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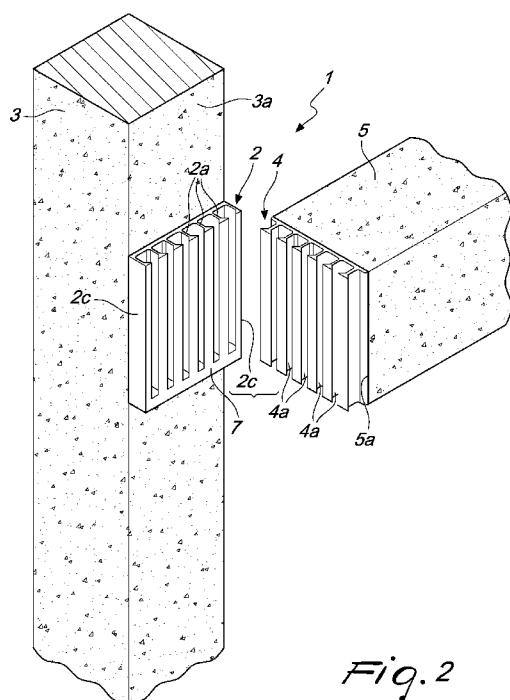


Fig. 2

(57) Abstract: A device for joining building elements which comprises at least one pair of joining members (2, 4), respectively at least one first joining member (2), which is fixed to a first element to be joined (3), and a second joining member (4), which is fixed to a second element to be joined (5) and can be coupled to the first joining member (2). According to the invention, each one of the joining members (2, 4) has a comb-like structure with respective coupling teeth (2a, 4a) defined which protrude from a face (3a, 5a) of the corresponding element to be joined (3, 5) which faces the other element to be joined (3, 5) and are arranged mutually side-by-side and mutually spaced apart along a first direction which is substantially parallel to the aforementioned face (3a, 5a). The coupling teeth (2a, 4a) of one of the joining members (2, 4) are engageable in the interspaces (2b, 4b) that are comprised between the coupling teeth (2a, 4a) of the other joining member (2, 4).



DEVICE FOR JOINING BUILDING ELEMENTS

The present invention relates to a device for joining building elements.

In the construction sector, joining devices are known which make it possible to connect prefabricated structural elements, and which also allow the exchange of flexural and/or torsional actions, requiring on-site castings to complete the joining.

The principal limitation of such known devices consists of the laborious work required for the completion of the structural join and for the necessary operations, and the consequent execution times and consequent costs.

The aim of the present invention is to provide a device for joining building elements which is capable of improving the known art in one or more of the above mentioned aspects.

Within this aim, an object of the invention is to provide a device for joining building elements that makes it possible to mutually connect structural elements, prefabricated and/or made on-site, of various material for building construction.

Another object of the invention is to provide a device for joining building elements that can also be adopted in order to connect structural elements to elements that have no structural function, or in order to connect non-structural elements to each other.

Another object of the present invention is to provide a device for joining building elements that offers simple and rapid installation.

Another object of the present invention is to provide a joining device that is capable of offering the widest guarantees of reliability and safety in use.

Another object of the invention is to provide a device for joining building elements that is easy to implement in terms of construction and which can be obtained and installed at low cost.

This aim and these and other objects which will become better apparent hereinafter are achieved by a device for joining building elements according to claim 1, optionally provided with one or more of the characteristics of the dependent claims.

5 Further characteristics and advantages of the invention will become better apparent from the description of preferred, but not exclusive, embodiments of the device for joining building elements according to the invention, which are illustrated for the purposes of non-limiting example in the accompanying drawings wherein:

10 Figure 1 is a perspective view of a beam and a pillar that are mutually connected by way of a joining device according to the invention;

Figure 2 is an exploded perspective view of the device according to the invention;

15 Figure 3 is a cross-sectional view of the joining device according to the invention, taken along a plane perpendicular to the pillar, with the corresponding joining members decoupled from each other;

Figure 4 is a cross-sectional view of the device according to the invention, taken along a plane perpendicular to the pillar, with the corresponding joining members mutually coupled;

20 Figure 5 is a front elevation view of a first joining member of the device according to the invention;

Figure 6 is a cross-sectional view taken along the line VI-VI in Figure 5;

