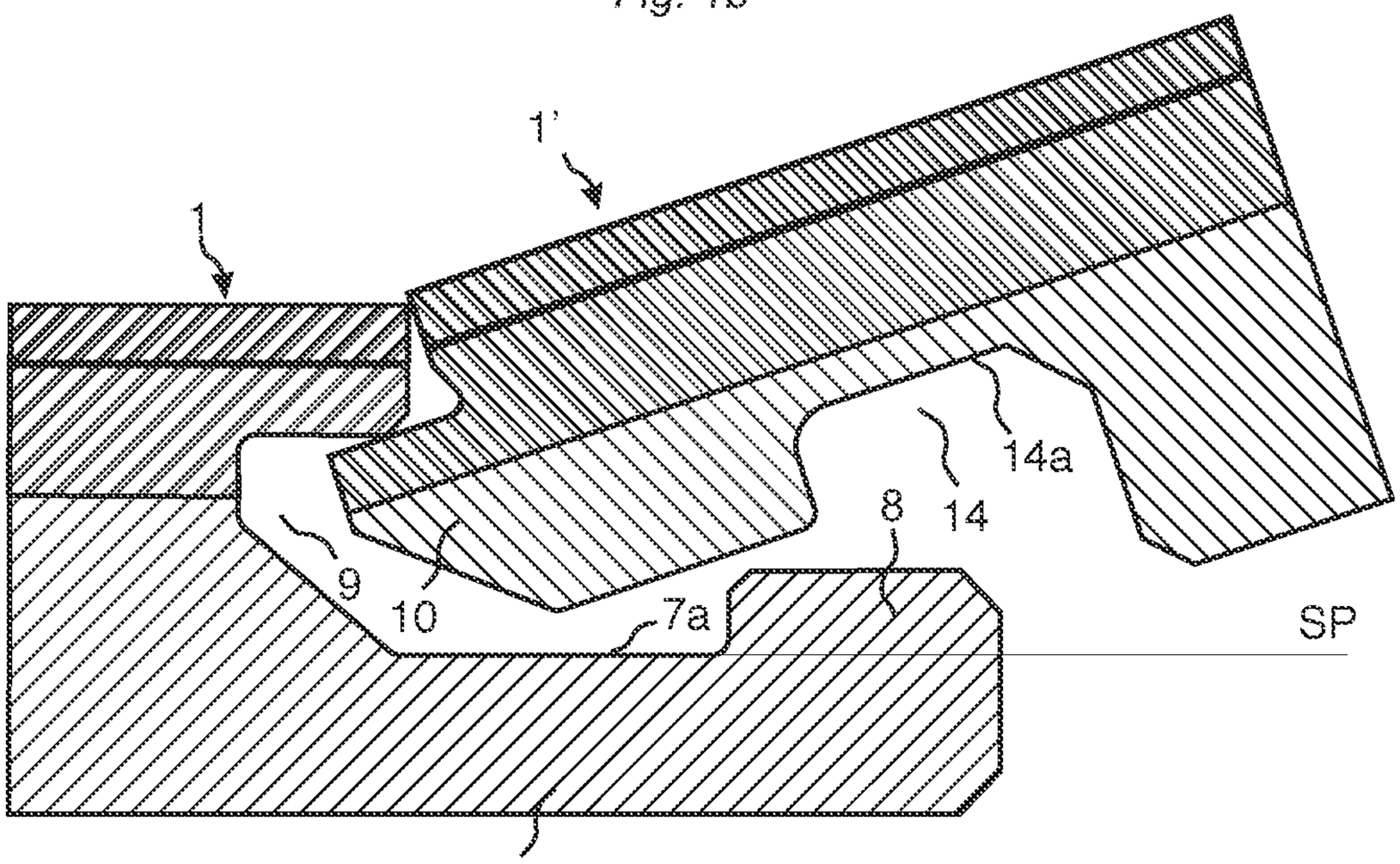


Fig. 1b



KNOWN TECHNOLOGY

Fig. 2a

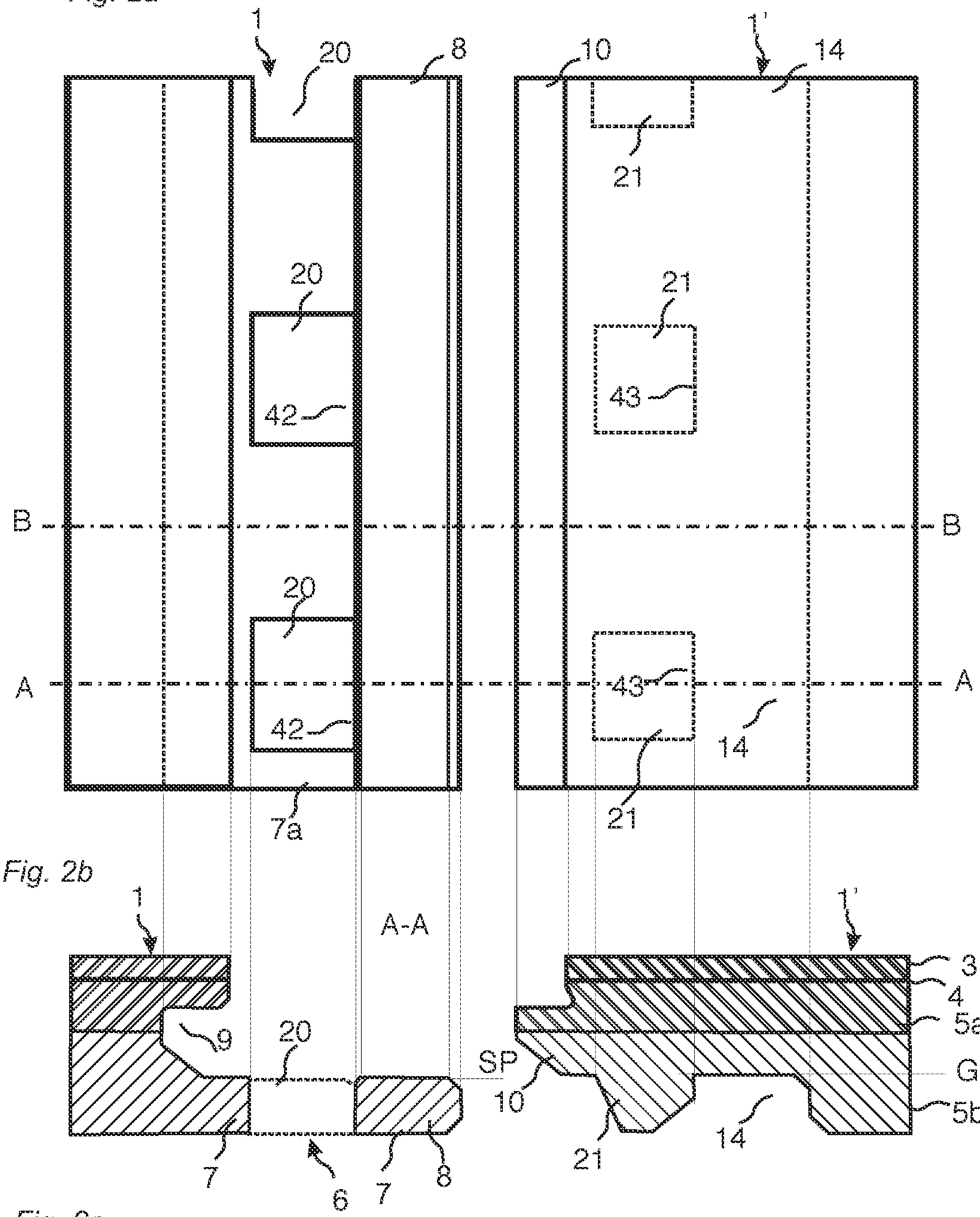


Fig. 2b

Fig. 2c

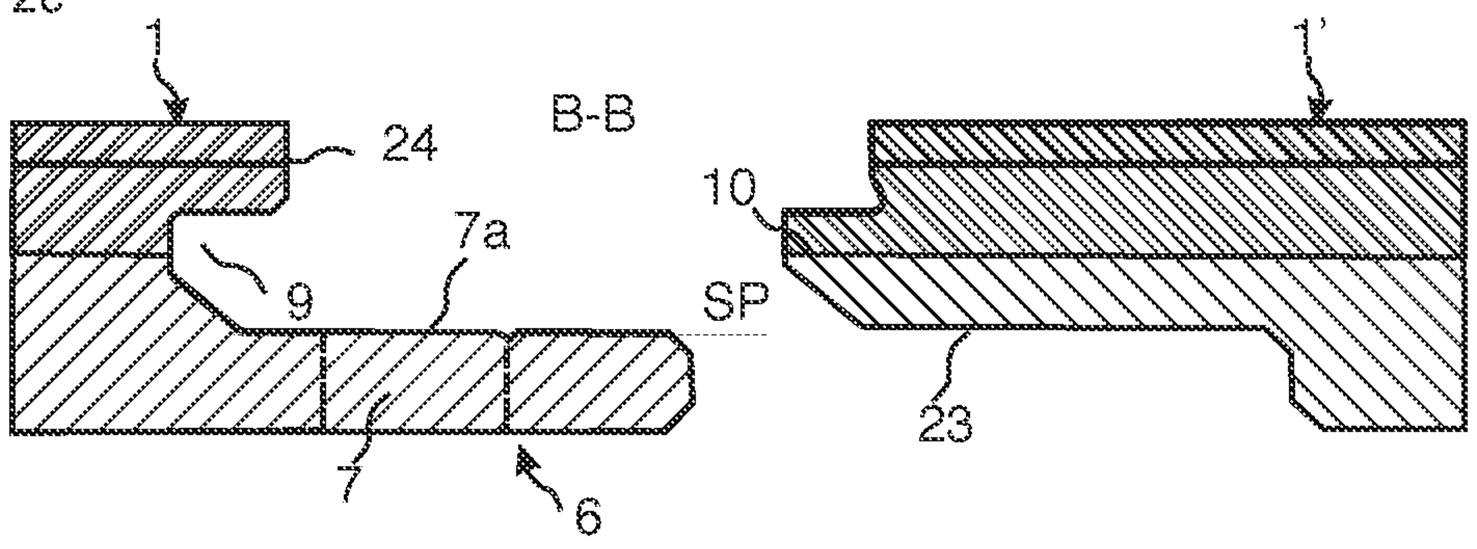


Fig. 3a

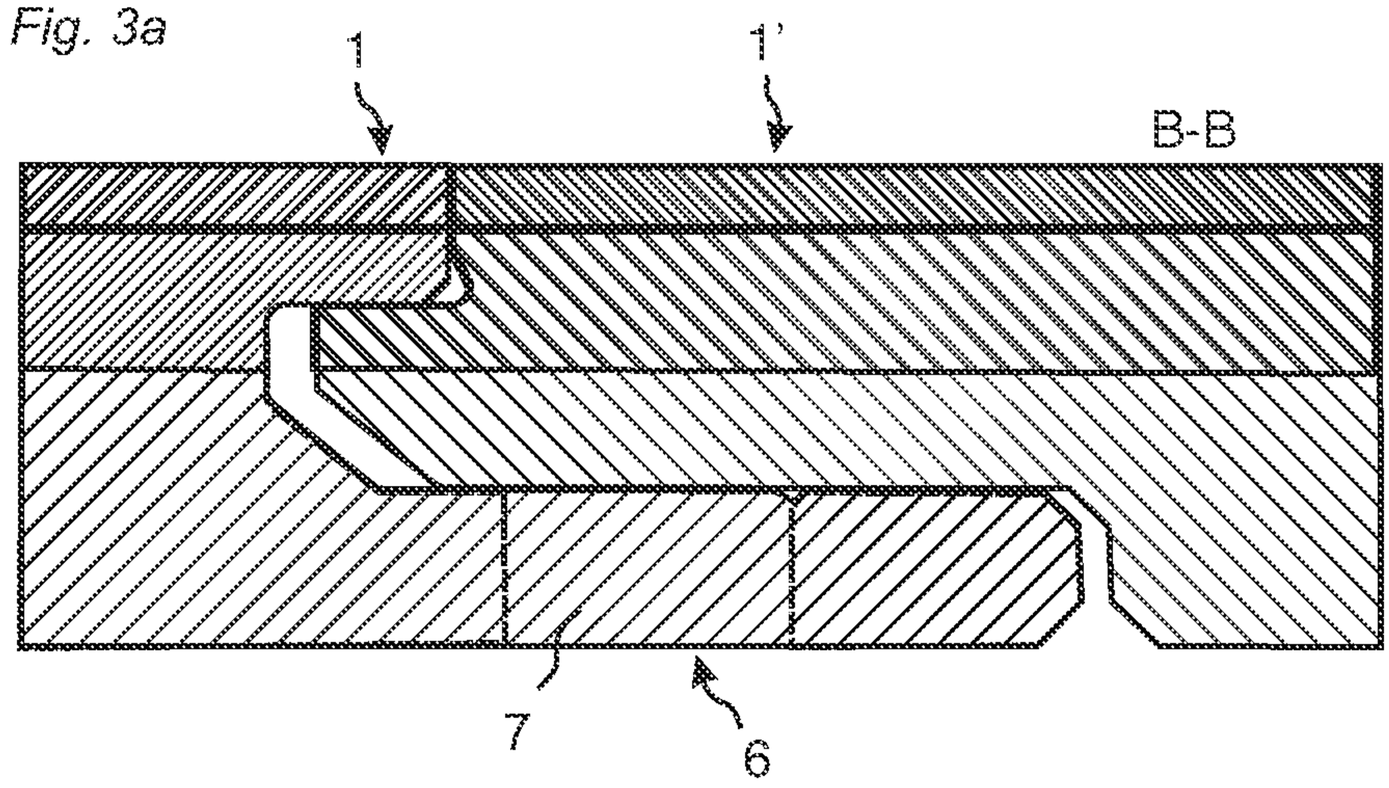


Fig. 3b

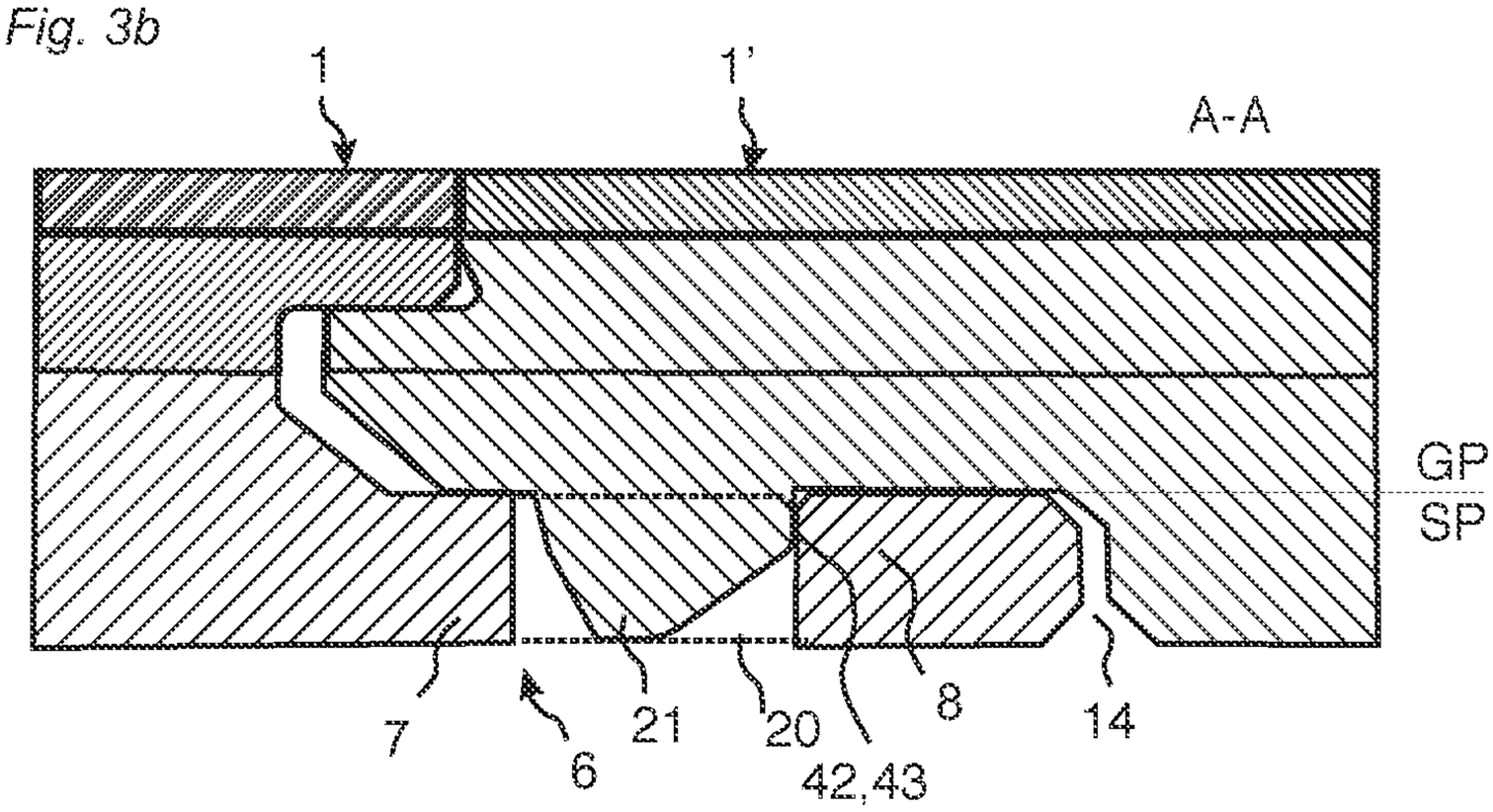


Fig. 3c

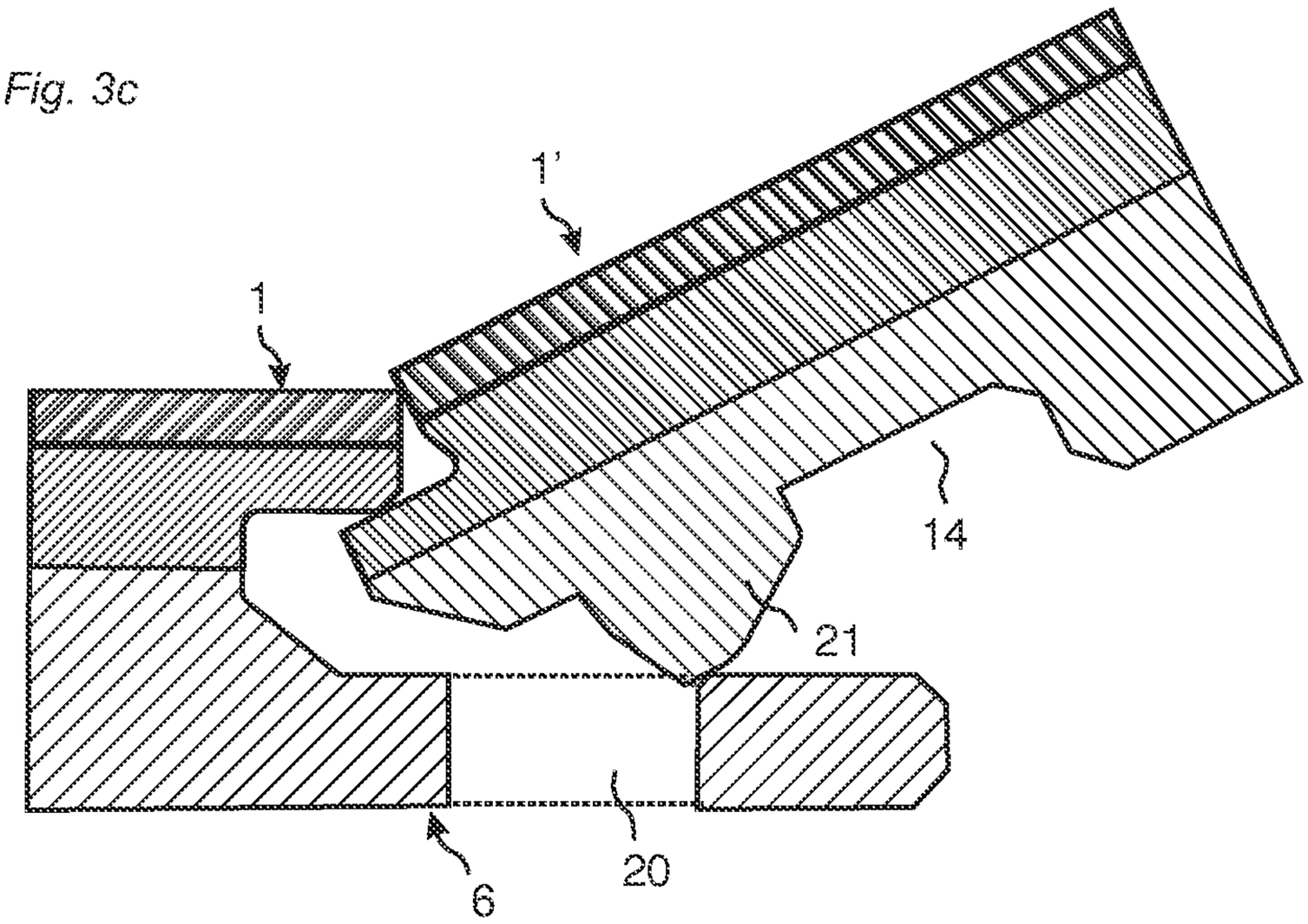


Fig. 4a

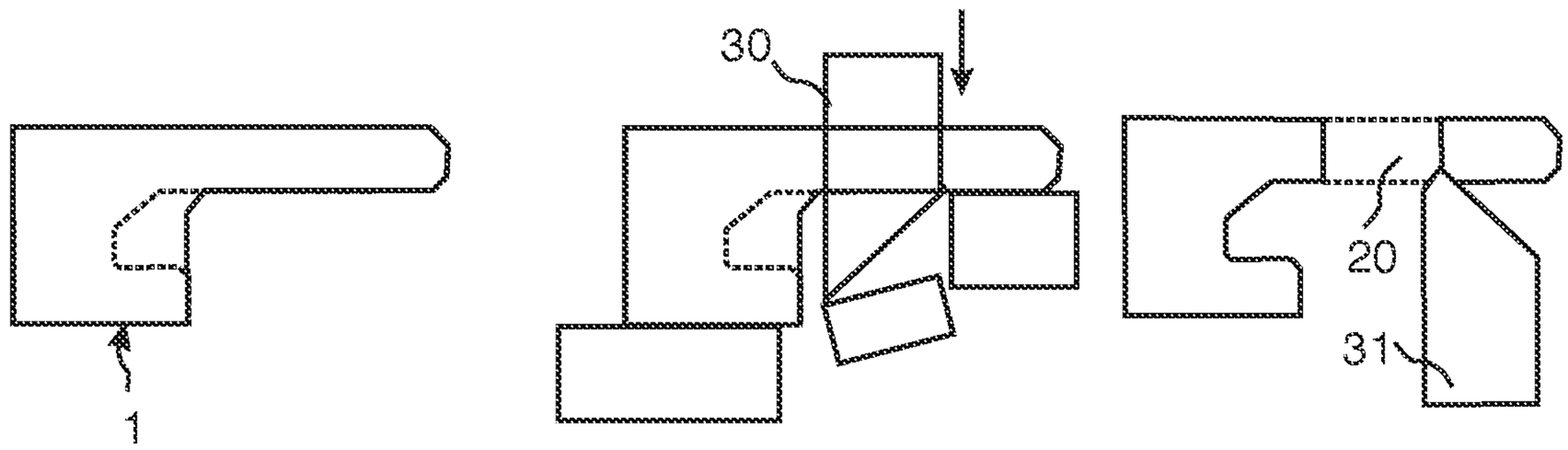


Fig. 4b

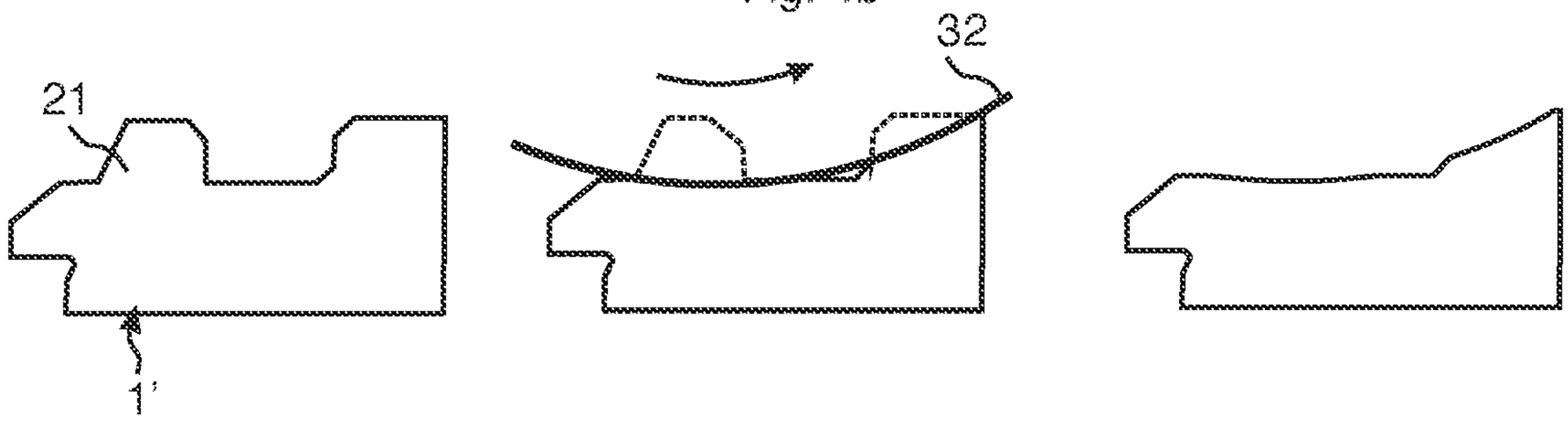


Fig. 4c

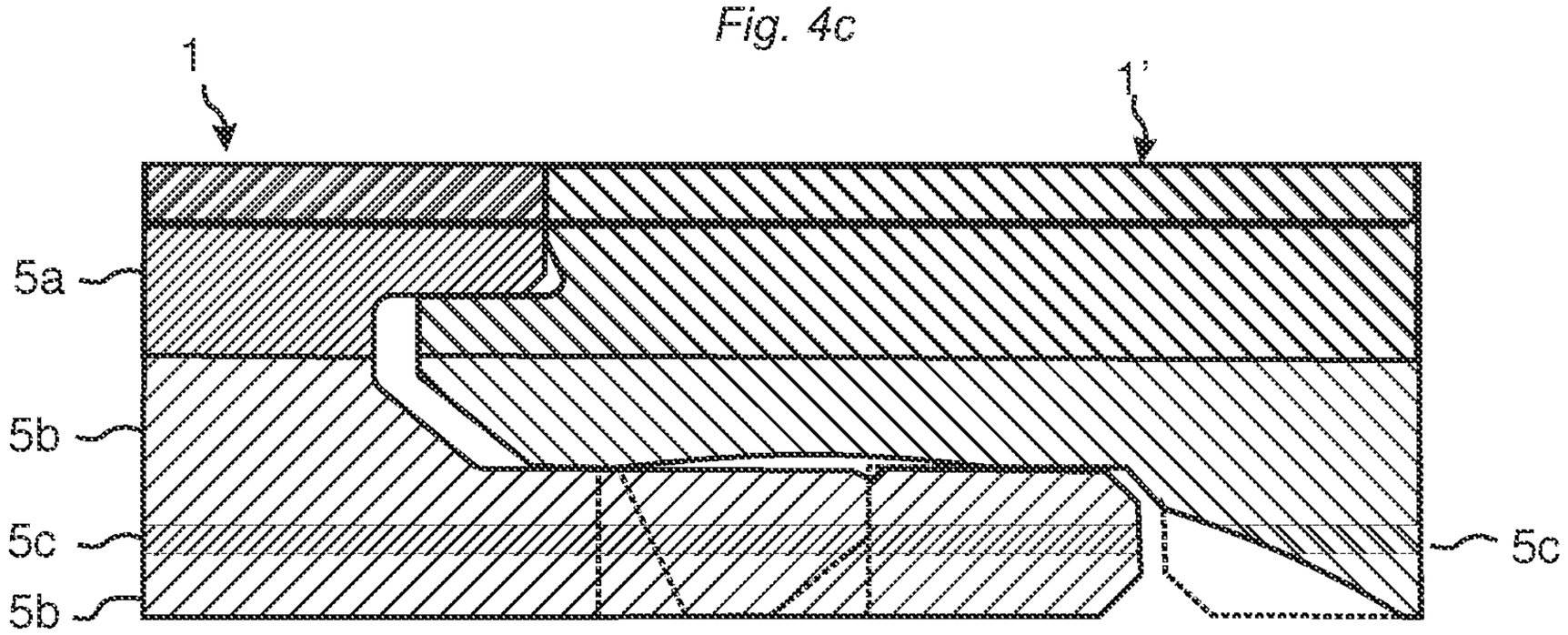


Fig. 4d

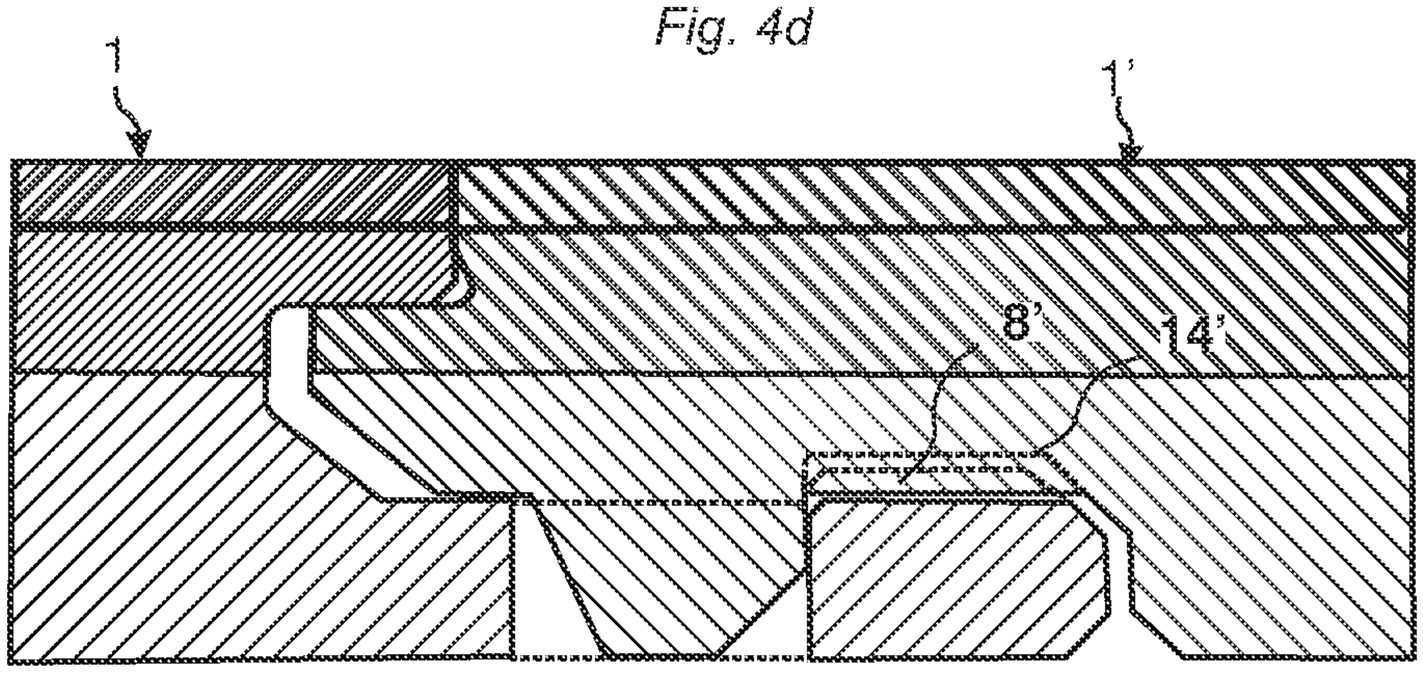