25 Figure 7 is a cross-sectional view taken along the line VII-VII in Figure 5;

Figure 8 is a front elevation view of a second joining member of the device according to the invention;

Figure 9 is a cross-sectional view taken along the line IX-IX in Figure 8;

30 Figure 10 is a cross-sectional view taken along the line X-X in Figure

8;

Figure 11 is a perspective view of the joining device according to the invention in the step of coupling the respective joining members;

Figure 12 is an exploded perspective view of a first possible variation
5 of embodiment of the invention;

Figure 13 is a perspective view of a beam connected to a pillar by way of a joining device according to the invention in the variation of embodiment in Figure 12;

Figure 14 is a cross-sectional view of the variation of embodiment in
10 Figure 12, taken along a plane perpendicular to the pillar, with the joining members mutually coupled;

Figure 15 is an exploded front elevation view of the first joining member of the variation of embodiment in Figure 12;

Figure 16 is a cross-sectional view taken along the line XVI-XVI in
15 Figure 15;

Figure 17 is a cross-sectional view taken along the line XVII-XVII in Figure 16;

Figure 18 is a schematic, exploded perspective view of the components of the variation of embodiment in Figure 12 of the joining
20 device according to the invention in their step of mutual mating;

Figure 19 is an exploded perspective view of a second possible variation of embodiment of the joining device according to the invention, with parts omitted for the sake of simplicity and with the second joining member rotated in order to better show its characteristics;

Figure 20 is a perspective view of a beam and a pillar which are mutually connected by way of the device according to the invention in the variation of embodiment in Figure 19;

Figure 21 is an exploded cross-sectional view taken along a plane perpendicular to the pillar of the variation of embodiment in Figure 19;

Figure 22 is a cross-sectional view, along a plane perpendicular to the
30

pillar, of a step of mounting the joining device according to the invention in the variation of embodiment in Figure 19;

Figure 23 is a cross-sectional view of the variation of embodiment in Figure 19 taken along a plane perpendicular to the pillar;

5 Figure 24 is a cross-sectional view of the variation of embodiment in Figure 19 taken along a plane perpendicular to the pillar, different from the one in Figure 23;

Figure 25 is an exploded front elevation view of the first joining member of the variation of embodiment in Figure 19;

10 Figure 26 is a cross-sectional view taken along the line XXVI-XXVI in Figure 25;

Figure 27 is a cross-sectional view taken along the line XXVII-XXVII in Figure 25;

15 Figure 28 is a front elevation view of the second joining member of the variation of embodiment in Figure 19;

Figure 29 is a cross-sectional view taken along the line XXIX-XXIX in Figure 28;

Figure 30 is a cross-sectional view taken along the line XXX-XXX in Figure 28;

20 Figure 31 is an exploded perspective view of the second variation of embodiment of the device according to the invention;

Figure 32 is an exploded perspective view of a third variation of embodiment of the invention, with parts omitted and with the second joining member rotated with respect to the first joining member;

25 Figure 33 is a perspective view of a pillar and a beam which are mutually connected by way of the device according to the invention in the third variation of embodiment in Figure 32;

Figure 34 is an exploded cross-sectional view of the third variation of embodiment, taken along a plane perpendicular to the pillar;

30 Figure 35 is a cross-sectional view of the third variation of

embodiment of the device according to the invention, taken along a plane perpendicular to the pillar;

Figure 36 is a cross-sectional view of the third variation of embodiment of the invention, taken along a plane perpendicular to the pillar, different from the one in Figure 35;

Figure 37 is a front elevation view of the first joining member of the third variation of embodiment of the invention;

Figure 38 is a cross-sectional view taken along the line XXXVIII-XXXVIII in Figure 37;

Figure 39 is a cross-sectional view taken along the line XXXIX-XXXIX in Figure 37;

Figure 40 is a front elevation view of the second joining member of the third variation of embodiment of the invention;

Figure 41 is a cross-sectional view taken along the line XLI-XLI in Figure 40;

Figure 42 is a cross-sectional view taken along the line XLII-XLII in Figure 40;

Figure 43 is an exploded perspective view of the third variation of embodiment of the invention;

Figure 44 is a perspective view of another embodiment of a closure element.

With reference to the figures, the device for joining building elements according to the invention, which is generally designated by the reference numeral 1, comprises at least one pair of joining members, which are constituted respectively by at least one first joining member 2, which is fixed to a first element to be joined 3, and a second joining member 4, which is fixed to a second element to be joined 5 and can be coupled to the first joining member 2.

As in the examples shown, the first and the second elements to be joined 3 and 5 can be constituted by a pillar and a beam and they can be

made of reinforced concrete, wood, steel or other suitable material.

If the elements to be joined are made of reinforced concrete, they can be prefabricated or they can be provided on-site.

It should be noted that there is no reason why the device according to
5 the invention cannot also be used to connect structural elements other than a
beam and a pillar and, optionally, also to connect structural elements to
elements that have no structural function, such as, for example, when
connecting a structural element, like a pillar, a beam, a partition and the like
to a dividing wall supporting element, such as, for example, a metallic
10 profile that forms part of an dividing drywall, or in order to connect non-
structural elements to each other, such as, for example, in a connection
between supporting elements, for example one vertical and the other
horizontal, both part of the same structural infill wall.

According to the invention, each one of the joining members 2 and 4
15 has a comb-like structure with respective coupling teeth 2a and 4a defined,
which protrude from a face of the corresponding element to be joined 3, 5,
generally designated with 3a and 5a, which faces the other element to be
joined 3, 5.

In particular, the coupling teeth 2a and 4a of the joining members 2
20 and 4 are arranged mutually side-by-side and mutually spaced apart along a
first direction which is substantially parallel to the face 3a and 5a of the
respective element to be joined 3 and 5, so that respective interspaces 2b
and 4b are defined between the coupling teeth 4a and 5a of the joining
members 2 and 4. For example, as in the embodiment shown, the
25 aforementioned first direction can be a substantially horizontal direction.

More specifically, the coupling teeth 2a and 4a of one of the joining
members 2, 4 are engageable in the interspaces 2b and 4b that are comprised
between the coupling teeth 2a, 4a of the other joining member 2, 4.

Advantageously, the coupling teeth 2a and 4a of the joining members
30 2, 4 extend, substantially mutually parallel, along a second direction which

is substantially parallel to the face 3a and 5a of the corresponding element to be joined 3 and 5 and substantially perpendicular to the aforementioned first direction along which the coupling teeth 2a and 4a are mutually side-by-side.

5 Conveniently, the first and the second joining member 2 and 4 can be made of a metallic material, such as, for example, steel, optionally provided with protection, such as, for example, galvanization, or of composite material.

Advantageously, the joining device according to the invention can be
10 completed by having the coupling teeth 2a and 4a of each one of the joining members 2 and 4 embedded in a casting 6 for filling the interspaces 2b and 4b comprised between the coupling teeth 2a and 4b.

Such filling casting 6 is, in practice, carried out with the joining
members 2, 4 coupled to each other by way of introduction into the
15 interspaces 2b, 4b of a permeation material that is capable, once cured, of exchanging at least compression stresses.

With this arrangement, the joining device according to the invention allows the simultaneous or non-simultaneous exchange of axial, flexural, shear and torsion actions.

20 Advantageously, the permeation material can be constituted by high-performance fluid mortar with controlled shrinkage, preferably if the joining members 2, 4 are made of metal, or two-component epoxy resin, preferably if the joining members 2, 4 are made of composite material.

It must be noted that, more generally, the material that constitutes the
25 joining elements 2, 4, its protection if any, and the permeation material can be chosen as a function of the type, dimensions and materials of the elements to be joined 3 and 5 which are to be mutually connected, and of the actions for which the possibility of exchange is desired, and of the environment in which the joining device will be situated.

30 In greater detail, as shown for the purposes of example in Figure 11,

the second joining member 4 can be coupled to the first joining member 2 by way of the insertion of each one of the coupling teeth 4a of the second joining member 4 into a corresponding interspace 2b which is defined between the coupling teeth 2a of the first joining member 2, following a sliding of the coupling teeth 4a of the second joining member 4 with respect to the coupling teeth 2a of the first joining member 2 along a direction that is substantially parallel to the aforementioned second direction along which the coupling teeth 2a and 4a extend.