Fig. 5a

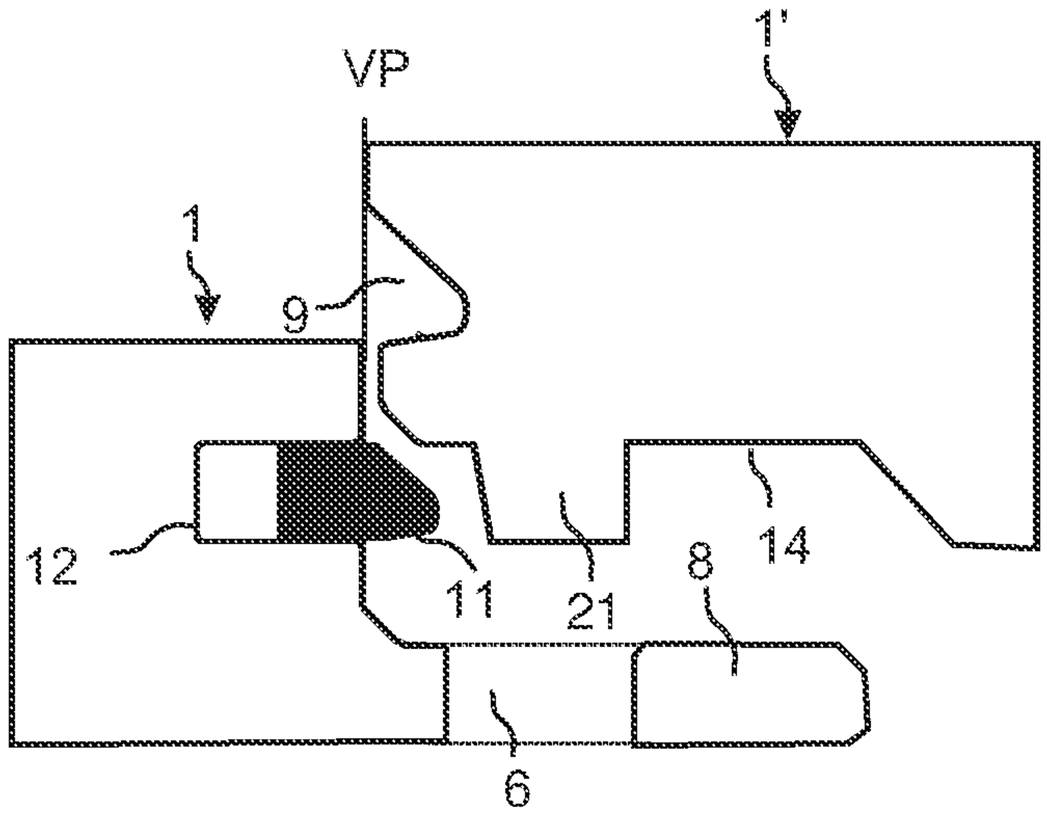


Fig. 5b

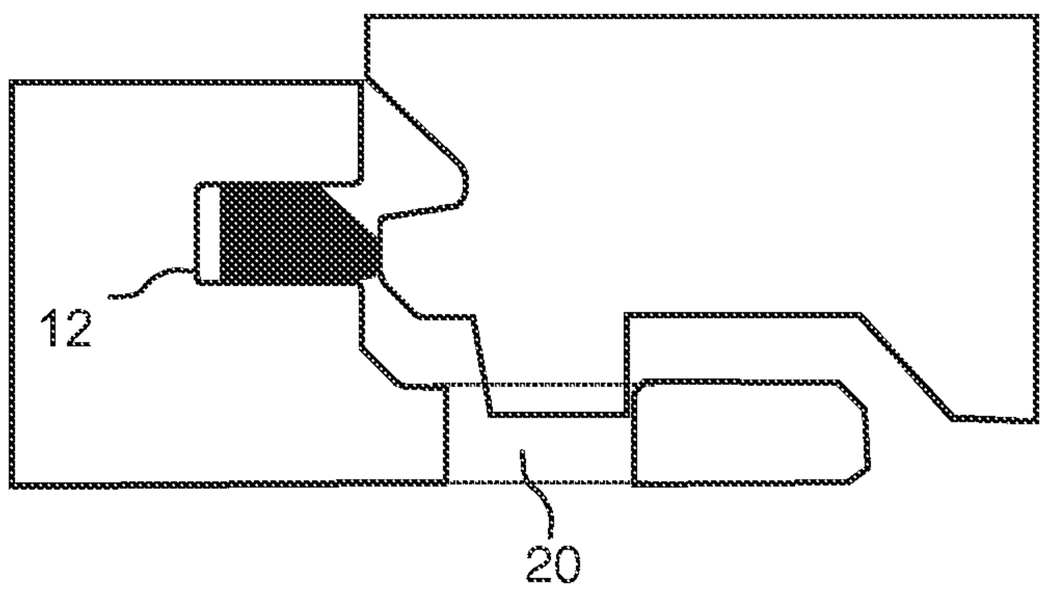


Fig. 5c

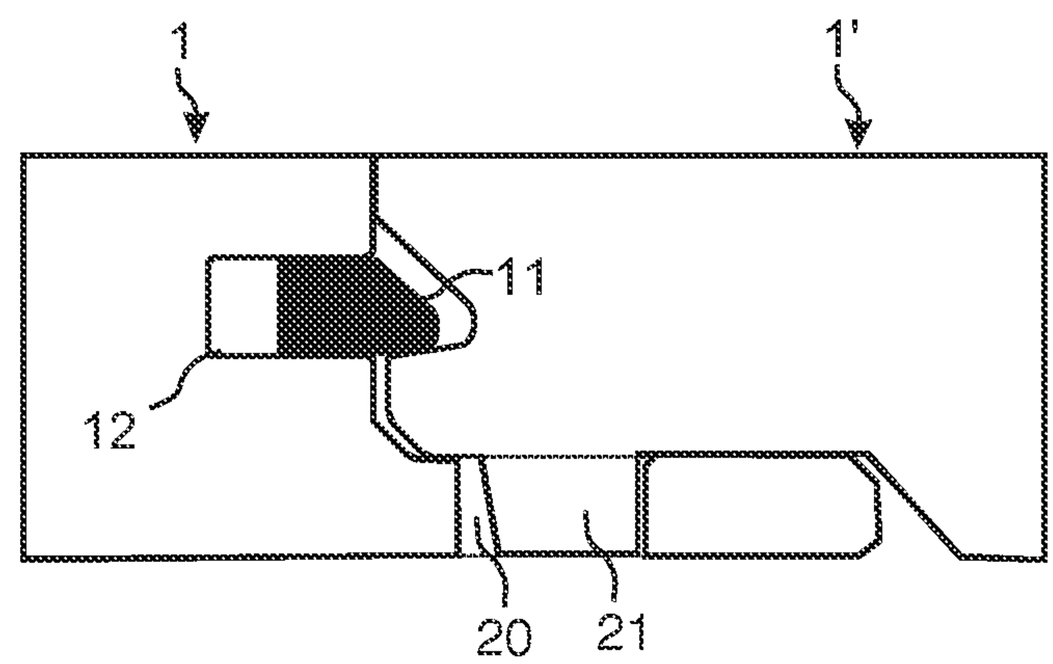


Fig. 5d

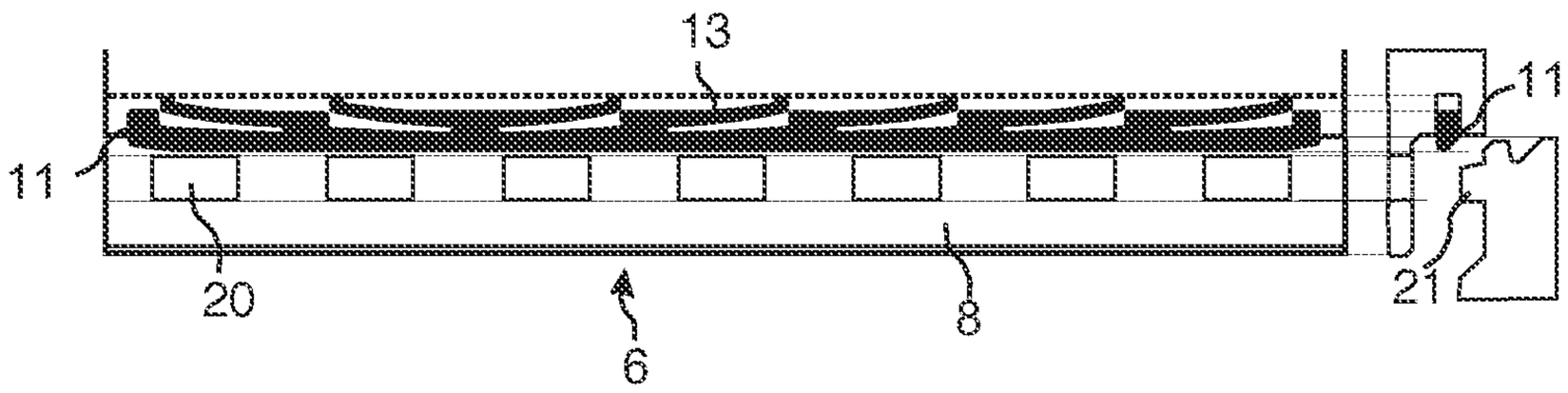


Fig. 6a

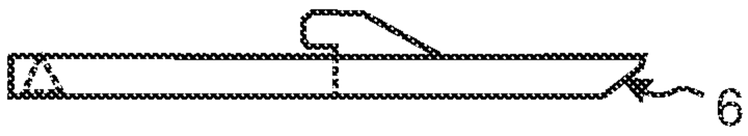


Fig. 6b

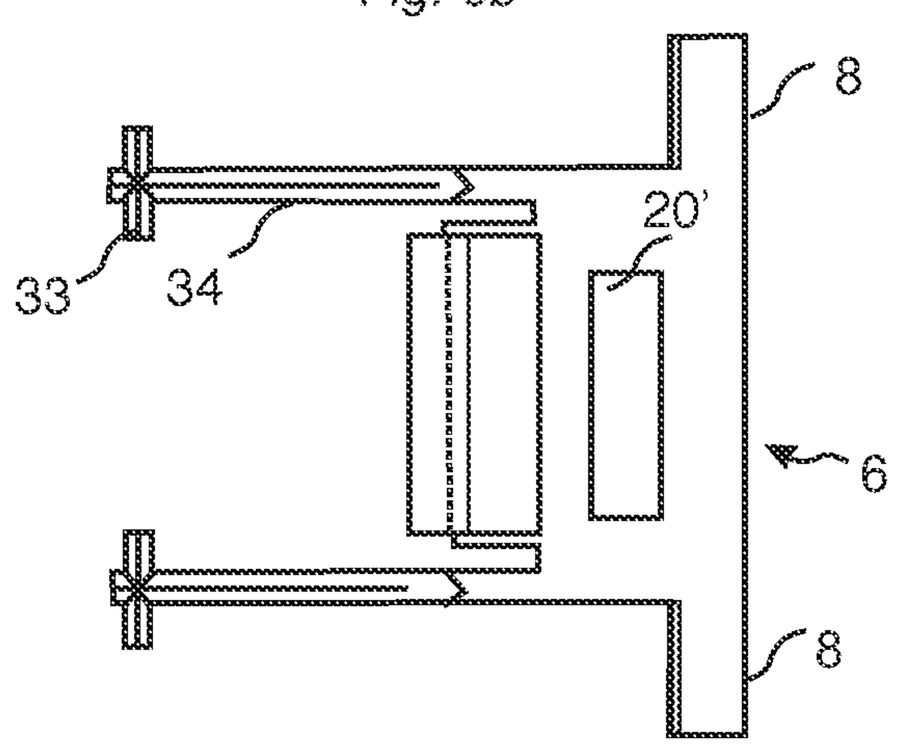


Fig. 6c

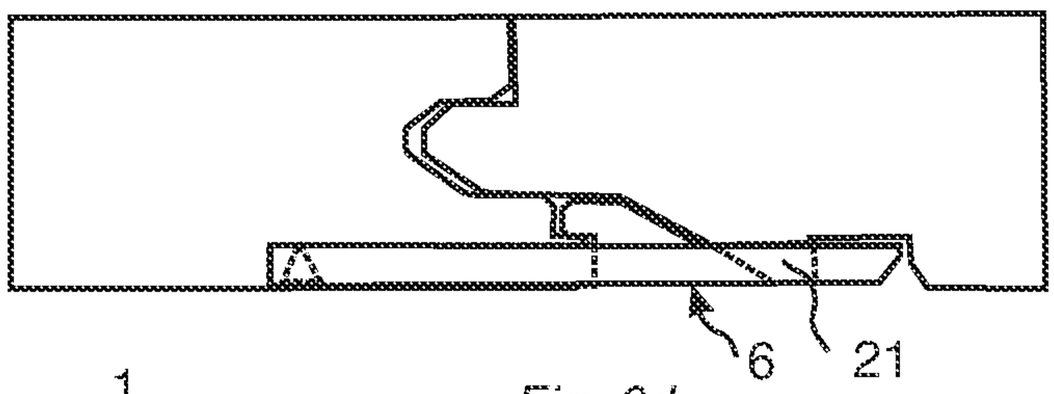


Fig. 6d

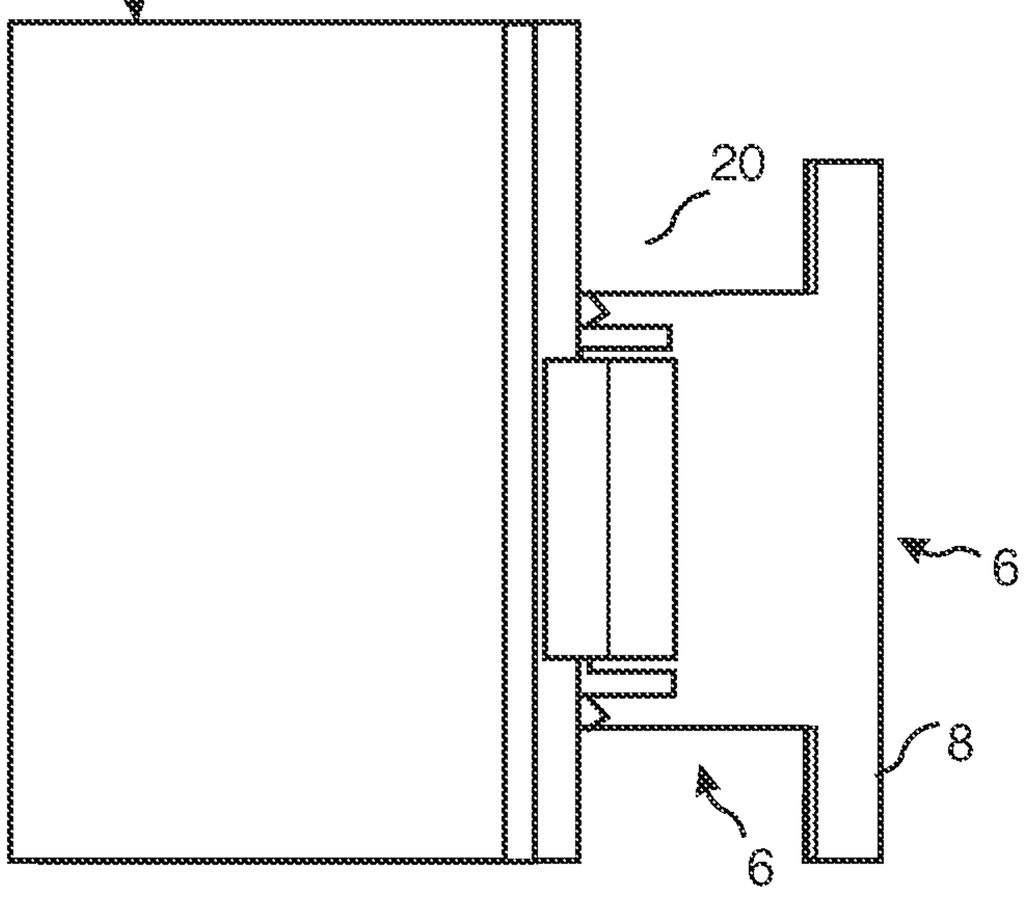


Fig. 7a

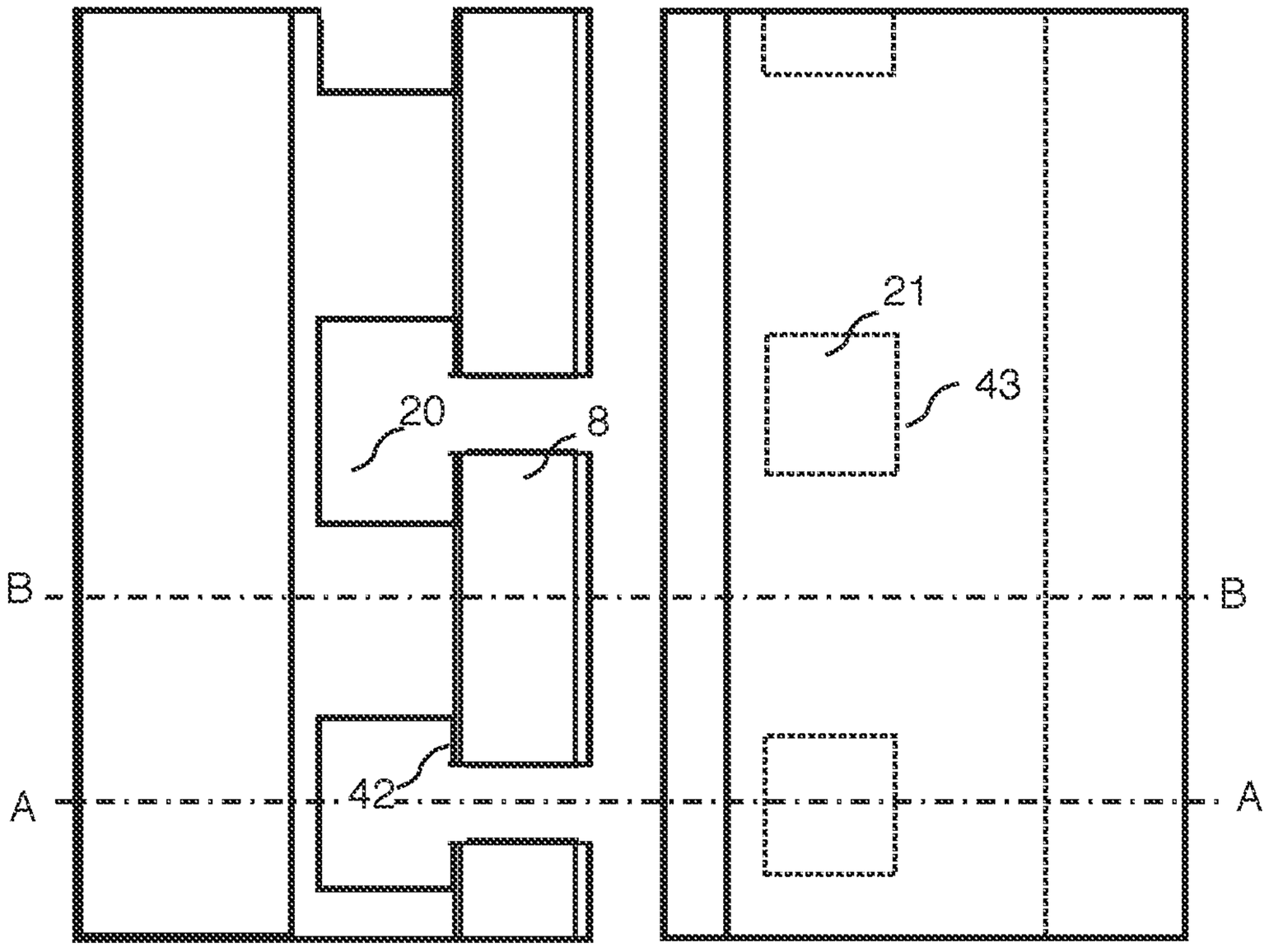


Fig. 7b

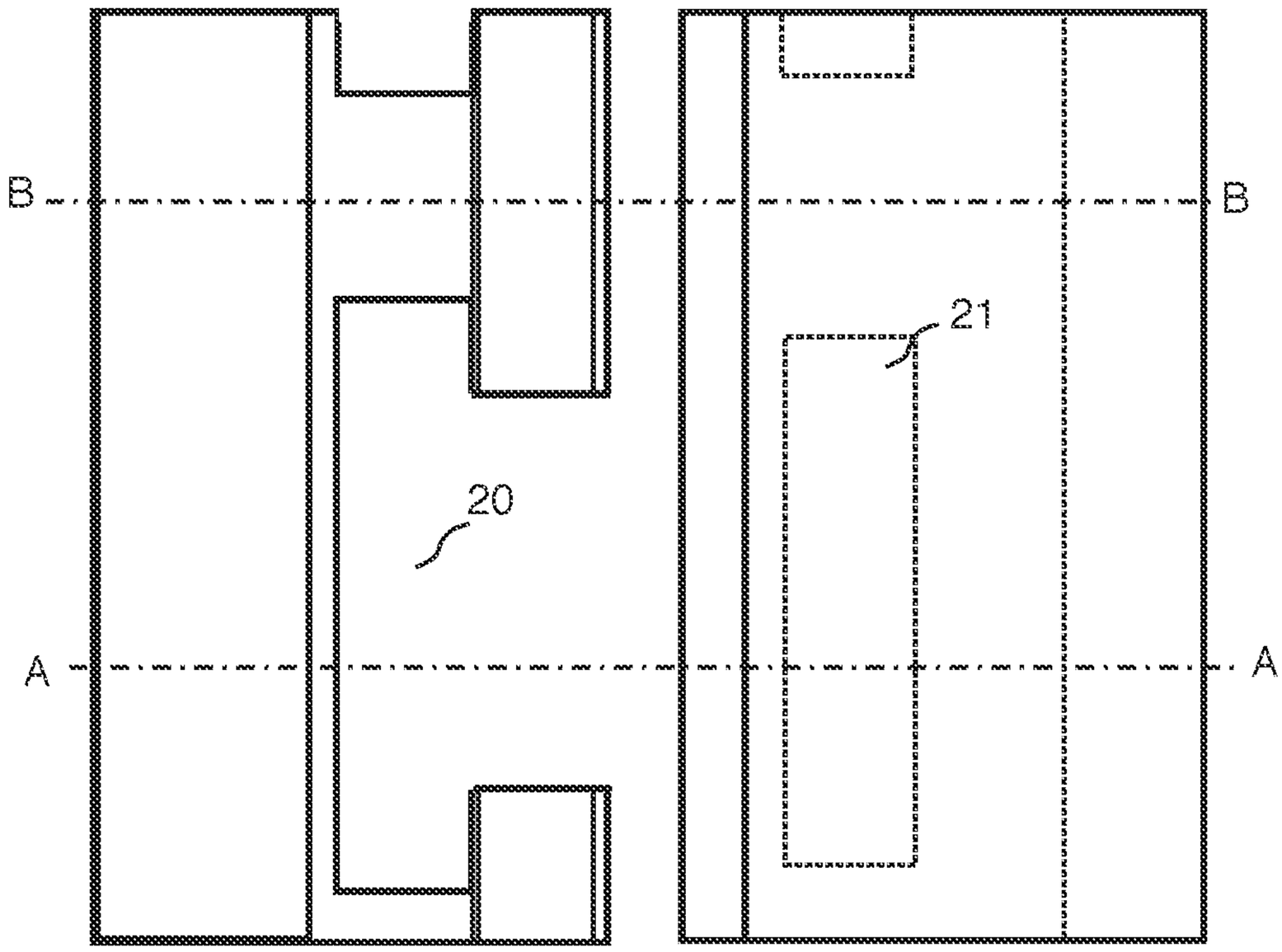