Advantageously, the first joining member 2 has at least one abutment bracket 7, which can be engaged via resting contact by the coupling teeth 4a of the second joining member 4 and is arranged substantially on the side of the first joining member 2 that lies opposite with respect to the side for inserting the coupling teeth 4a of the second joining member 4 into the interspaces 2b between the coupling teeth 2a of the first joining member 2.

In particular, according to the embodiment shown, the abutment bracket 7 is arranged on the side of the first joining member 2 that is directed downward, while on the side of the first joining member 2 that is directed upward the coupling teeth 4a of the second joining member 4 can be inserted into the corresponding interspaces 2b.

In this manner, again as shown in Figure 11, it is possible to connect the second element to be joined 5, which in the example shown is constituted by a beam, to the first element to be joined 3, which in the example shown is constituted by a pillar, by descending the second element to be joined 5 from above with respect to the first element to be joined 3.

Conveniently, prevention means are provided which make it possible, when the first joining member 2 and the second joining member 4 are mutually coupled, to prevent the disengagement of the coupling teeth 4a of the second joining member 4 from the interspaces 2b between the coupling teeth 2a of the first joining member 2 by way of a movement of the second joining member 4 relative to the first joining member 2 along a direction

that is substantially perpendicular to the face 3a, 5a of the first or of the second element to be joined 3, 5, i.e. substantially perpendicular to the aforementioned first direction and second direction.

In more detail, the coupling teeth 2a, 4a of the joining members 2a and 4a, advantageously, each have a plate-like body 8 and a respective widened head 9, wider than the corresponding plate-like body 8, which is arranged at the end of the respective coupling tooth 2a, 4a that is directed away from the face 3a, 5a of the corresponding element to be joined 3, 5, in order to define, between the widened heads 9 of the coupling teeth 2a and 4a of each one of the members to be joined 2, 4, slits 10 which can be passed through by the plate-like bodies 8 but not by the widened heads 9 of the coupling teeth 2a, 4a of the other joining member 2, 4, when the joining members 2, 4 are mutually coupled.

Conveniently, the widened head 9 of each coupling tooth 2a and 4a comprises at least one lateral expansion 9a which protrudes from the plate-like body 8 of the corresponding coupling tooth 2a, 4a and which has, on its side directed toward the corresponding element to be joined 3, 5, at least one inclined portion 9b which gives the widened head 9 a flared shape as one goes progressively farther from the corresponding plate-like body 8, proceeding in the opposite direction to the corresponding element to be joined 3, 5.

Conveniently, each one of the joining members 2, 4 further comprises a respective anchoring plate 11, which can be fixed, on one of its faces 11a, to the face 3a, 5a of the corresponding element to be joined 3, 5 and which supports, on its opposite face 11b, the corresponding coupling teeth 2a, 4a.

The technique used to fix the anchoring plate 11 of the joining members 2, 4 to the corresponding element to be joined 3, 5 can be, for example, welding, bolting, adhesive bonding or the like and, in general, can be chosen based on the materials that make up the anchoring plate 11 and the element to be joined 3, 5 to which it is to be fixed, based on the

procedure followed in order to provide the joining and based on the actions that the joining device itself needs to be capable of exchanging.

More specifically, the anchoring plates 11 of the joining members 2, 4 and the corresponding connections to the elements to be joined 3, 5 can, 5 conveniently, be dimensioned, for example by way of a method for calculating finite elements, as a function of the stressing tensions and of the applicable technical regulations in force.

More generally, the dimensions of the joining device according to the invention and the number of coupling teeth 2a and 4a of the joining 10 members 2 and 4 can be calculated as a function of the size, of the materials and of the function of the elements to be joined 3, 5 and of the actions for which exchange needs to be permitted.

It should be noted that the device according to the invention can be dimensioned and structured so as to obtain, optionally, a perfect 15 interlocking between the coupling teeth 2a, 4a of the joining members, thus creating a total continuity between the first and the second joining member 2 and 4.