Fig. 8a

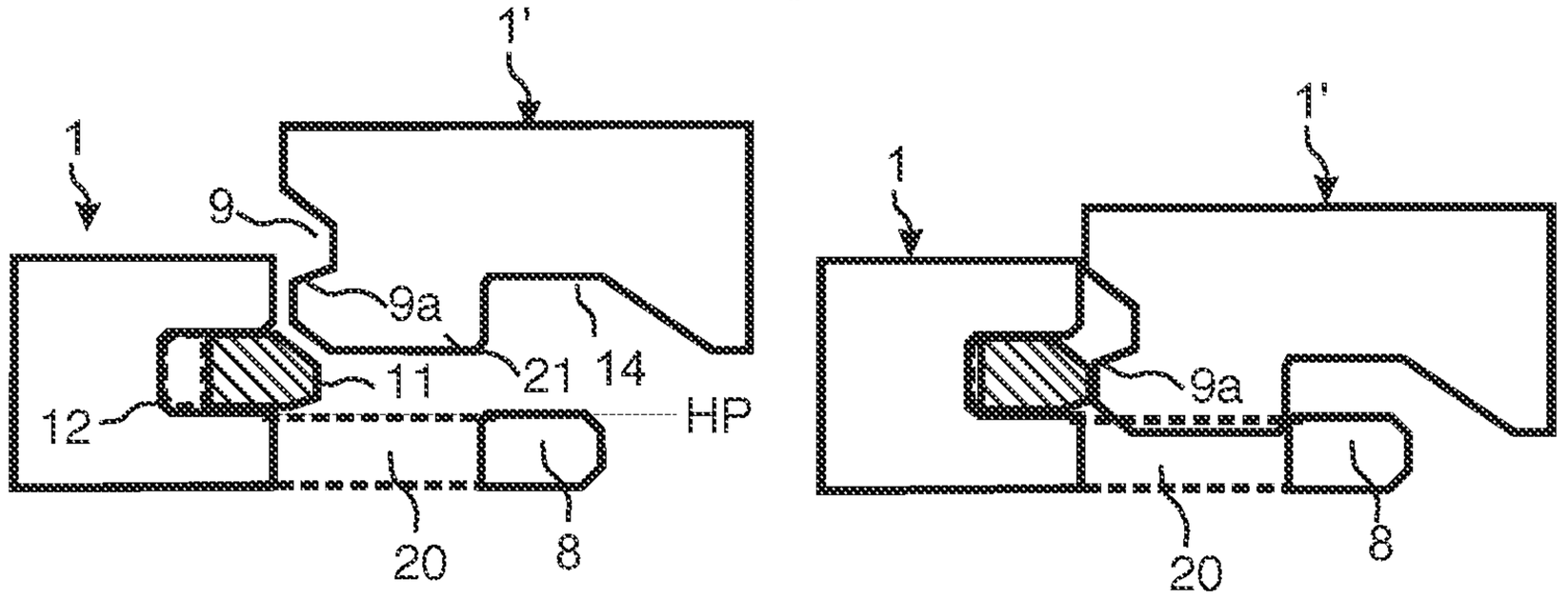


Fig. 8b

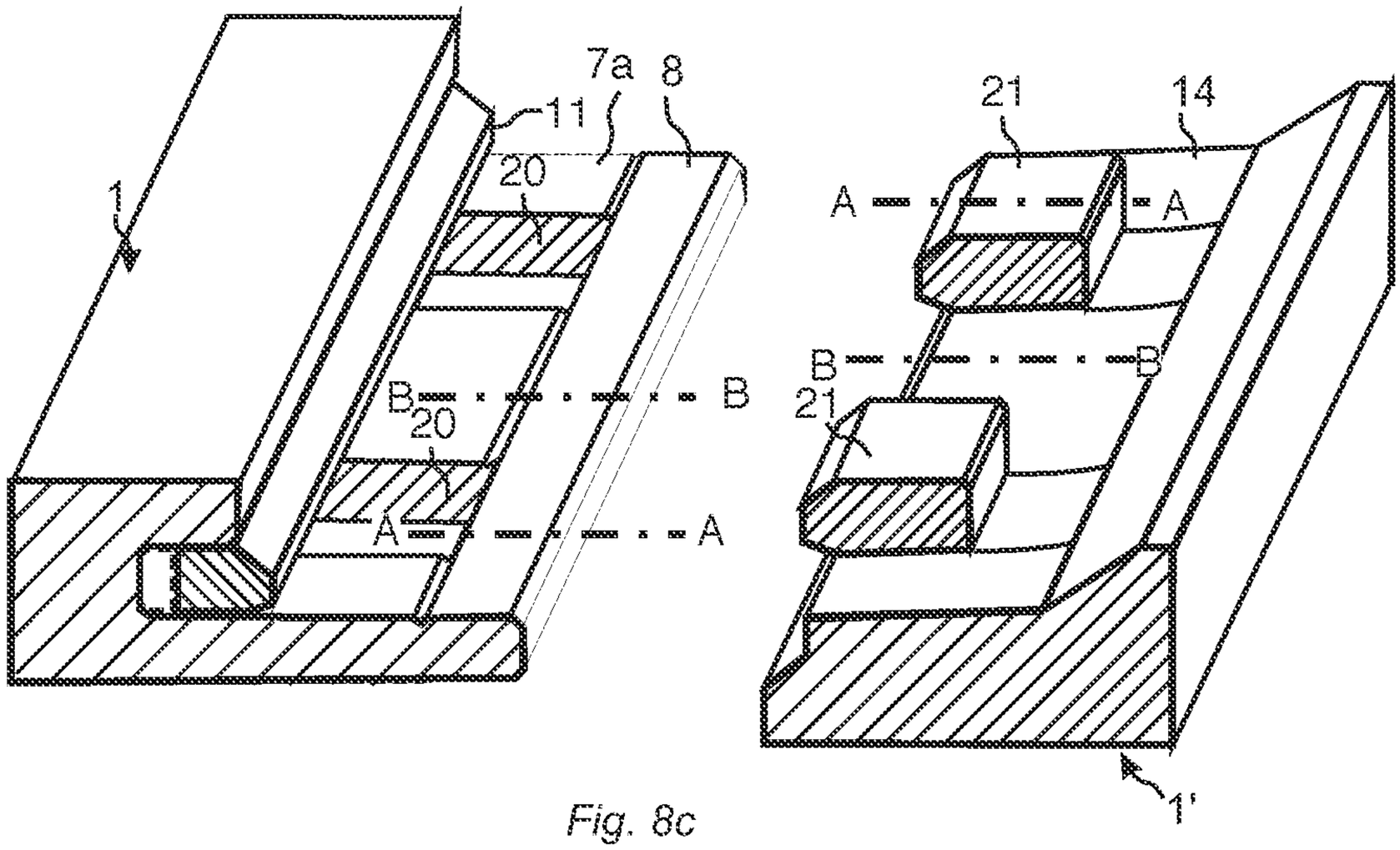


Fig. 8c

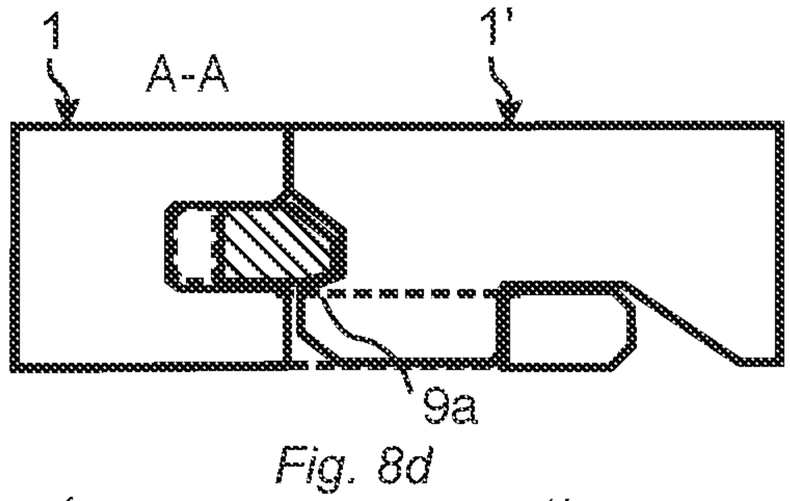


Fig. 8d

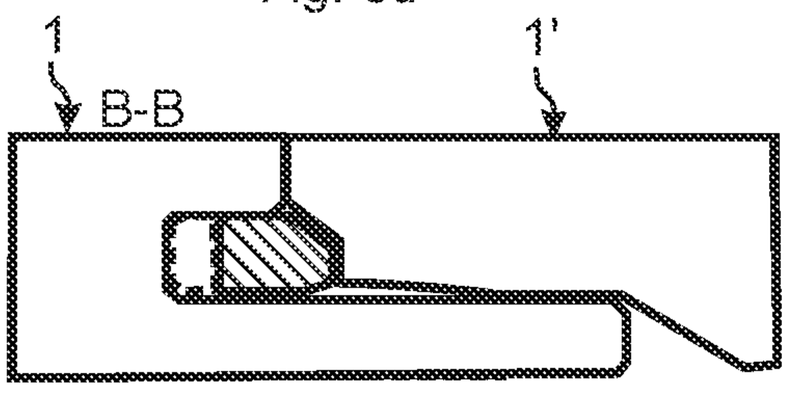


Fig. 9a

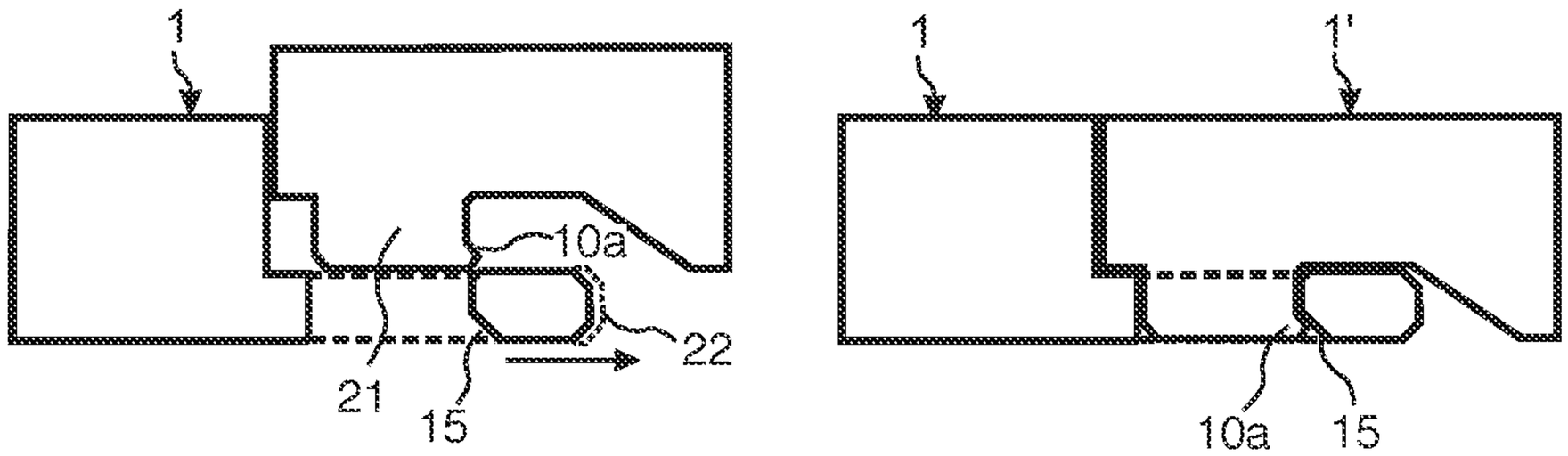


Fig. 9b

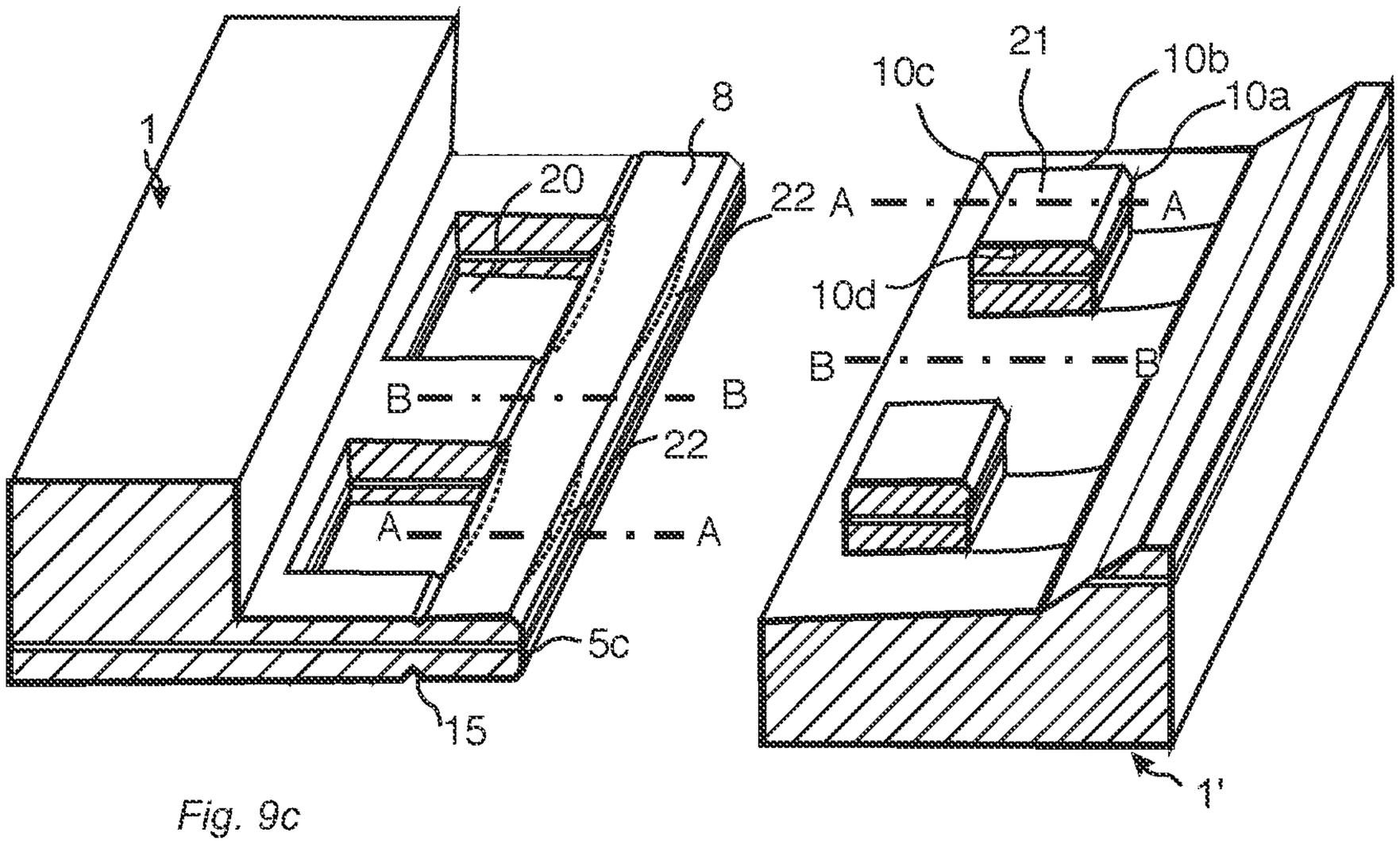


Fig. 9c

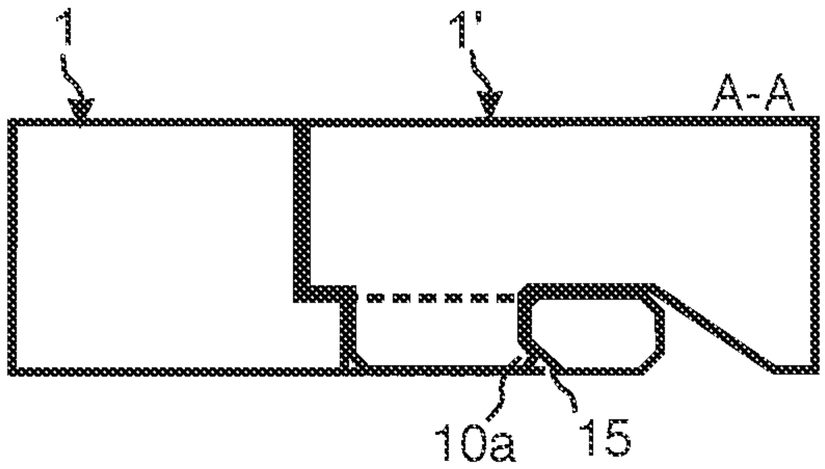


Fig. 9d

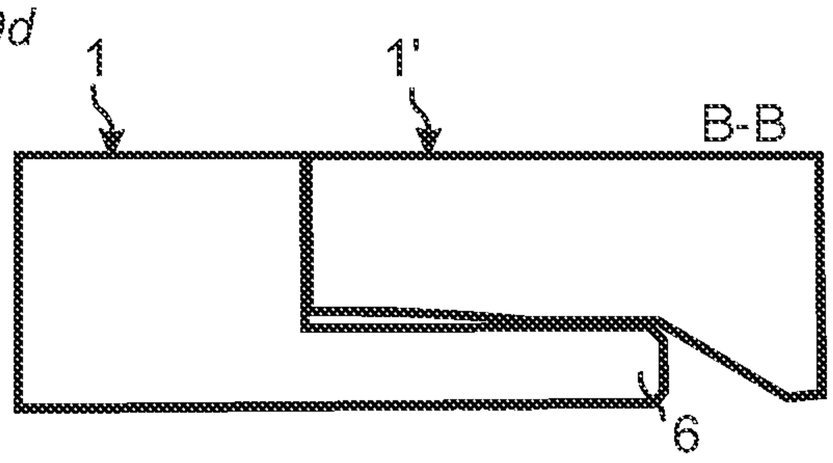


Fig. 10a

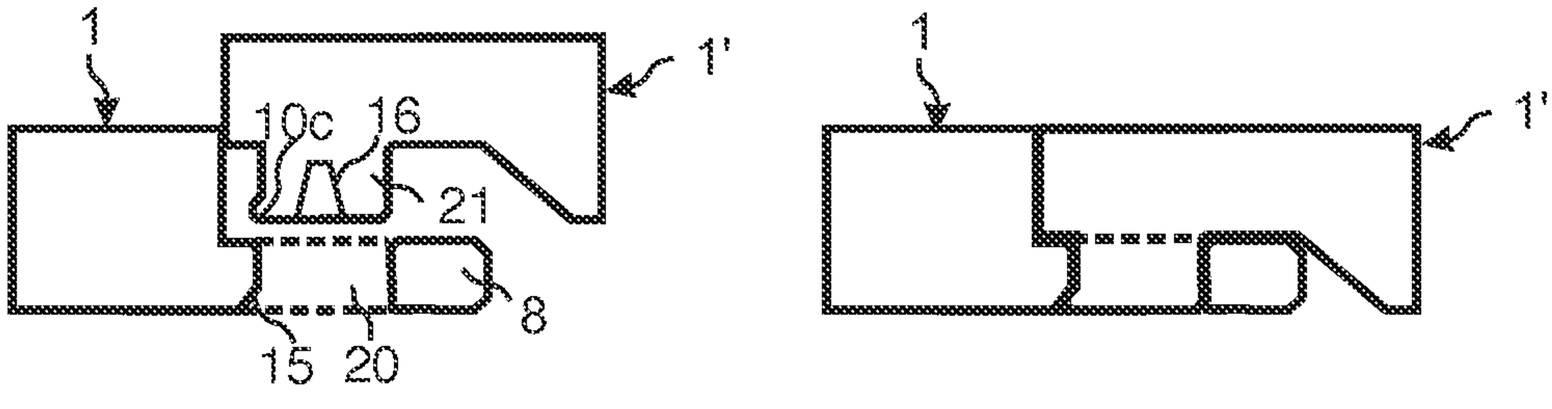


Fig. 10b

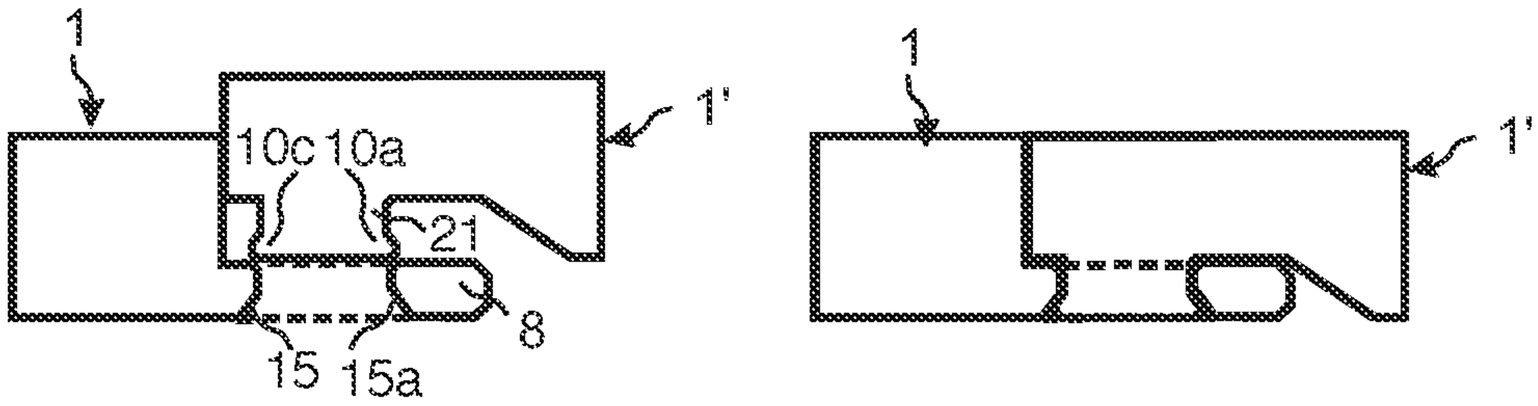


Fig. 10c

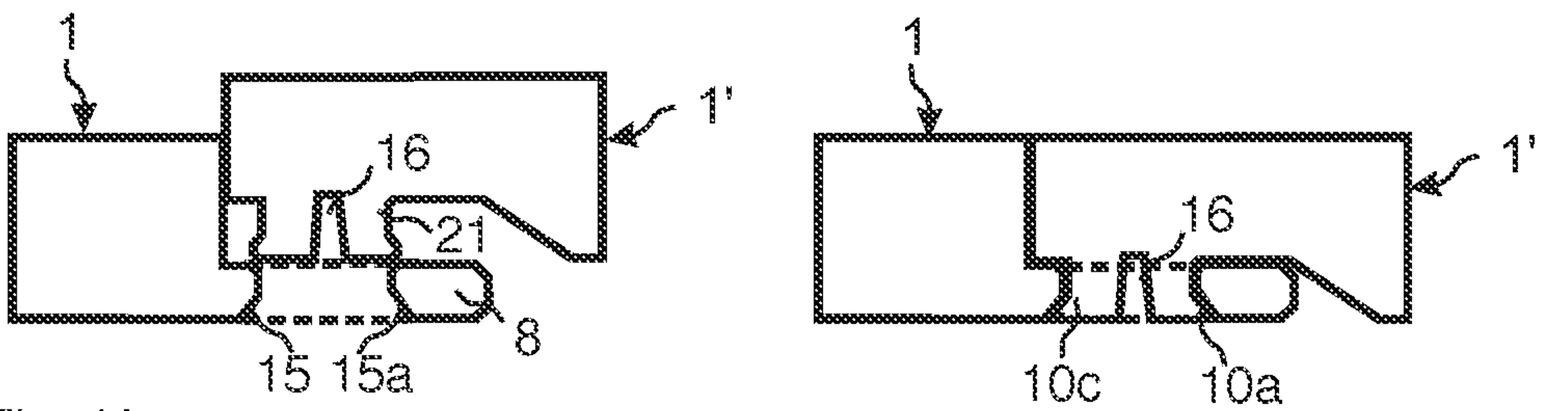


Fig. 10c

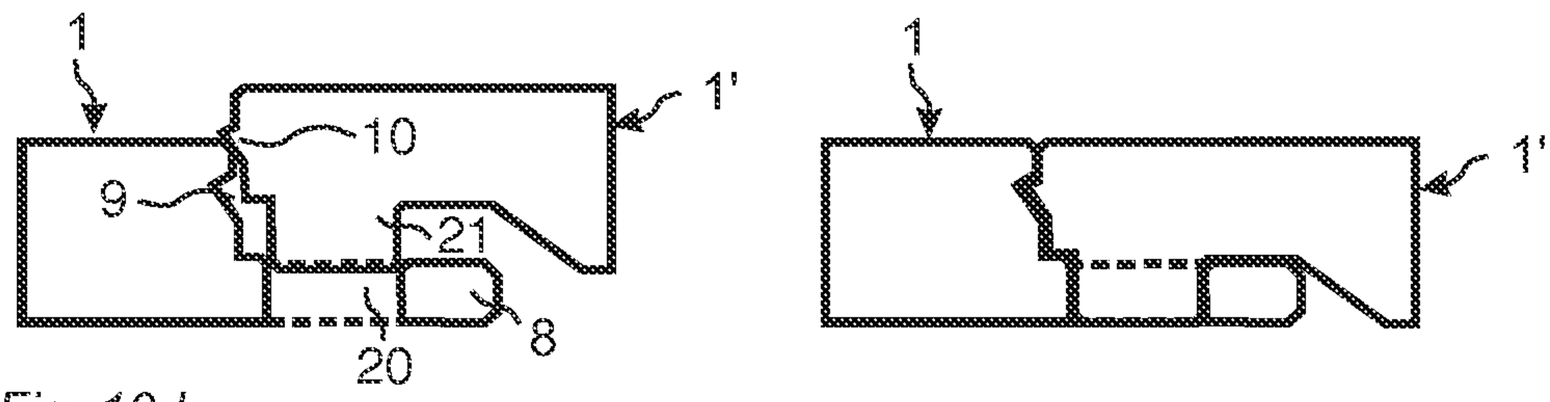


Fig. 10d

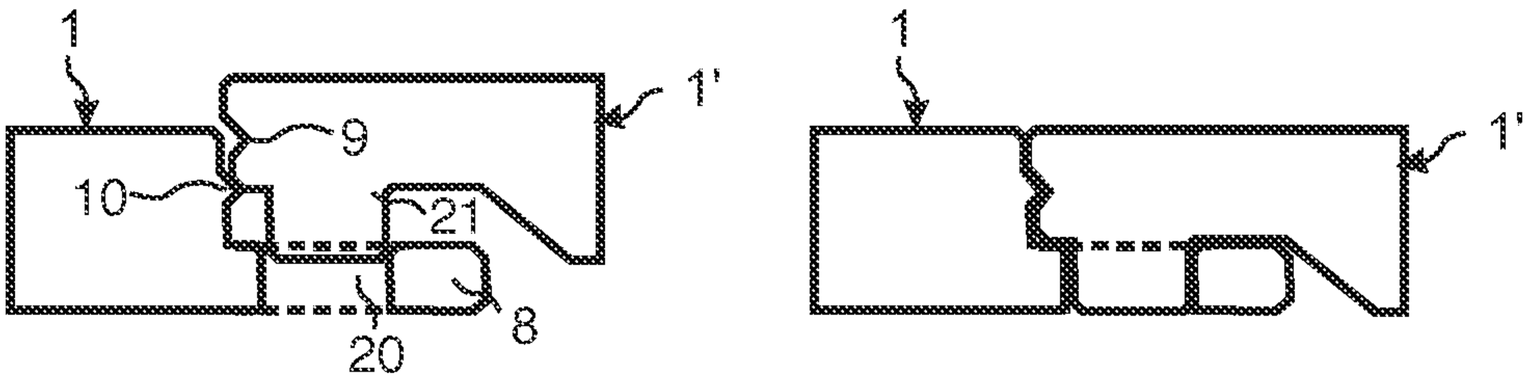


Fig. 10e

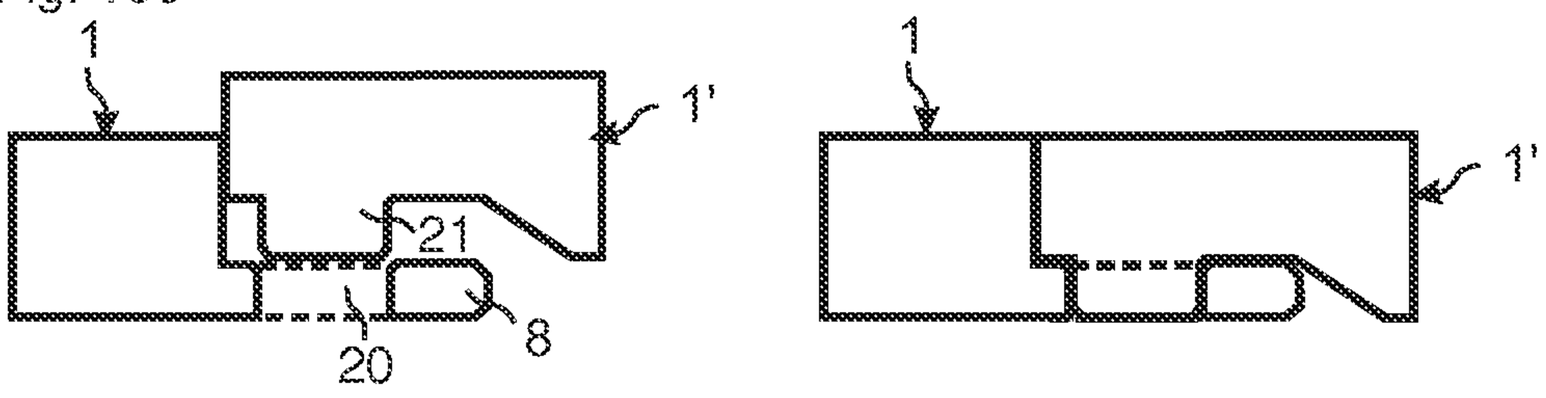


Fig. 11a

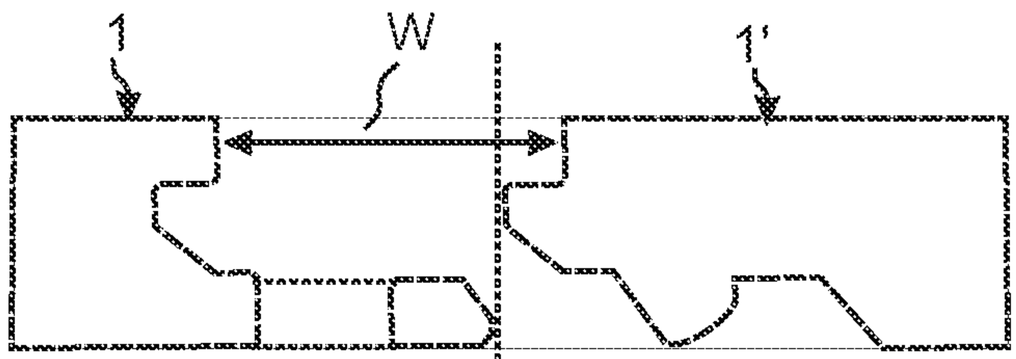


Fig. 11b

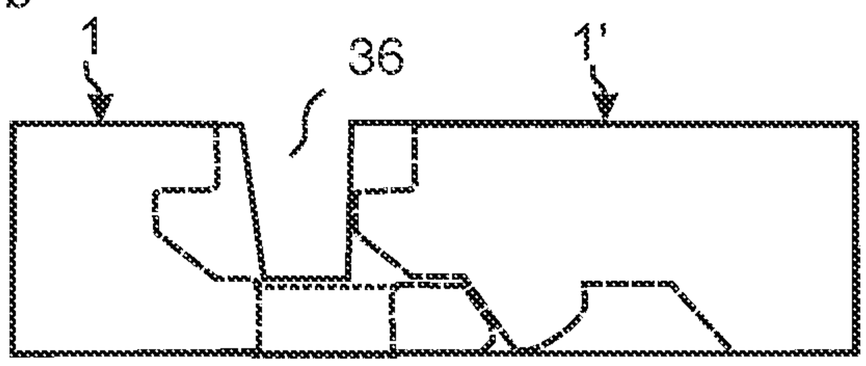


Fig. 11c

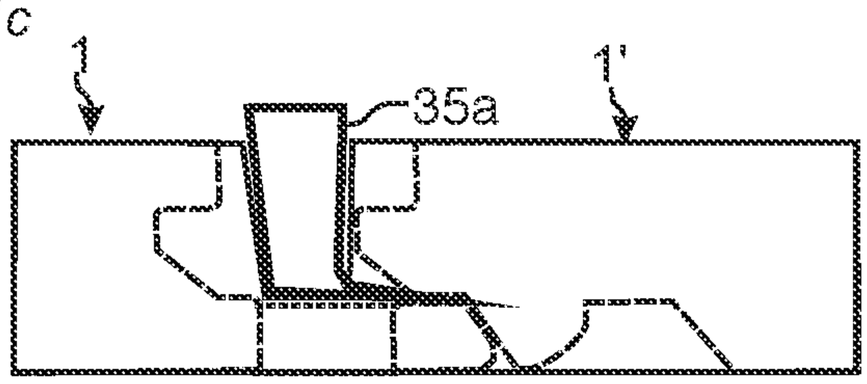
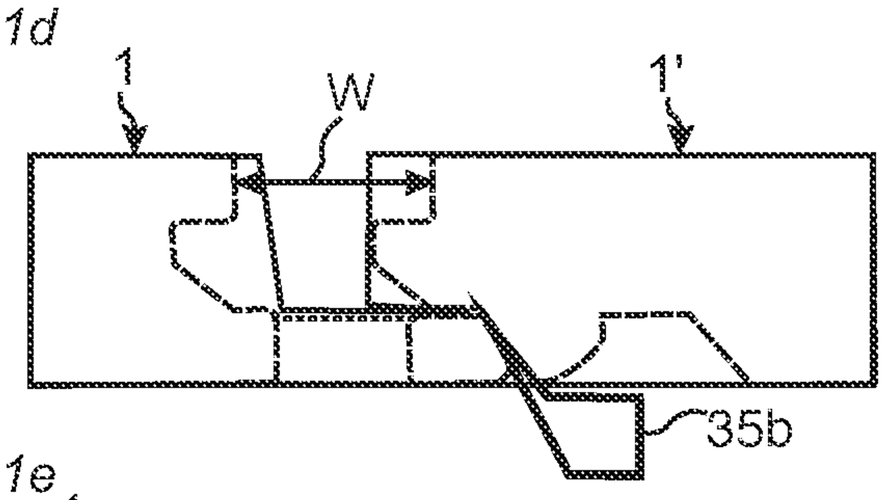


Fig. 11d



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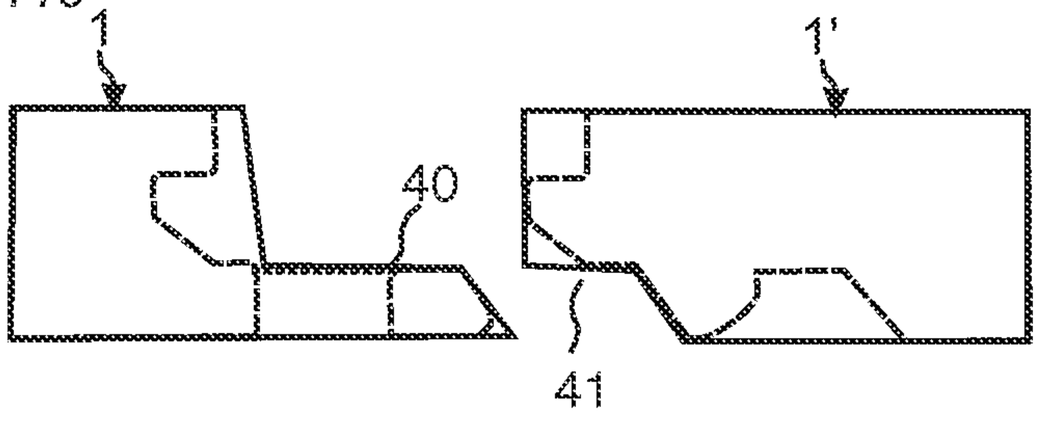