Advantageously, the first joining member 2 can, optionally, have a pair of lateral coupling teeth 2c which are arranged on mutually opposite 20 sides, coupling teeth 2a, so that, when the joining members 2 and 4 are coupled together, the coupling teeth 4a of the second joining member 4 are interposed between the lateral coupling teeth 2c of the first joining member 2.

With reference in particular to Figures 12-18, according to a possible 25 embodiment, it is possible that the side of the first joining member 2, through which the coupling teeth 4a of the second joining member 4 are inserted into the corresponding interspaces 2b, can be closed, after inserting the coupling teeth 4a of the second joining member 4 and optionally applying the filling casting 6, by way of at least one closure element 102, 30 which can be connected to the first joining member 2.

For example, such closure element can be provided by an elongated body 102a, conveniently flattened in cross-section, which is arranged, with its axis, substantially parallel to the face 3a of the first element to be joined 3 and resting against the first joining member 2 and, more specifically, against the corresponding coupling teeth 2a, 2c, in practice being positioned, as illustrated, at the other end from the abutment bracket 7.

Advantageously, a plurality of projections 102b extend from the face of the elongated body 102a that is directed toward the first joining member 2, and are adapted to be inserted into the interspaces 2b between the coupling teeth 2a of the first joining member 2.

More preferably, there are pairs of such projections 102b which define, between them, a seat 102c in which a respective coupling tooth 2a of the first joining member 2 is engaged.

Conveniently, there are means for fixing the closure element 102 to the first joining member, which are, for example, provided by an elongated engagement element 103, which can engage with at least one of the coupling teeth 2a, 2c of the first joining member 2 and with at least one of the projections 102b of the closure element 102.

For example, the elongated engagement element 103 can be constituted by a bolt 103a which can engage with each one of the coupling teeth 2a, 2c of the first joining member 2 and with each one of the projections 102b of the closure element 102 by way of its insertion into special holes 104a and 104b, which are defined respectively in the coupling teeth 2a, 2c of the first joining member 2 and in the projections 102b of the closure element 102 and are mutually coterminous.

Extraction from the holes 104a, 104b of the bolt 103a is, advantageously, prevented by lock nuts 103b which can be screwed on the ends of the bolt 103a or by a head and a nut arranged at the ends of the screw 103a.

It should be noted that the application of the closure element 102,

after execution of the filling casting 6, makes it possible to complete the connecting element, thus further increasing its resistance to torsion.

Figure 44 shows a different embodiment of the closure element 102 in which the protrusions 102b have a dimension, in the direction parallel to the longitudinal extension of the elongated body 102a, that is substantially equal to the distance between two consecutive coupling teeth 2a of the first joining member 2.

As shown in Figures 19 to 31, according to another possible variation of embodiment, the above mentioned prevention means which prevent the disengagement of the coupling teeth 4a of the second joining member 4 from the interspaces 2b between the coupling teeth 2a of the first joining element 2 can also be provided, optionally, by at least one locking pin 120, which engages at least one of the coupling teeth 2a, 2c, 4a of each one of the joining members 2, 4.

In particular, in this case, the coupling teeth 2a and 4a of the joining members 2a and 4a can again each have a plate-like body 8, but lack the widened head 9.

Preferably, there are several locking pins 120 which are, advantageously, arranged substantially perpendicular to the opposite flat faces of the coupling teeth 2a, 2c, 4a of the joining members 2, 4 and which can be constituted, for example, by threaded elements 120a which can be inserted into corresponding first accommodation openings 121a which are defined in the coupling teeth of one of the two joining members, for example the first joining member 2, as shown in the figures, and into corresponding second accommodation openings 121b which in turn are defined in the coupling teeth of the other one of the two joining members, in particular of the second joining member 4, and can be locked there using adapted lock nuts 120b which can be tightened, in particular, against the lateral coupling teeth 2c of the first joining member 2c.

Advantageously, in the variation of embodiment in Figures 19-31, the

first accommodation openings 121a are already provided in the coupling teeth 2a of the first joining member 2 and conveniently have a diameter that is calibrated to the transverse dimension of the corresponding locking pin 120, while the second accommodation openings 121b are, conveniently, provided on-site, after the correct positioning of the second joining member 4 with respect to the first joining member 2, with the insertion of the corresponding coupling teeth 4a into the interspaces 2b comprised between the coupling teeth 2a of the first joining member 2, and the correct reciprocal positioning of the elements to be joined 3, 5.