Fig. 11f

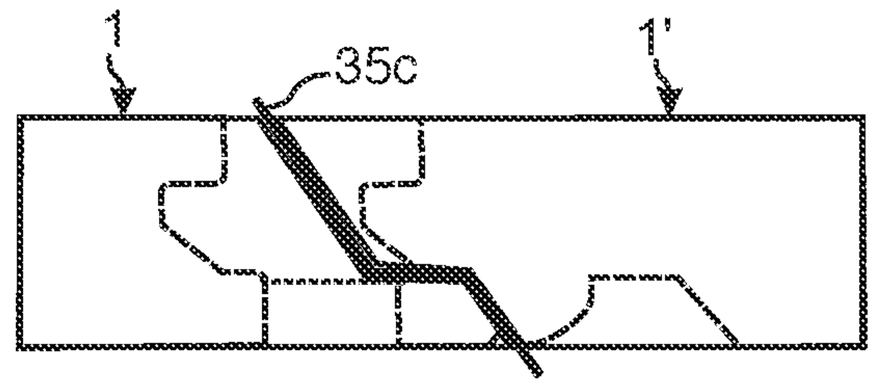


Fig. 12a

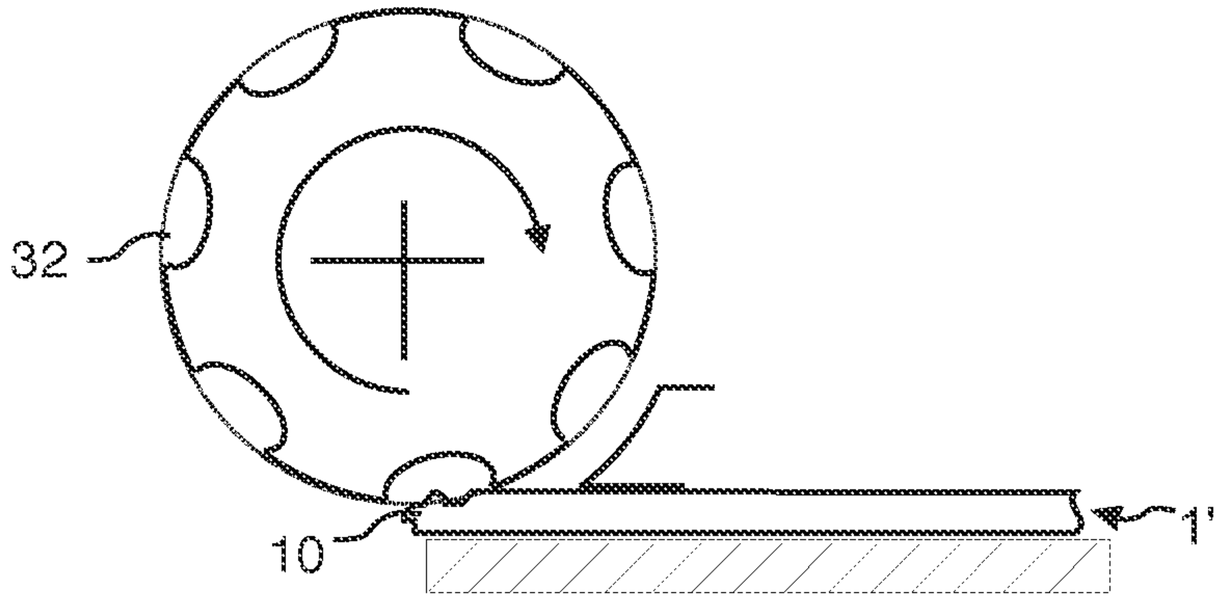


Fig. 12b

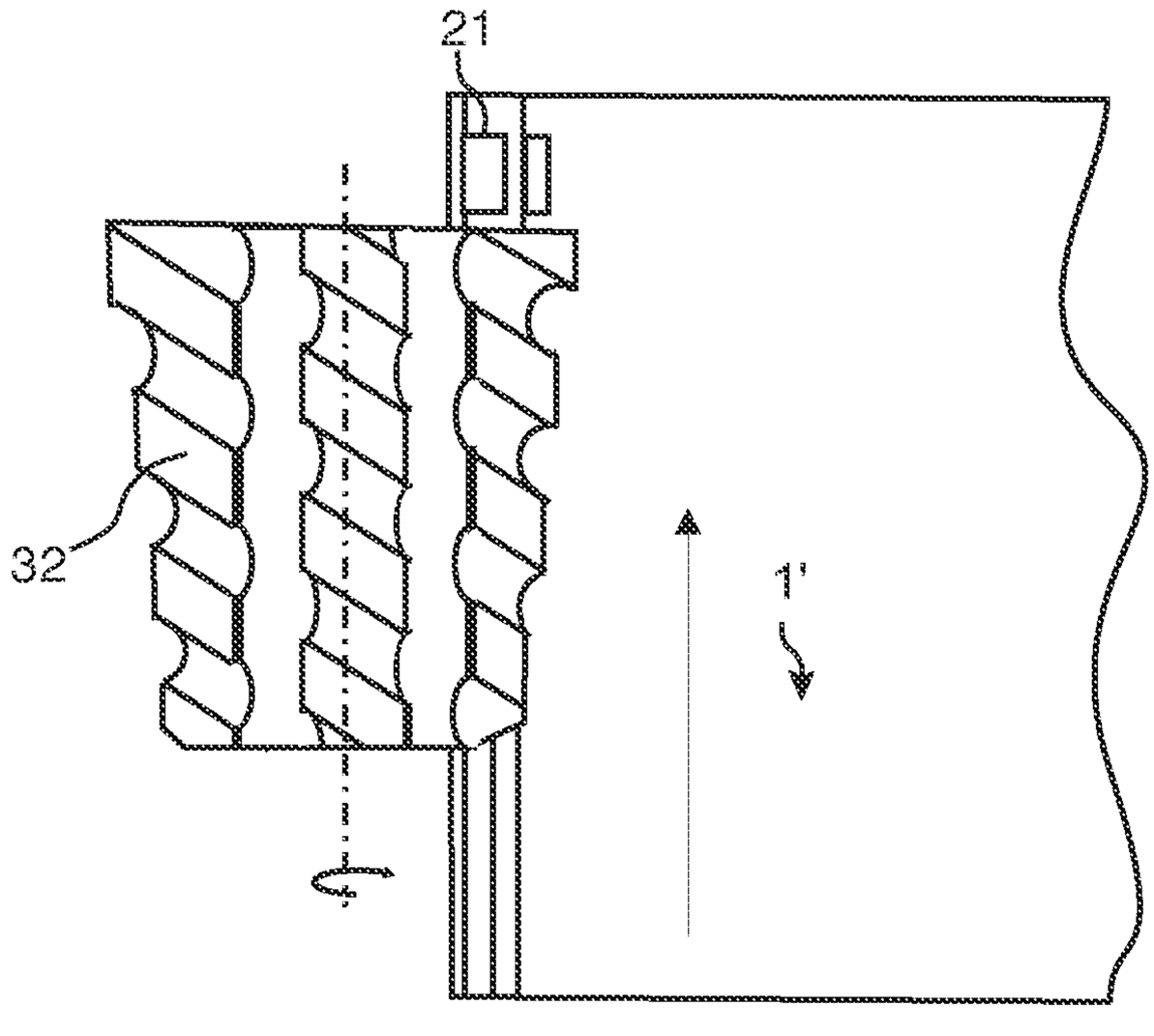


Fig. 13a

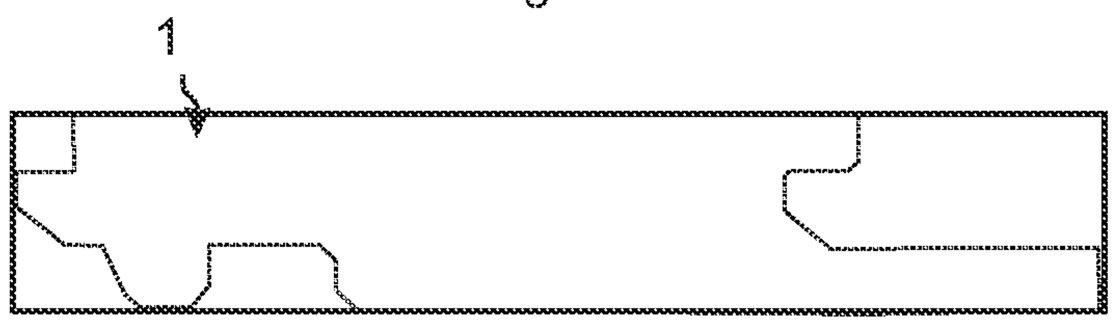


Fig. 13b

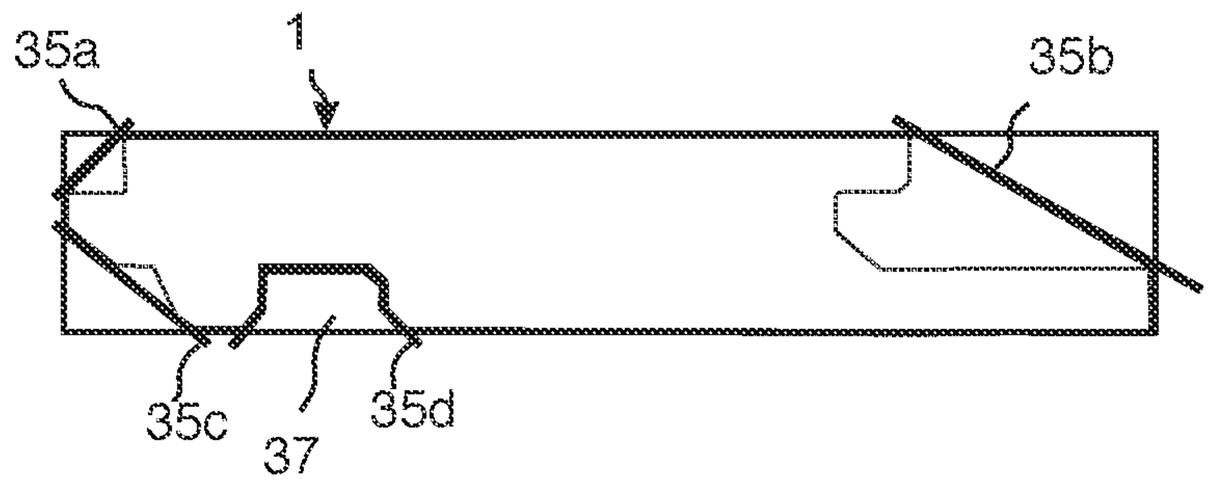


Fig. 13c

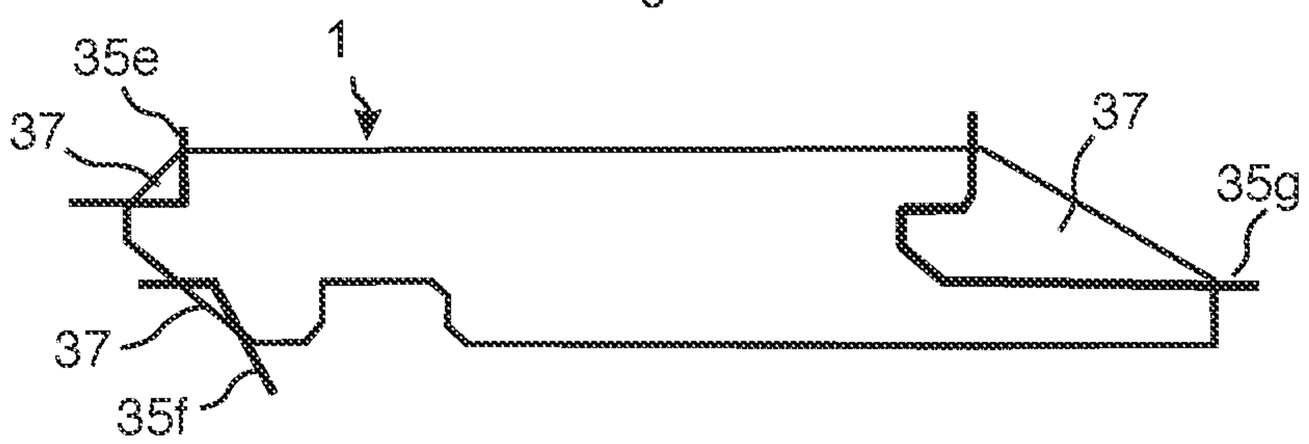


Fig. 13d

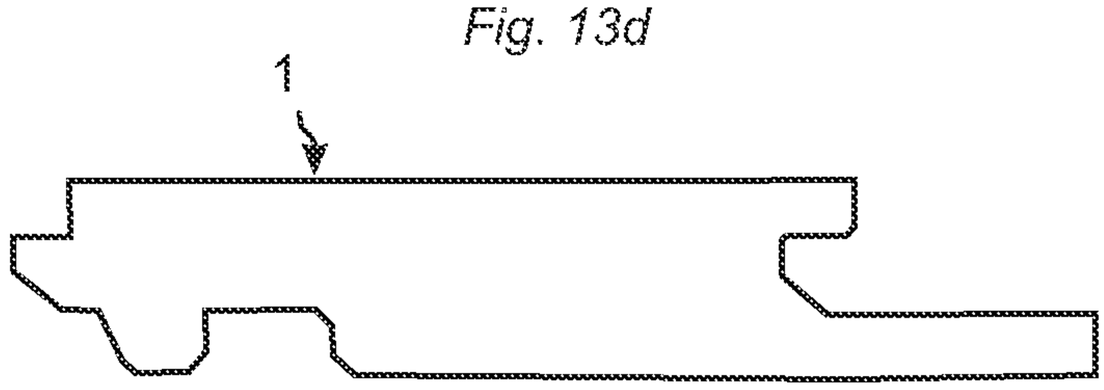


Fig. 14a

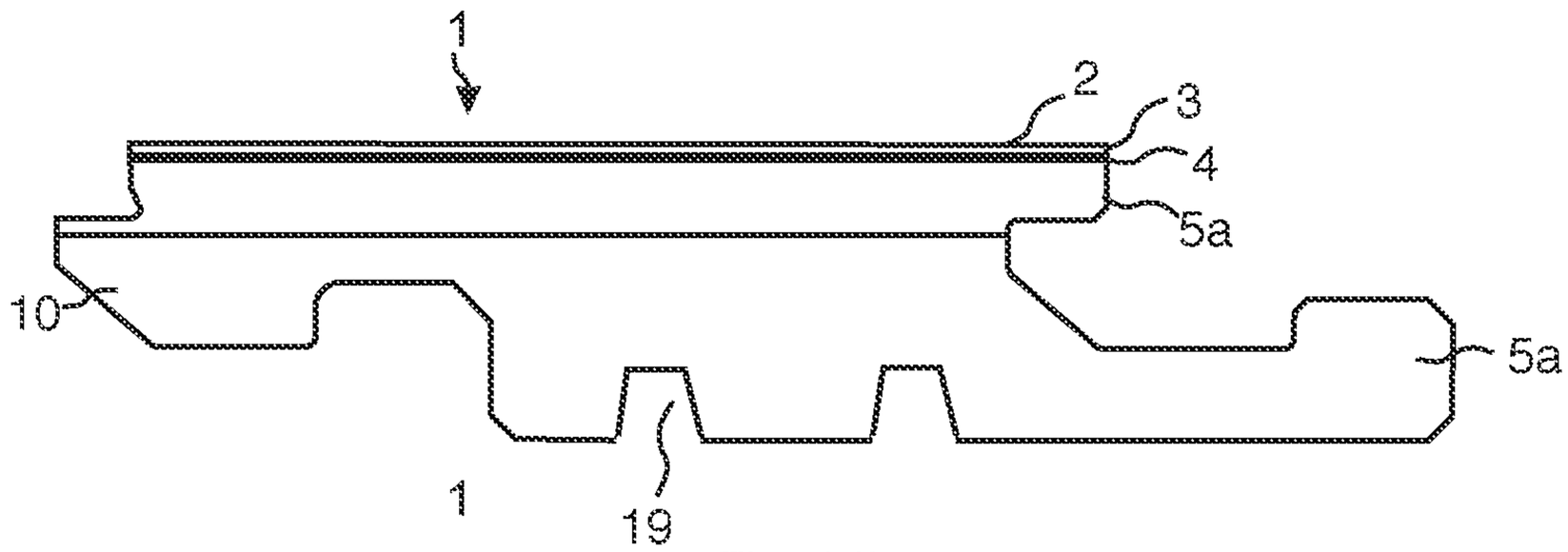


Fig. 14b

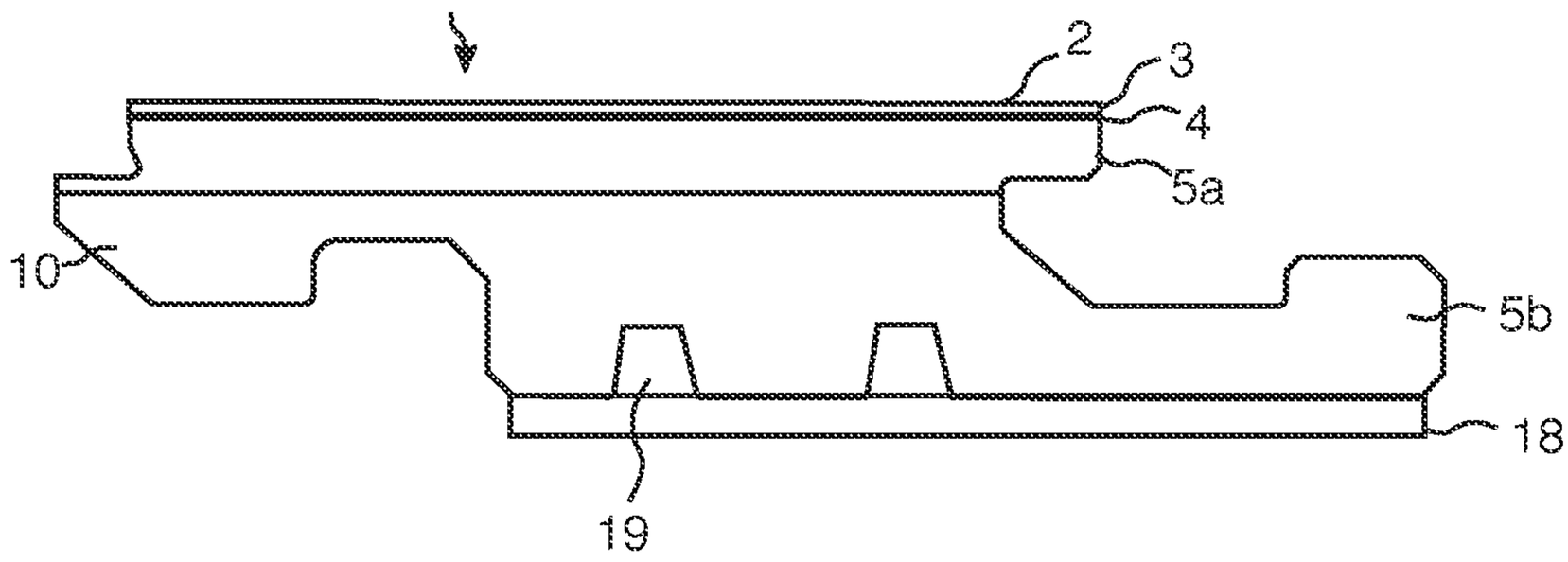


Fig. 14c

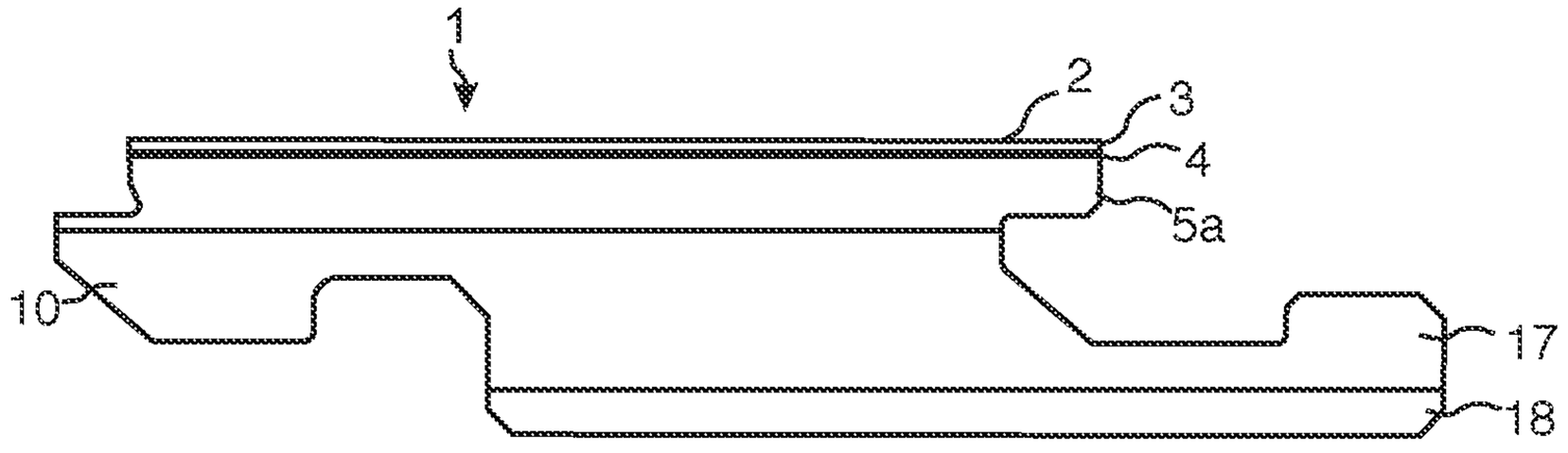


Fig. 14d

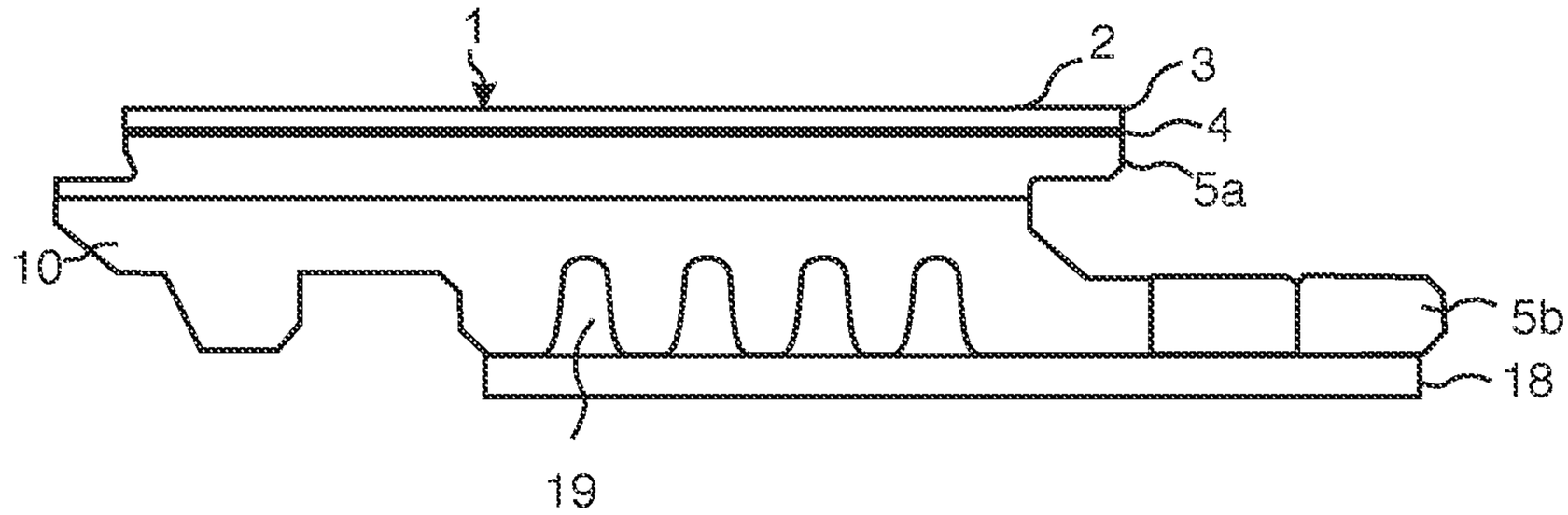


Fig. 15a

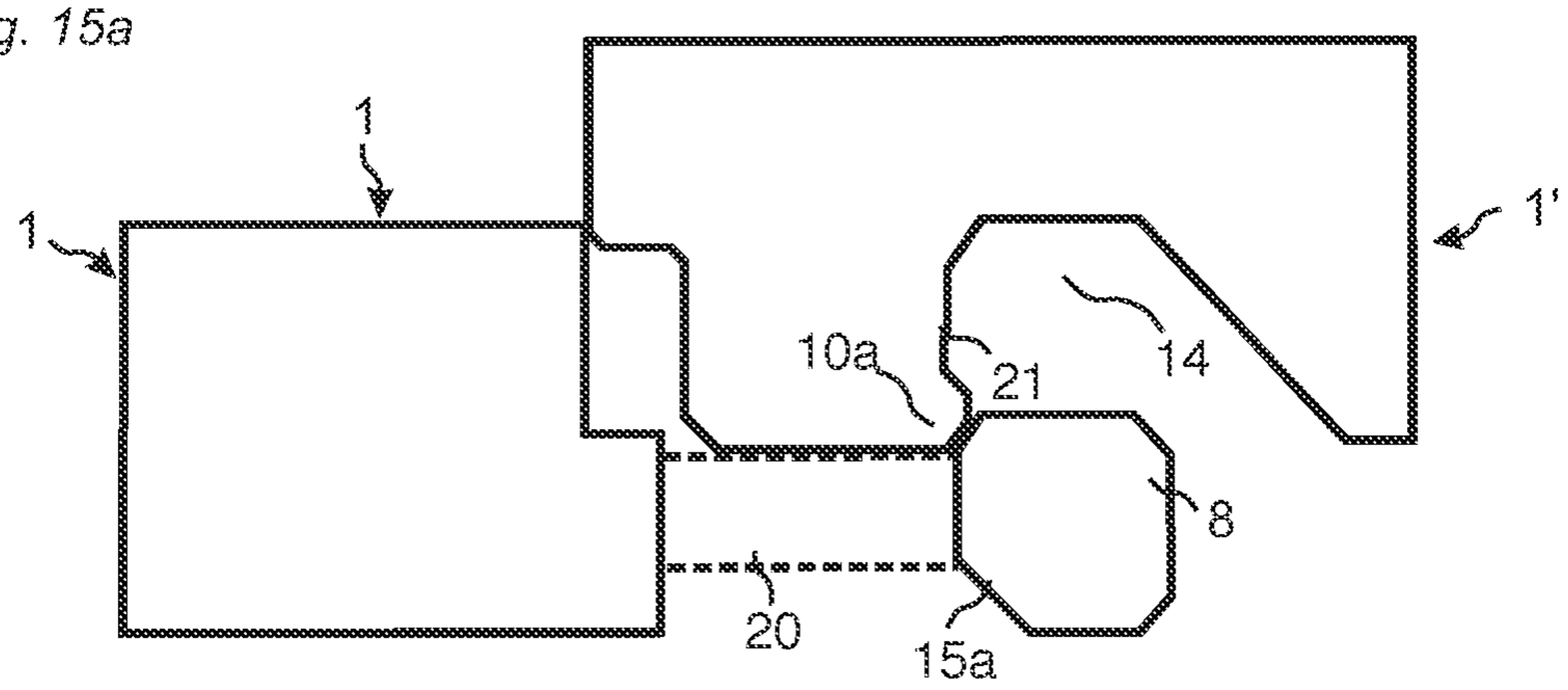


Fig. 15b

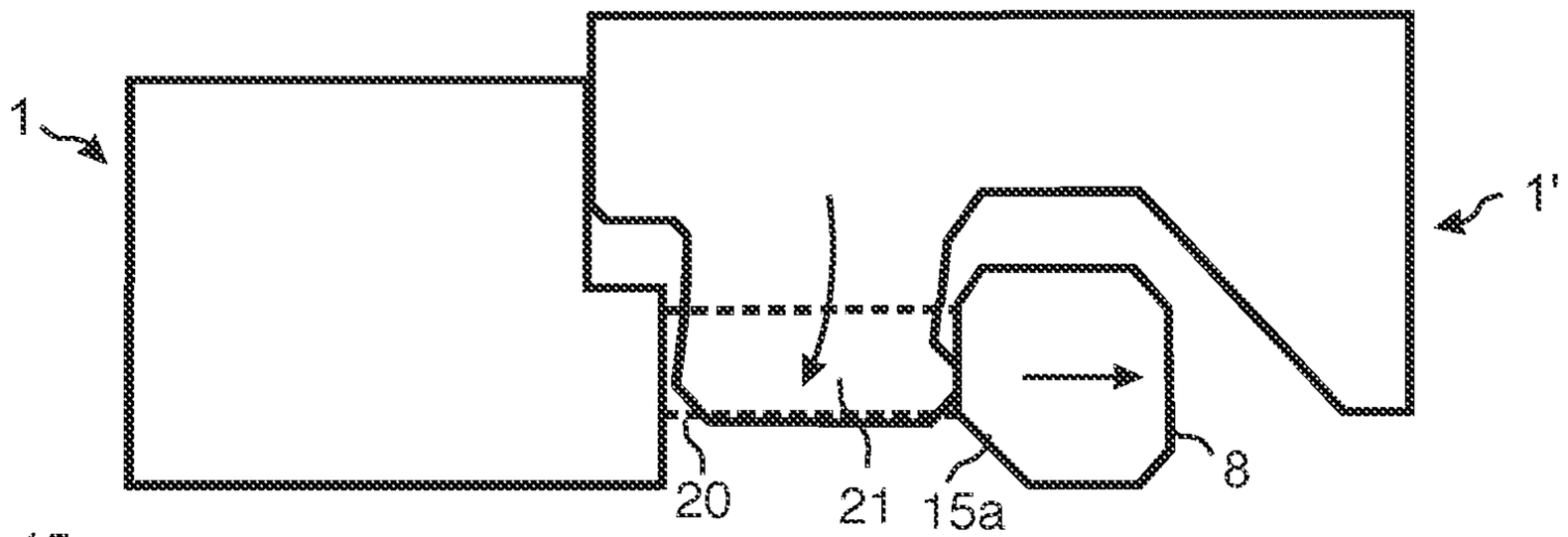


Fig. 15c

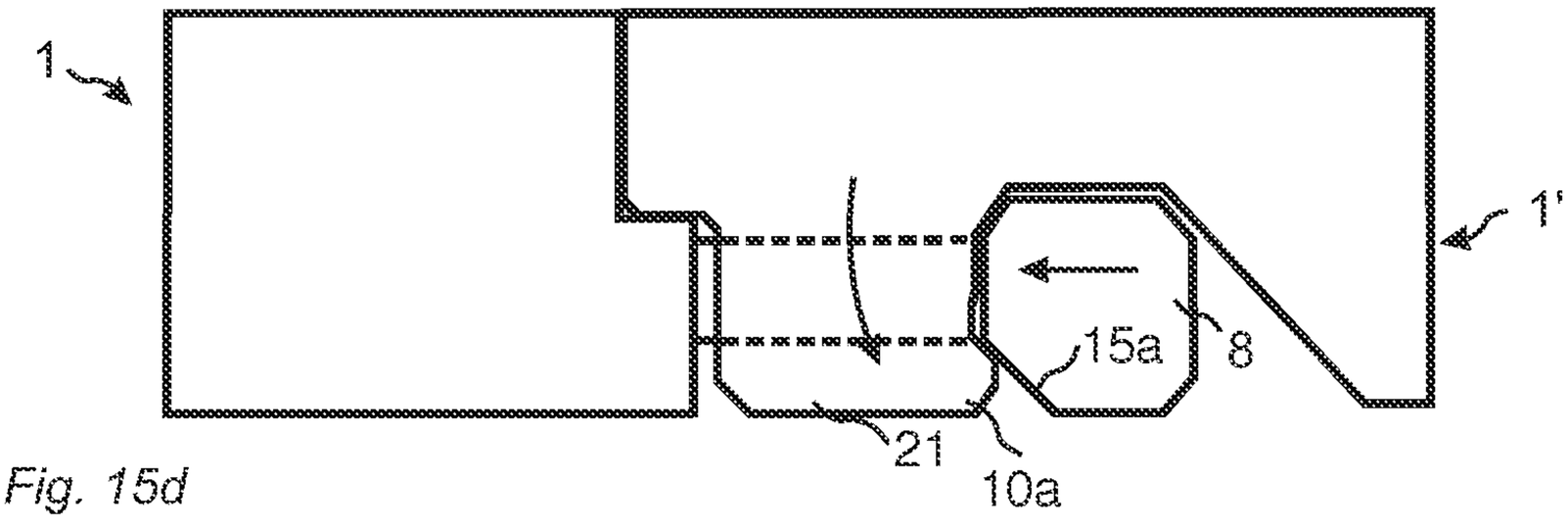


Fig. 15d

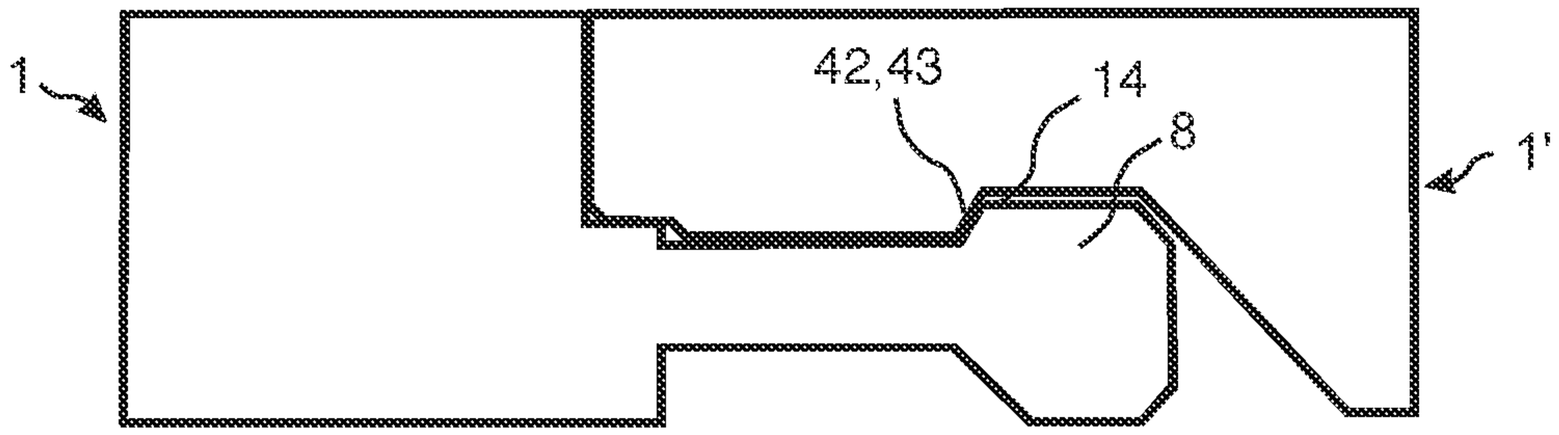


Fig. 16a

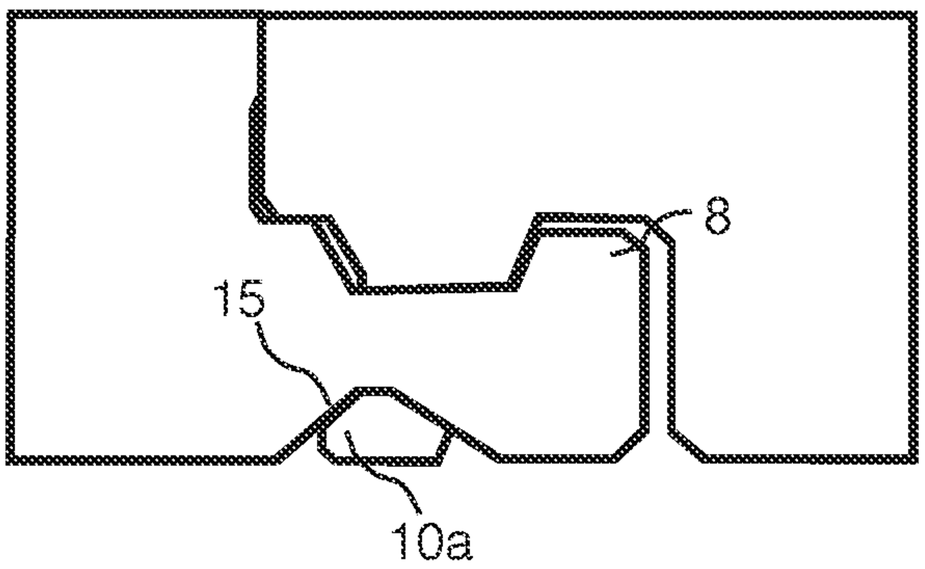


Fig. 16b

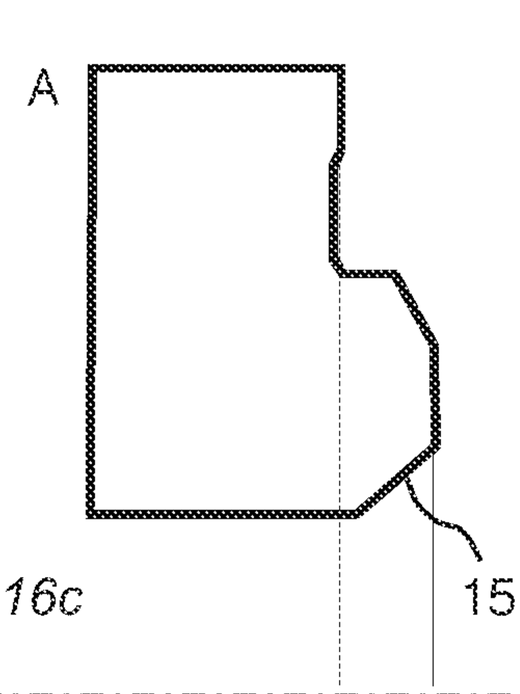
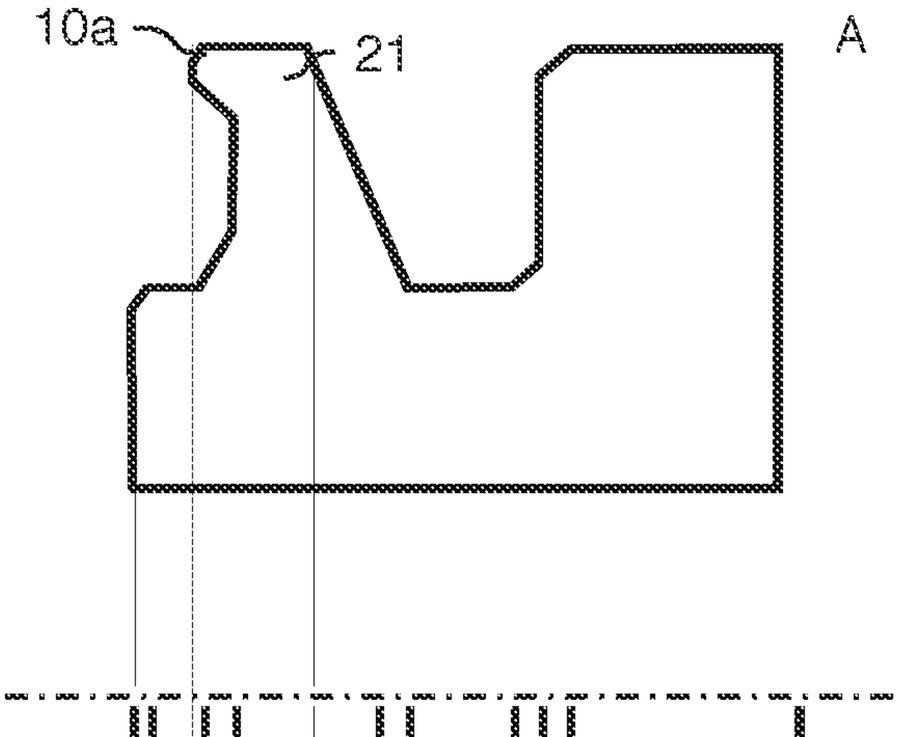


Fig. 16c



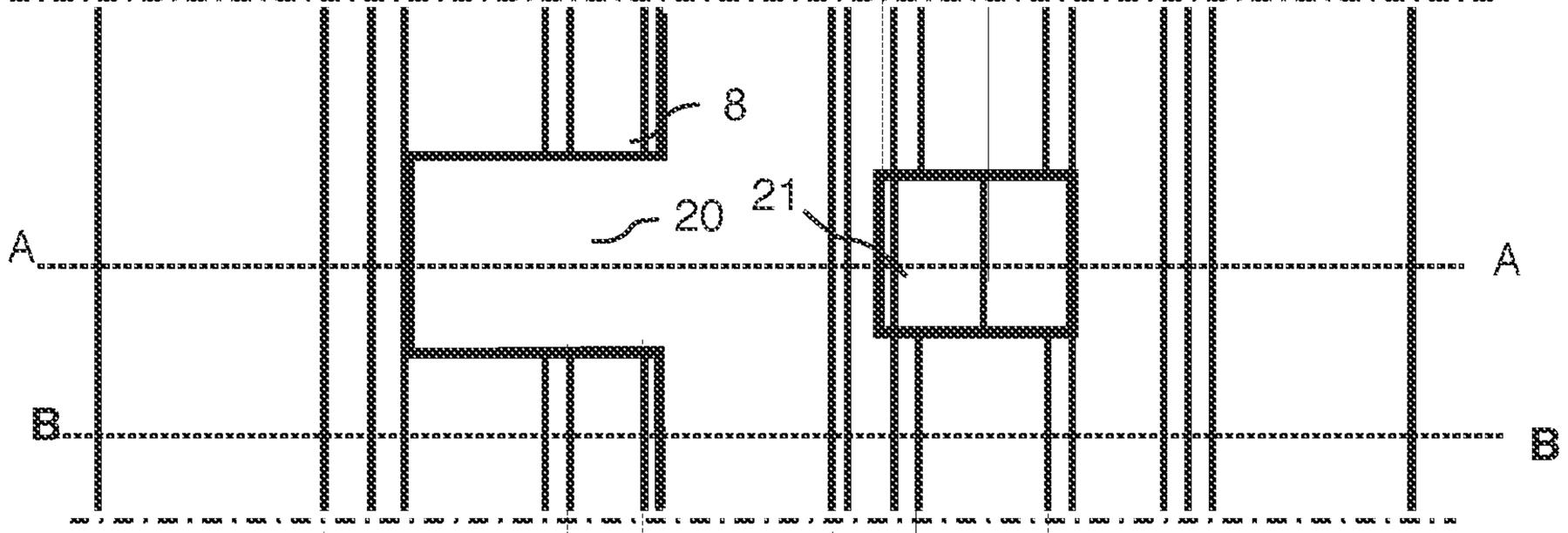
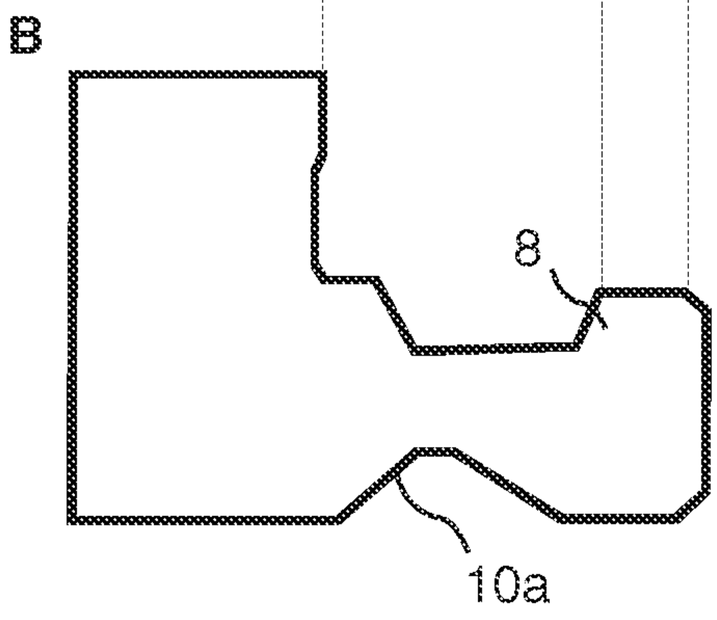