Conveniently, as shown in Figure 22, the second accommodation openings 121b can be provided on-site by way of a drill bit 105 actuated, for example, by a magnetic drill, using the first accommodation openings 121a as an abutment.

In this case, the coupling teeth 4a are, conveniently, structured so as to facilitate the drilling operation, for example by adopting a contained thickness.

Figures 32 to 43 show an additional variation of embodiment of the invention, in which the second accommodation openings 121b for the locking pins 120 are already provided in the coupling teeth 4a of the second joining member 4.

In this case, advantageously, the second accommodation openings 121b can have a larger dimension than that of the first accommodation openings 121a which are defined in the coupling teeth 2 of the first joining member 2, in order to enable the insertion of the locking pins 120 with predetermined mounting tolerances, so as to enable the correct positioning between the joining members 2, 4 and of the elements to be joined 3, 5 with respect to each other.

In this case too, in order to provide the filling casting 6, a permeation material can be used which is constituted by two-component epoxy resin, optionally loaded with sand or microsilice, which make it possible to

combine high mechanical performance with greater capacity to permeate empty spaces.

It should also be noted that the larger second accommodation openings 121b provided in the coupling teeth 4a of the second joining member 4 also make it possible to optimize the transmission of the compression tensions to the permeation material that constitutes the filling casting 6.

With reference again to Figures 32-43, it can be seen that it is also possible for the coupling teeth 4a of the second joining member 4 to be arranged in pairs that are mutually spaced apart, indicated with 123.

In particular, the coupling teeth 4a of each one of such pairs 123 can be inserted into a respective interspace 2b which is defined between the coupling teeth 2b of the first joining member 2, as can be seen in particular in Figure 35, or, as an alternative, it is possible to insert the coupling teeth 2a of the first joining member 2 between the coupling teeth 4a of each pair 123.

Use of the joining device according to the invention is the following.

With particular reference to the situation shown in the figures, in which the elements to be joined 3 and 5 comprise, respectively, a pillar and a beam, the first joining member 2 is fixed to a face 3a of the pillar which is intended to be facing toward an end of the beam to be connected to that pillar.

In particular, the first joining member 2 is, in this case, conveniently arranged with its side on which the abutment bracket 7 is arranged directed downward, as explained previously, while the second joining member 4 is fixed to a face 5a of the beam located at the end of that beam that is to be connected to the pillar and which is facing thereto.

With this arrangement and with reference, in particular, to the embodiment in Figures 1-11, the coupling teeth 4a of the second joining member 4 are therefore engageable in the interspaces 2b that are comprised

between the coupling teeth 2a of the first joining member 2 by way of a movement of the beam downward from above with respect to the pillar, until contact of the coupling teeth 4a of the second joining member 4 with the abutment bracket 7 is achieved.

5 The joining is subsequently completed by way of the application of the filling casting 6 so as to embed therein the coupling teeth 2a, 4a of the joining members 2 and 4 and the closure element 102 if applied, which is fixed to the first joining member 2 by way of inserting the elongated engagement element 103 into the holes 104a of the closure element 102 and
10 into the holes 104b of the first joining member 2.

With reference to the variation of embodiment in Figures 20-31, after inserting the coupling teeth 4a of the second joining member 4 into the interspaces 2b comprised between the coupling teeth 2a of the first joining member 2 via a movement that, in this case, can also be perpendicular to the
15 axis of the pillar, and after correctly positioning the beam with respect to the pillar, the technician proceeds to make the second accommodation openings 121b in the coupling teeth 4a of the second joining member 4 and, subsequently, to insert the locking pins 120 through the first and the second accommodation openings 121a, 121b of the coupling teeth 2a, 2c, 4a of the
20 joining members 2 and 4.

At this point the filling casting 6 can be applied and optionally also the closure element 102, as described above.