Fig. 16d



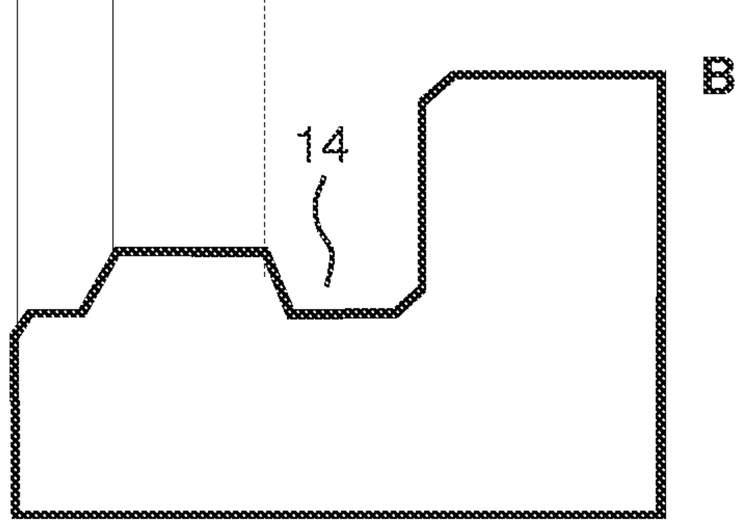


Fig. 17a

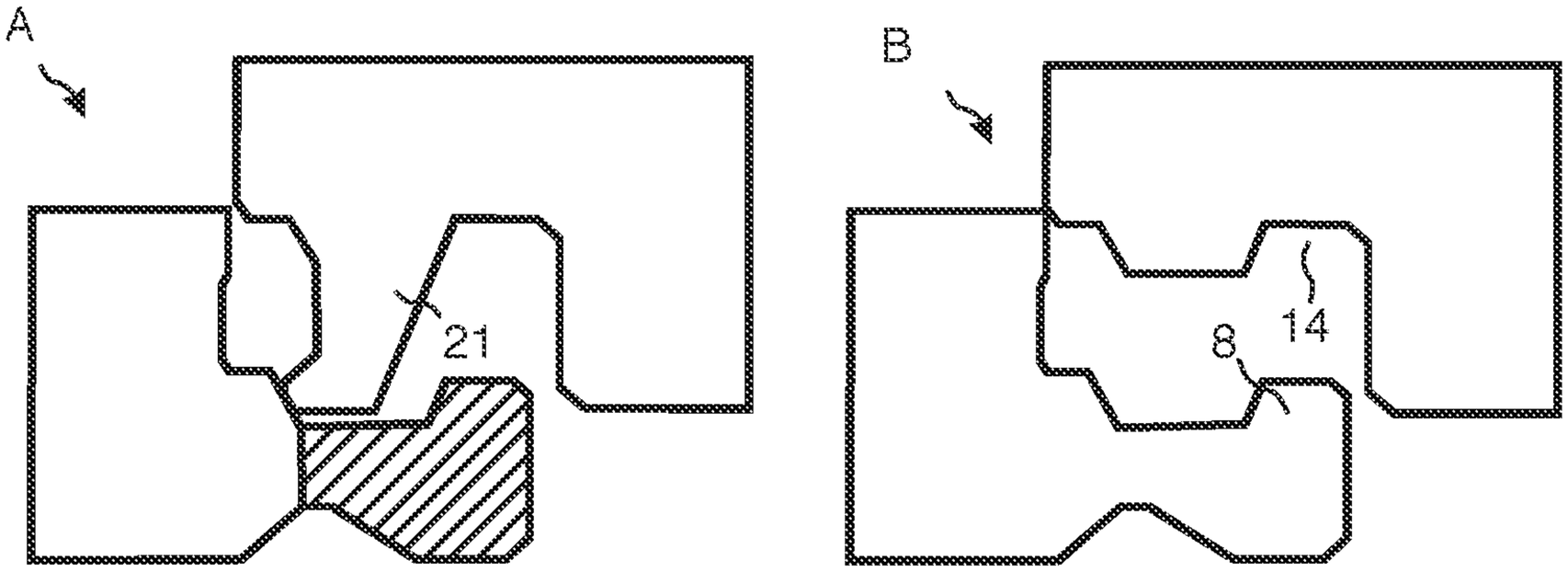


Fig. 17b

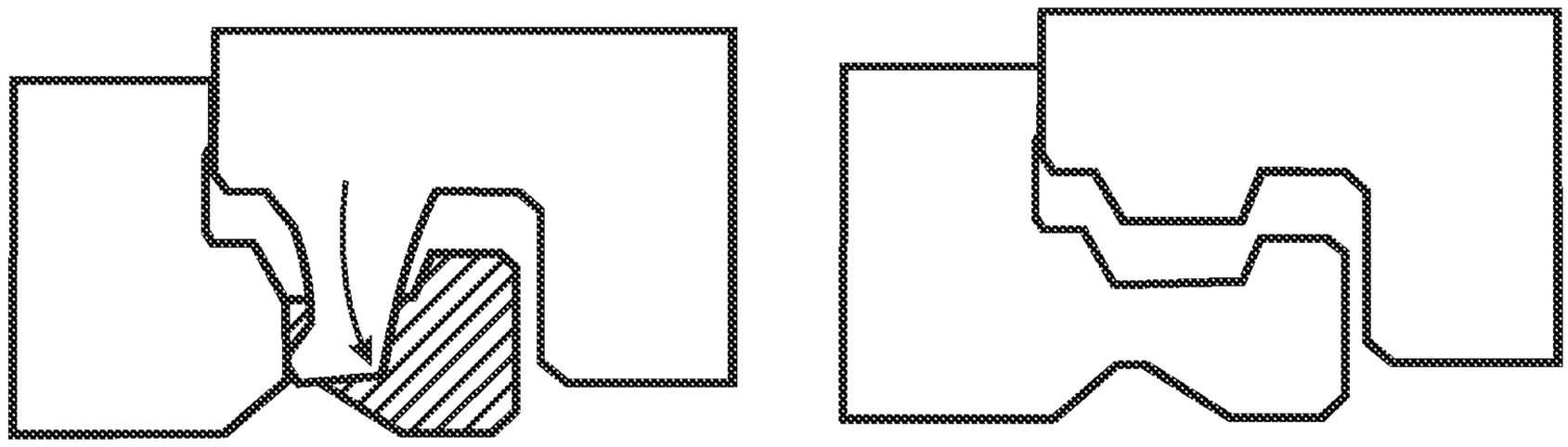


Fig. 17c

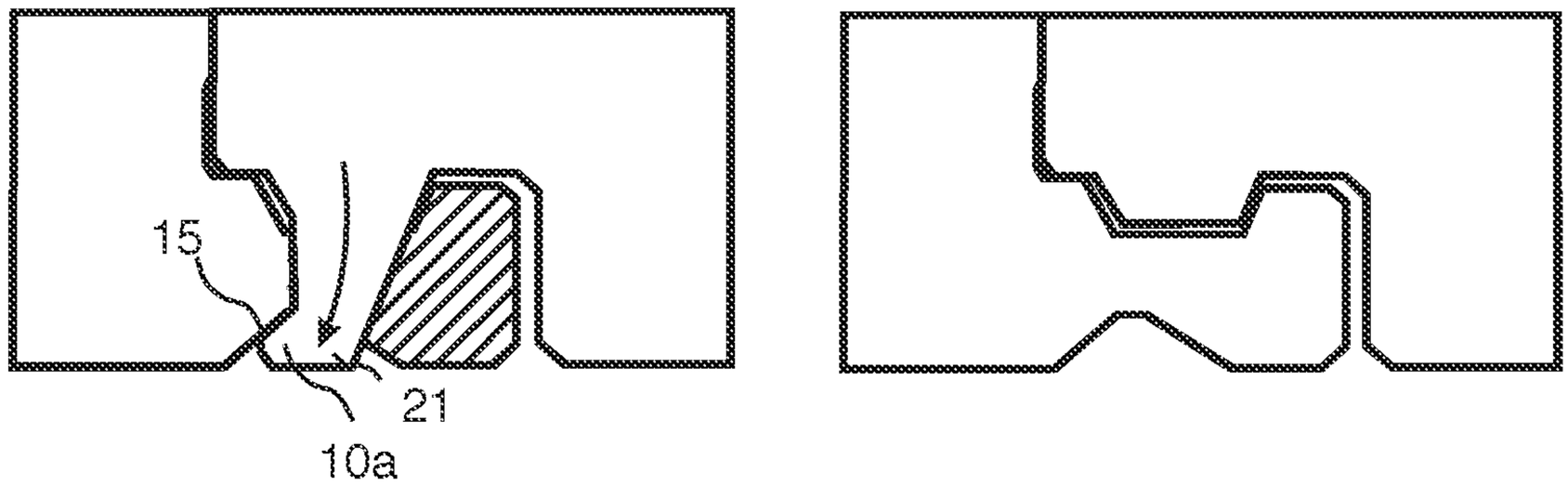


Fig. 18a

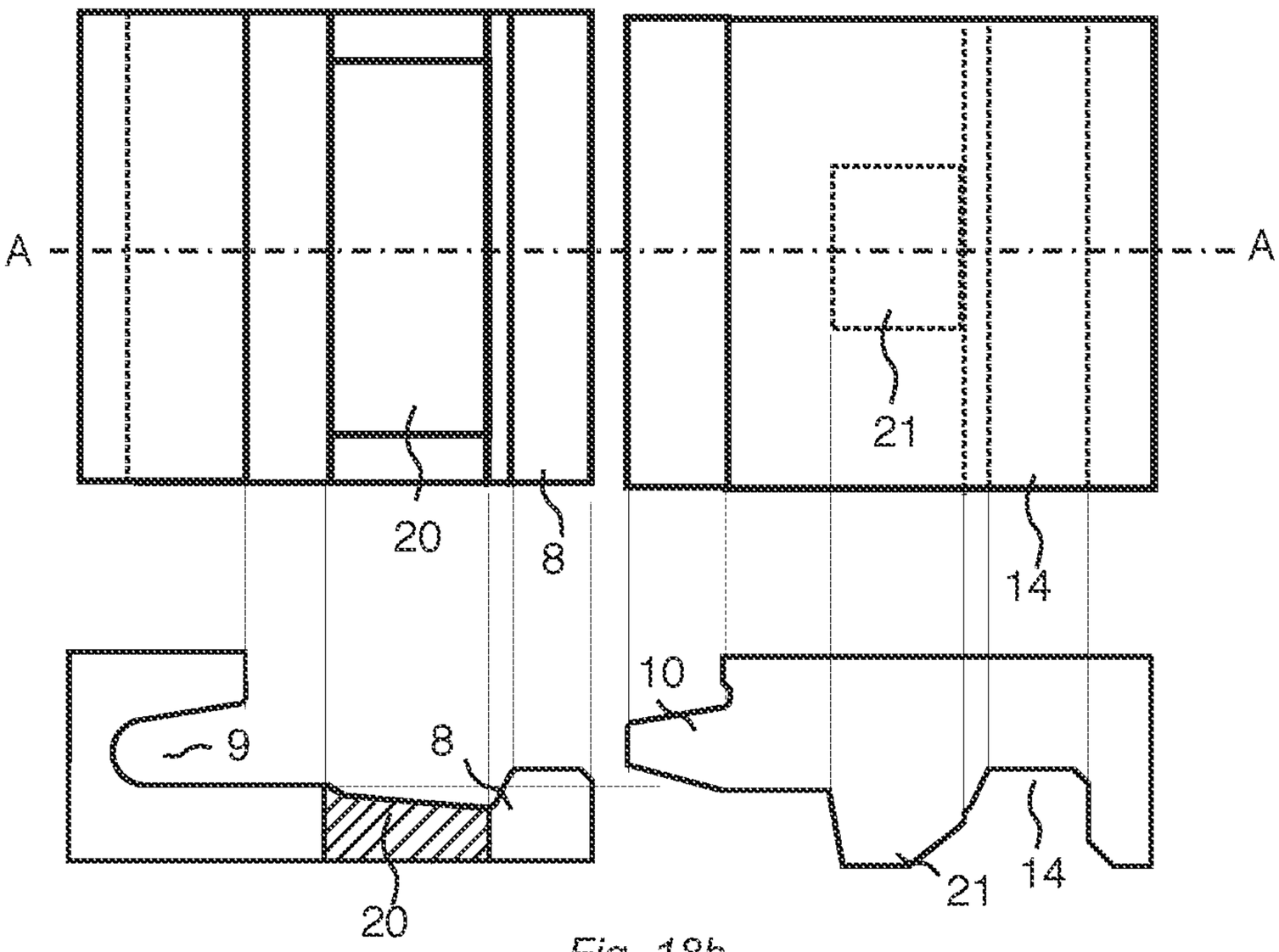


Fig. 18b

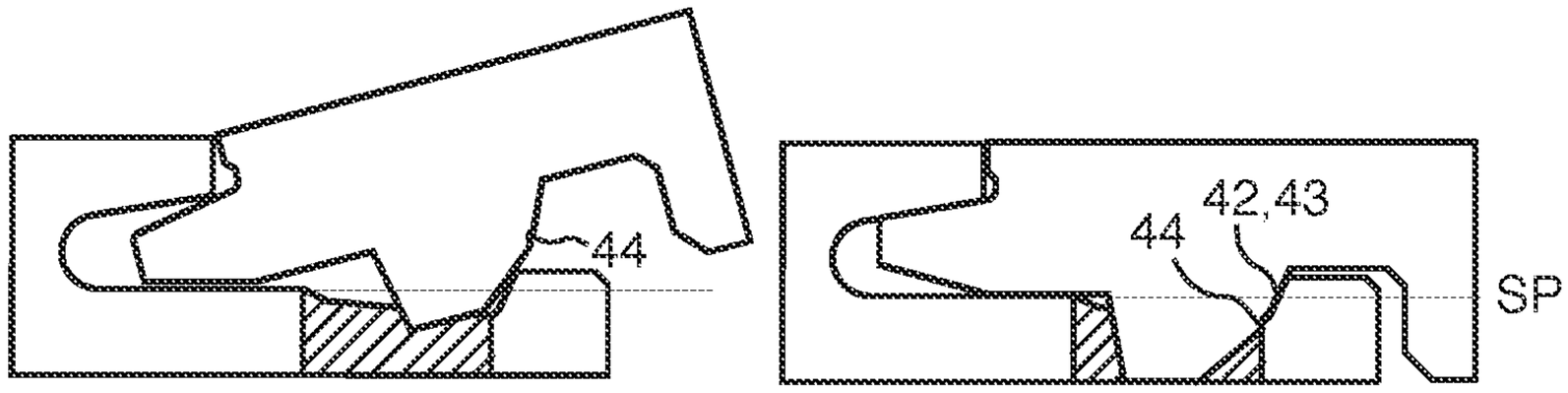


Fig. 18c

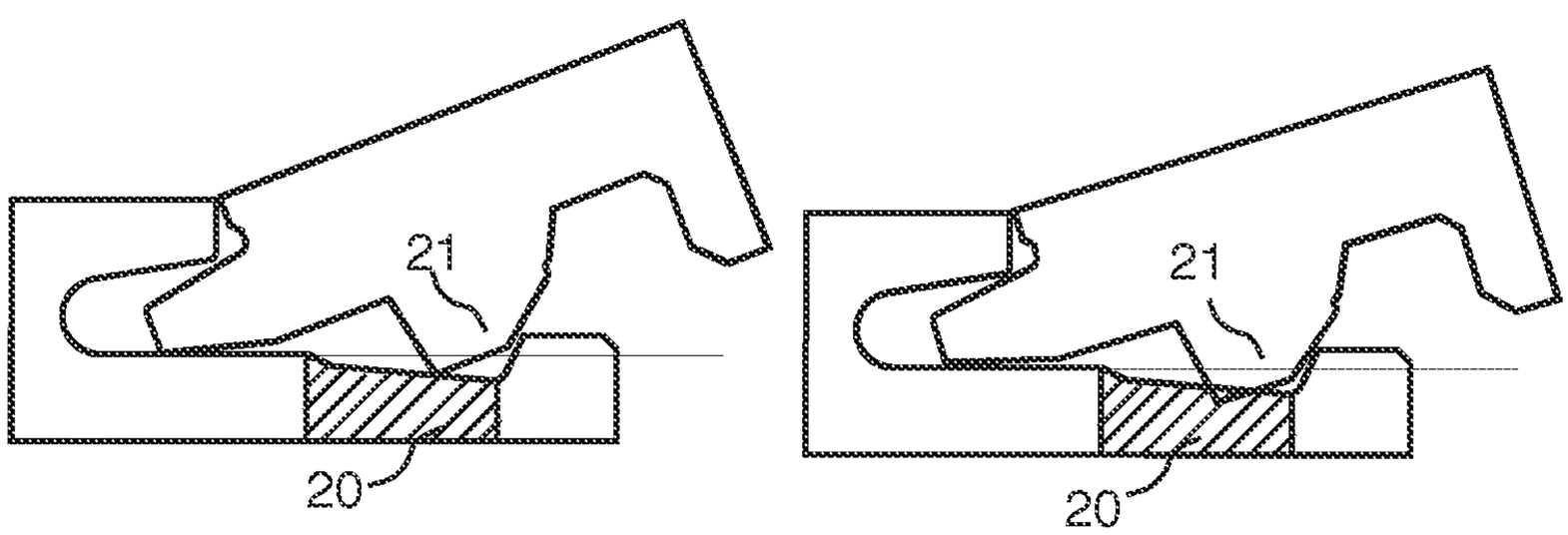


Fig. 18d

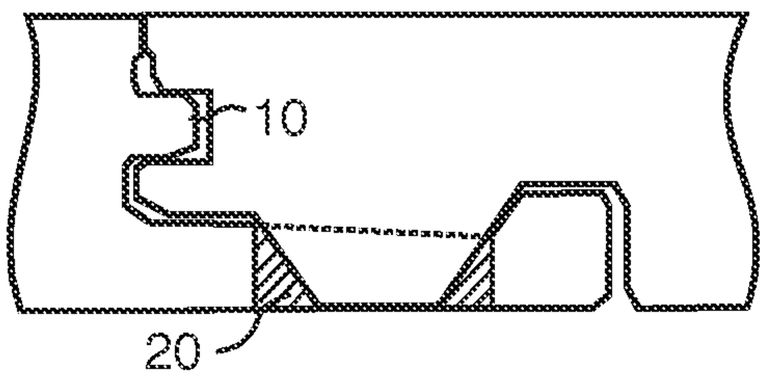


Fig. 19

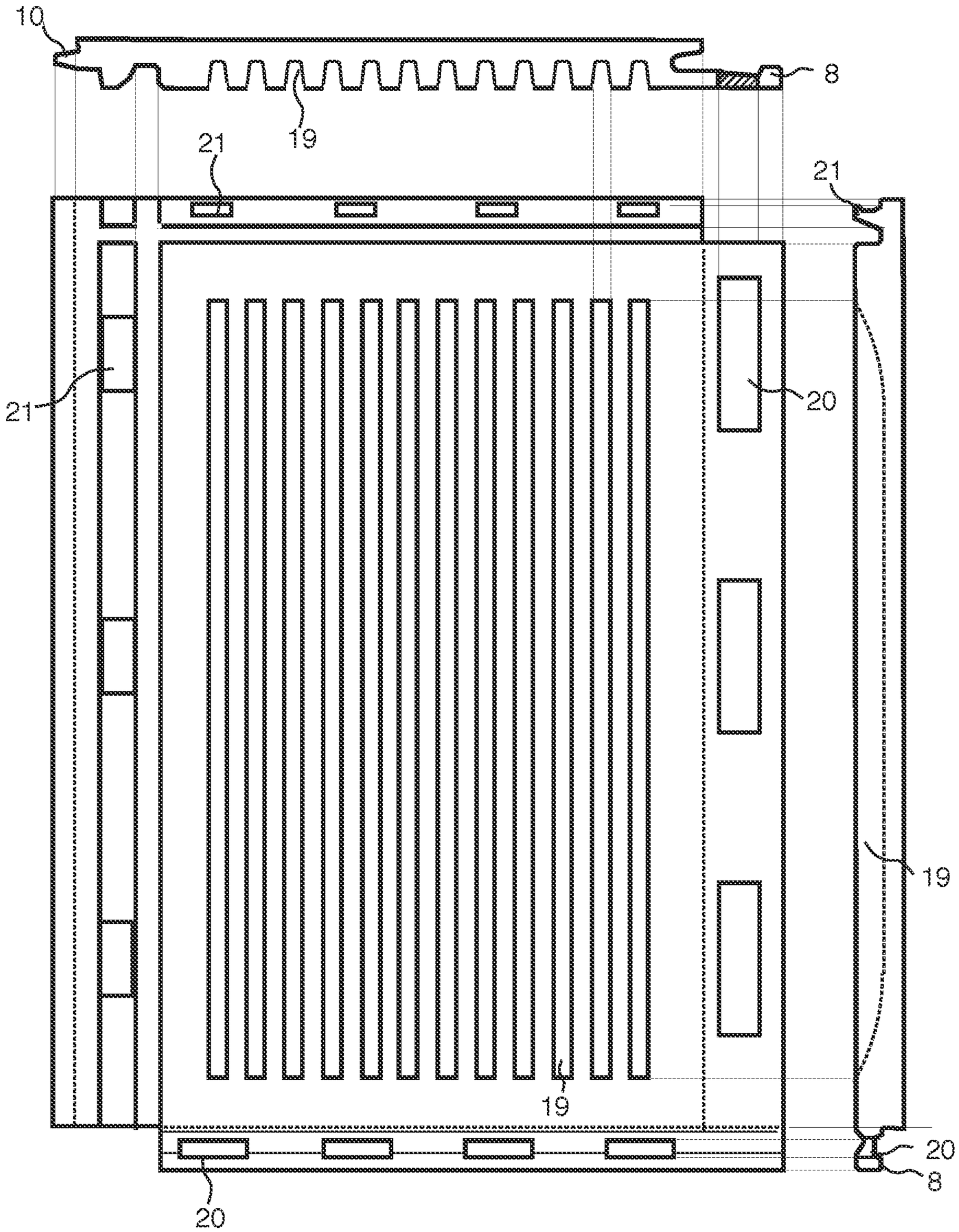


Fig. 20a

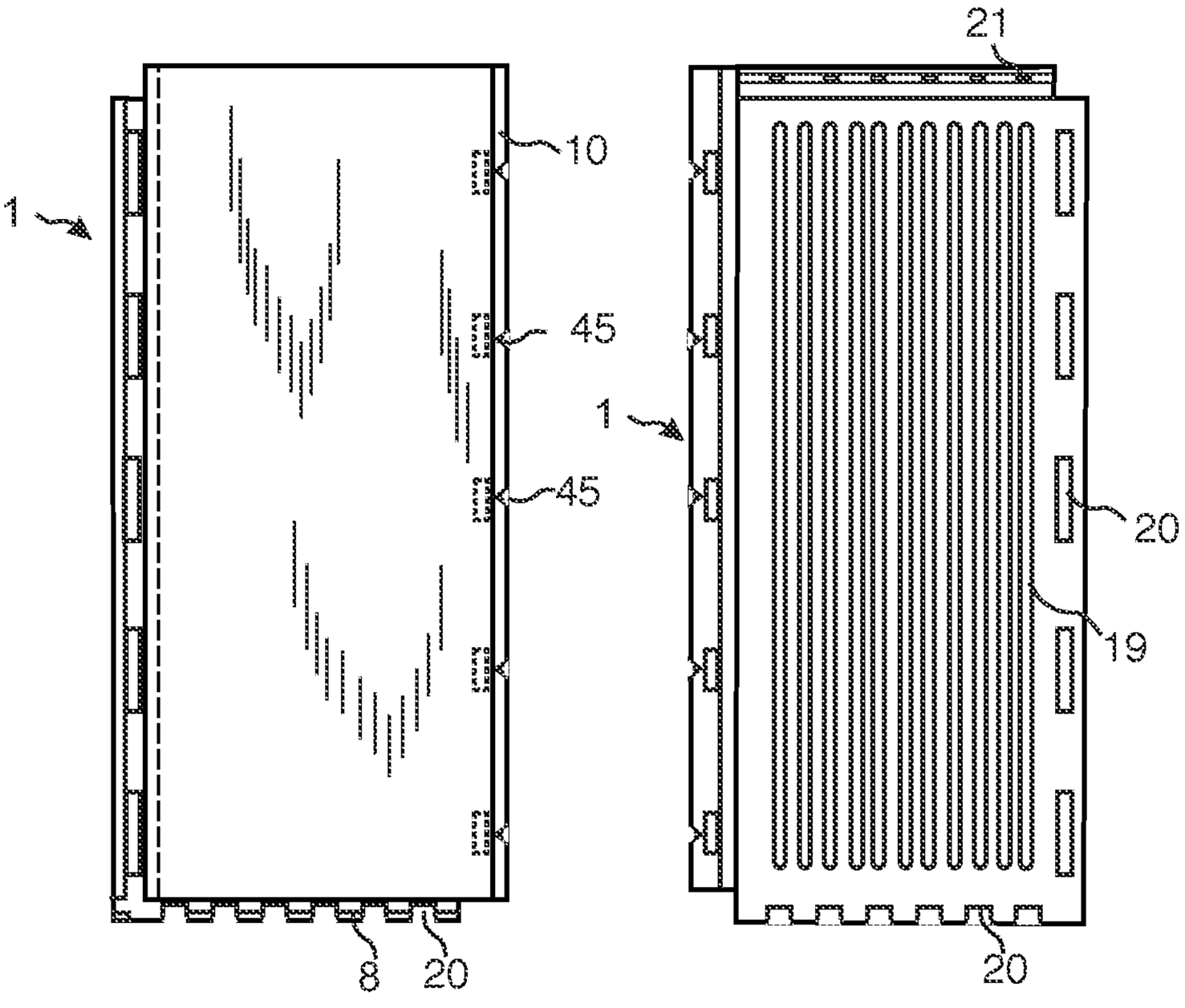


Fig. 20b

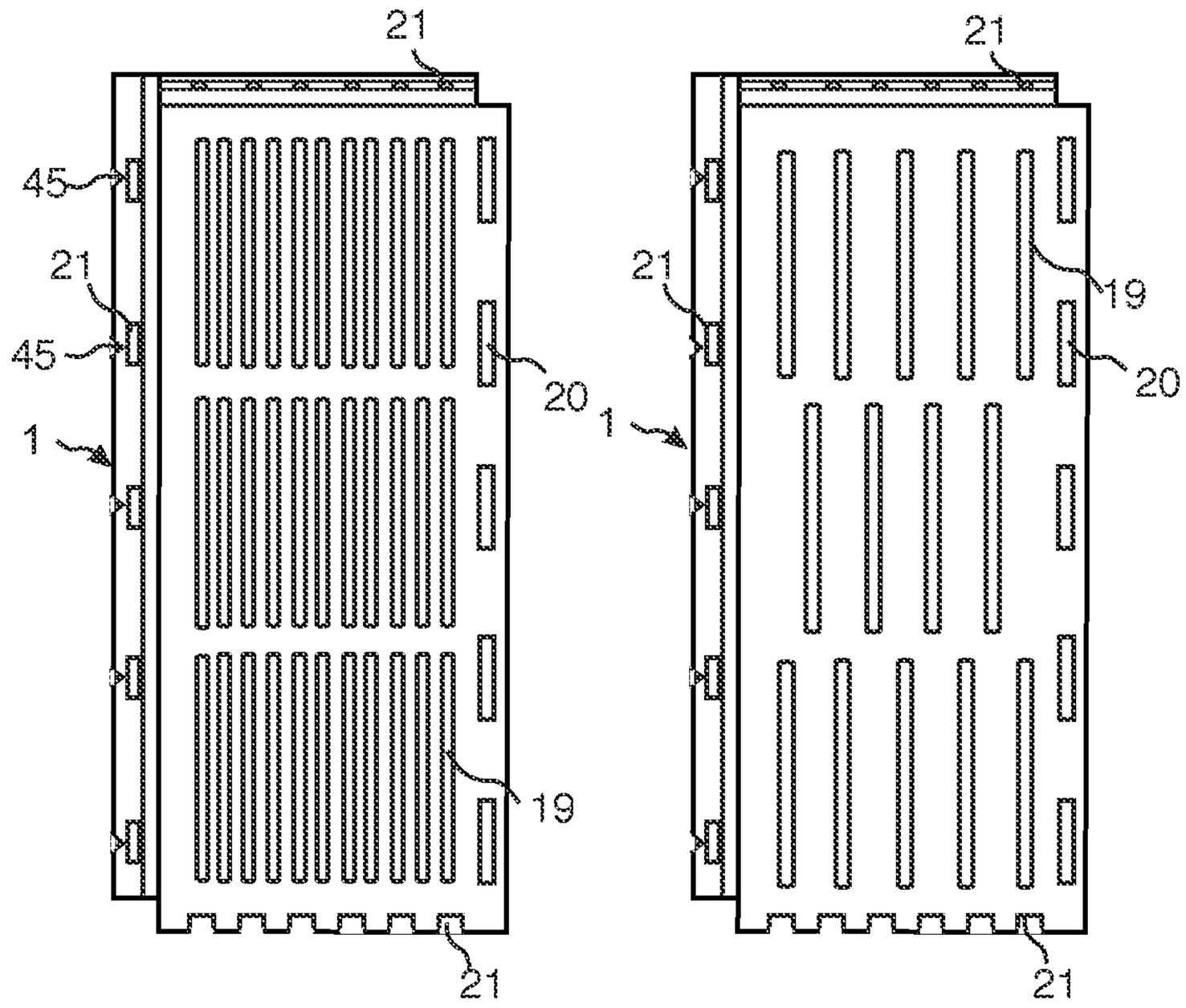


Fig. 21a

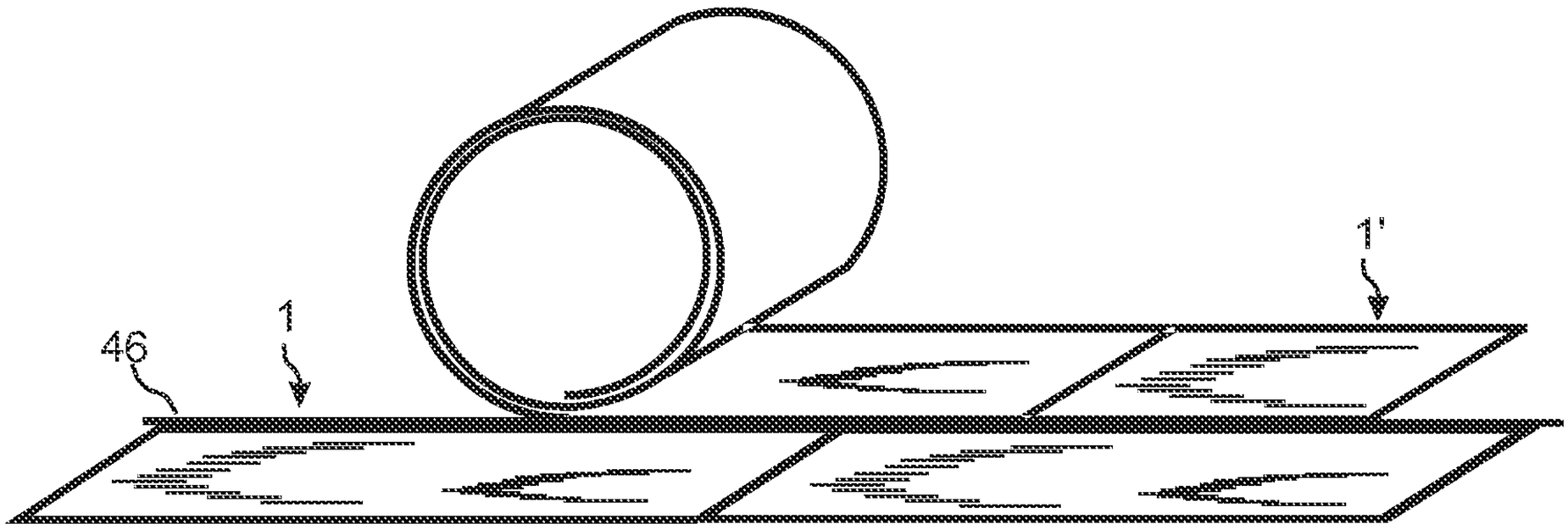


Fig. 21b

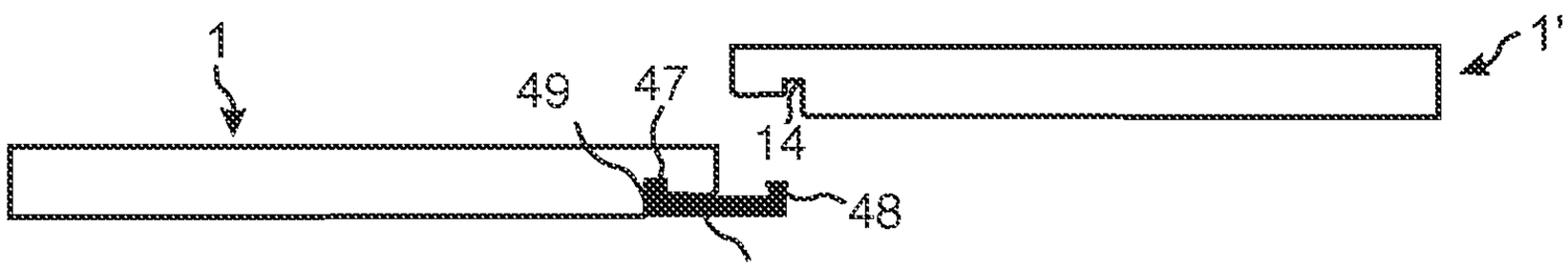


Fig. 21c

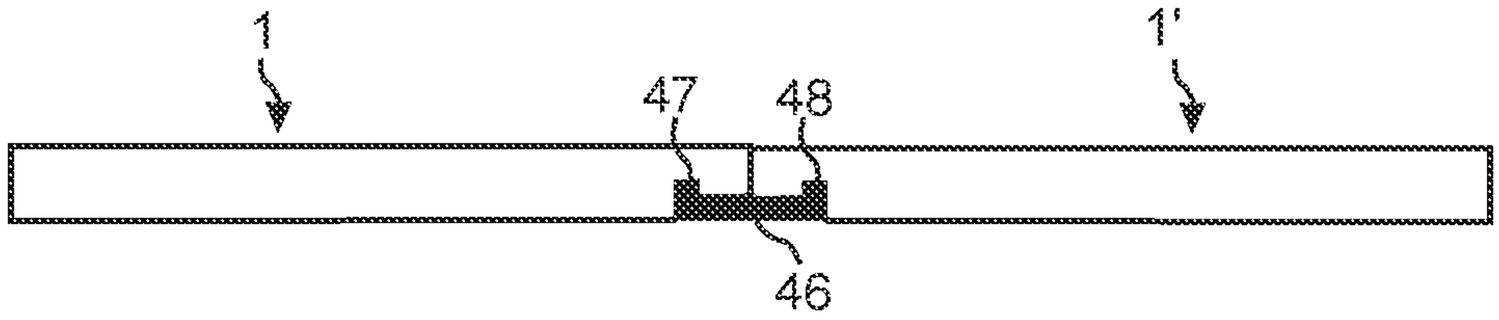


Fig. 21d

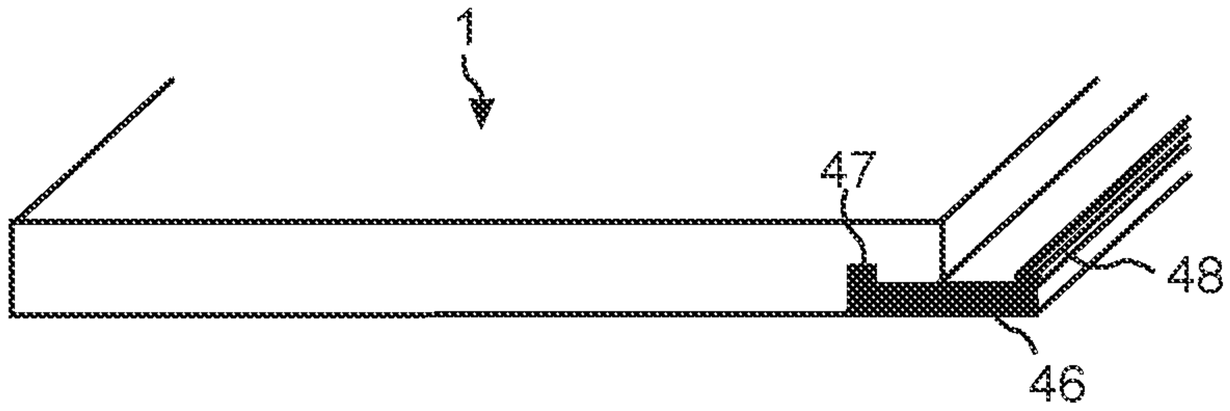


Fig. 22a

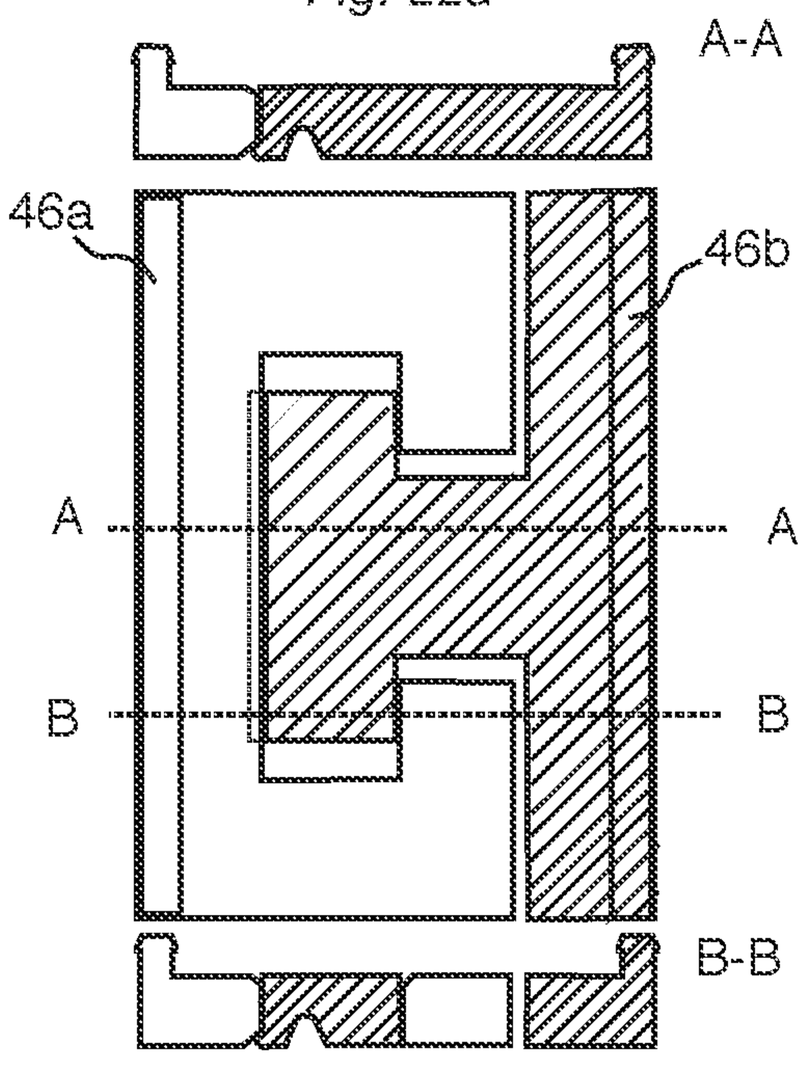


Fig. 22b

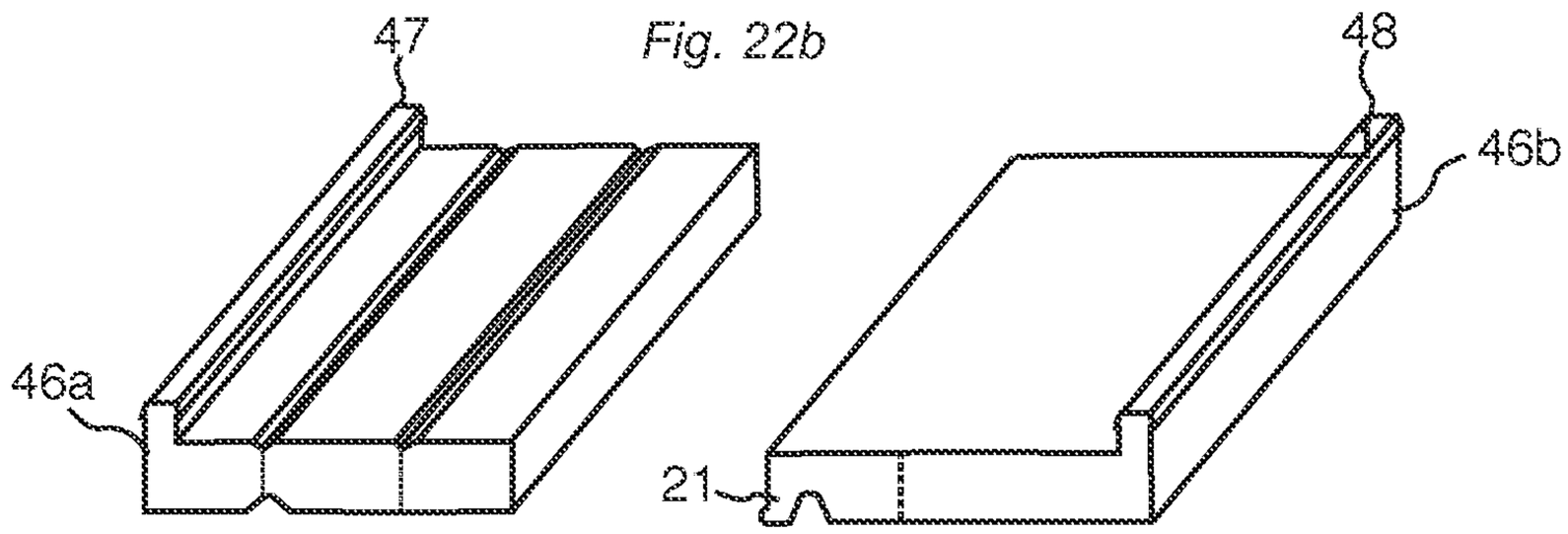


Fig. 22c

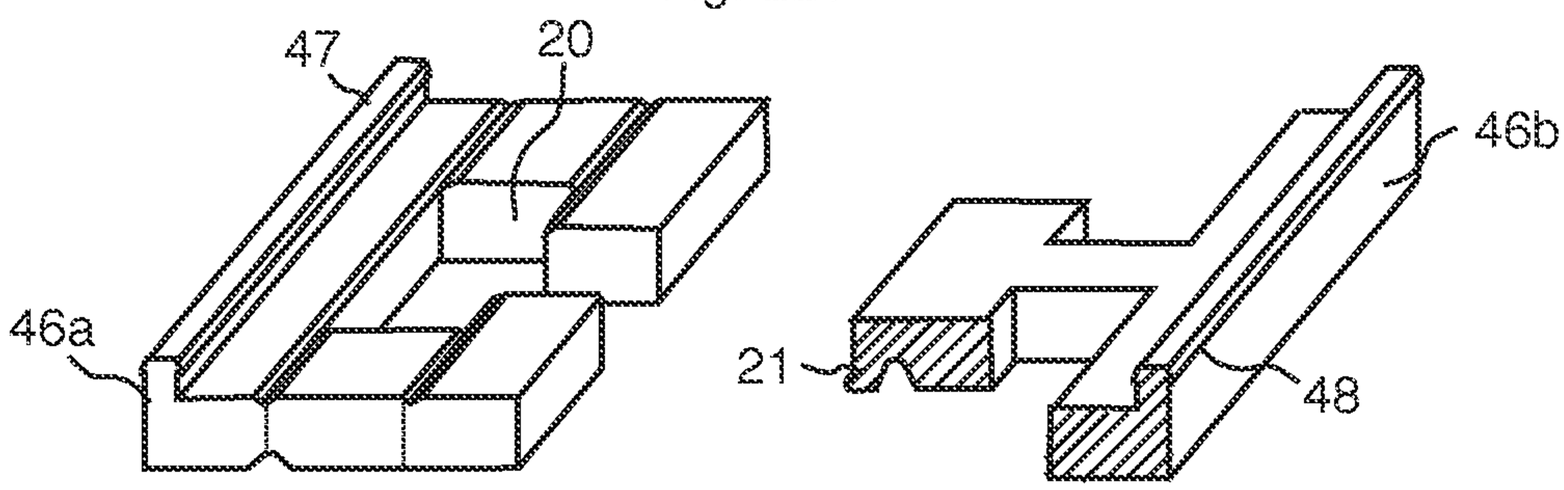


Fig. 22d

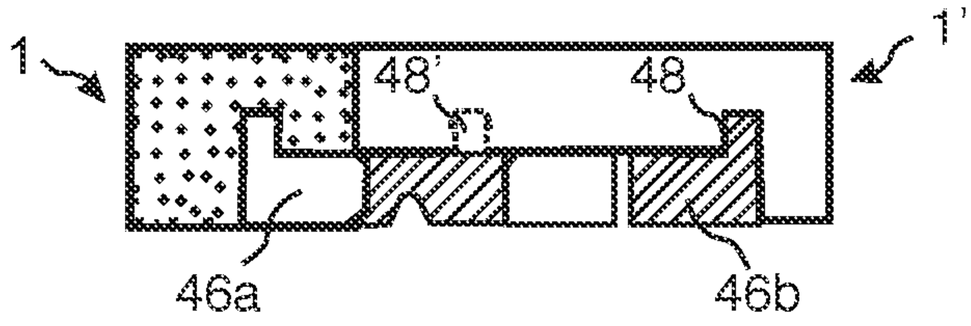
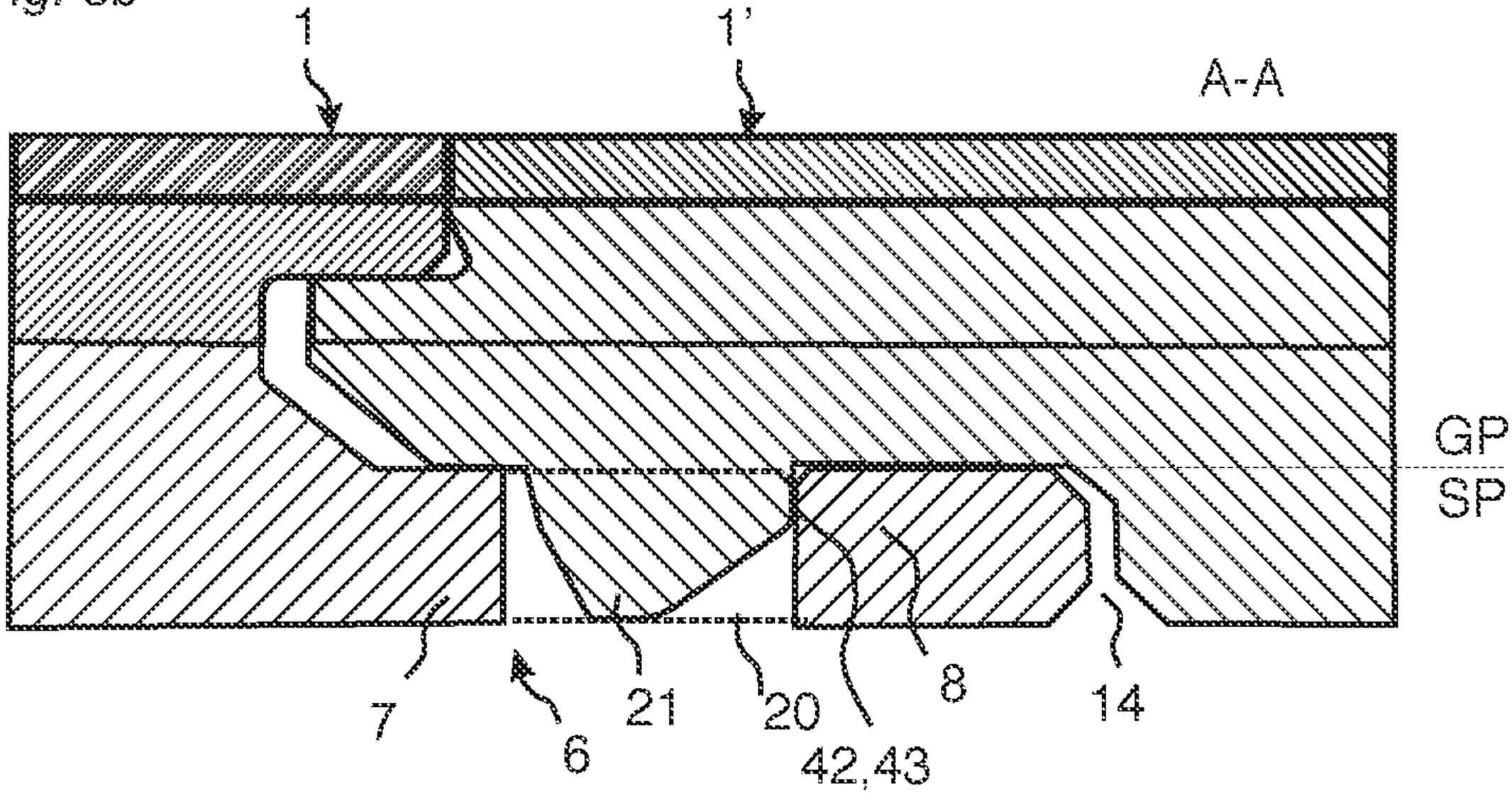



Fig. 3b