By contrast, in the variation of embodiment in Figures 32-43, after inserting the coupling teeth 4a of the second joining member 4 into the interspaces 2b comprised between the coupling teeth 2a of the first joining
25 member 2 and after, optionally, correcting the position of the beam with respect to the pillar, the technician proceeds to insert the locking pins 120 into the first and the second accommodation openings 121a, 121b of the coupling teeth 2a, 2c, 4a of the joining members 2 and 4, and subsequently
30 to complete the joining, as in the previous cases, using the filling casting 6

and optionally applying the closure element 102.

In practice it has been found that the invention fully achieves the intended aim and objects and, in particular, it is emphasized that the joining device according to the invention makes it possible to mechanically connect
5 elements to each other which can have the same or different functions or which are made of different materials, wholly or only partially prefabricated.

Another advantage of the invention is that it allows the exchange between the connected elements of any type of action and, as a result of the
10 necessary dimensioning, makes it possible to scale the extent of the actions that can be exchanged.

Consequently, in the construction sector, the device according to the invention makes it possible to increase the static indeterminacy of the building in which it is adopted (as required for example by Eurocodes for
15 increasing the structural safety of the building), to constrain the end of the pillar (partition) in order to reduce its length of free inflexion (and as a consequence the extent of buckling) and contribute, furthermore, to reducing the camber of the beam element.

Another important advantage of the invention is its simplicity in
20 installation, owing to the practicality of the operations required and the rapidity of their execution.

In particular, such simplicity of installation translates in the construction sector to the ability to connect a beam to two pillars simply by letting the beam fall from above so as to make it rest on the joining members
25 connected to the pillars, sufficient amounts of play being available in all directions, by virtue of the interspaces between the coupling teeth of the joining members, to achieve the correct positioning of the beam.

Again with reference in particular to the construction sector, the device according to the invention also offers the following advantages:

30 - it enables/facilitates the provision of multi-floor frames made up

entirely of prefabricated elements;

- it improves the characteristics of single-floor buildings, like factory/warehouse sheds;

- it enables/facilitates the provision of frames made up of pillars and
5 beams made of different materials;

- it enables/facilitates the provision of frames made up of pillars and beams, some prefabricated and others provided on-site.

It must also be pointed out that the invention permits mounting tolerances (proportioned to the types of structural elements to be joined) in
10 all three principal directions.

The invention thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the appended claims. Moreover, all the details may be substituted by other, technically equivalent elements.

15 Thus, for example, the device according to the invention can also be provided with means of adjustment or control of the reciprocal mounting tolerances of the joining members 2, 4.

For example, such means of adjustment or control of the mounting tolerances can comprise metallic spacers or shims, not shown, which can be,
20 conveniently, coupled to at least one of the two joining members 2, 4.

For example, such spacers can be inserted at the base of the anchoring plate 11 of the first joining member 2 and placed, conveniently, on the abutment bracket 7, so as to enable the correct vertical positioning of the second joining member 4, with respect to the first joining member 2, and,
25 therefore, of the elements to be joined 4, 5 with respect to each other.

In practice the materials employed, provided they are compatible with the specific use, and the contingent dimensions and shapes, may be any according to requirements and to the state of the art.

The disclosures in Italian Patent Applications No. 102019000006936
30 and 102020000006139 from which this application claims priority are

incorporated herein by reference.

Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such
5 reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

CLAIMS

1. A device for joining building elements, which comprises at least one pair of joining members (2, 4), respectively at least one first joining member (2), which is fixed to a first element to be joined (3), and a second
5 joining member (4), which is fixed to a second element to be joined (5) and can be coupled to said first joining member (2), characterized in that each one of said joining members (2, 4) has a comb-like structure with respective coupling teeth (2a, 4a) defined which protrude from a face (3a, 5a) of the corresponding element to be joined (3, 5) which faces the other element to
10 be joined (3, 5) and are arranged mutually side-by-side and mutually spaced apart along a first direction which is substantially parallel to said face (3a, 5a), the coupling teeth (2a, 4a) of one of said joining members (2, 4) being engageable in interspaces (2b, 4b) that are comprised between the coupling teeth (2a, 4a) of the other joining member (2, 4).

15 2. The device according to claim 1, characterized in that said coupling teeth (2a, 4a) extend, substantially parallel to each other, along a second direction which is substantially parallel to said face (3a, 5a) of the corresponding element to be joined (3, 5) and substantially perpendicular to said first direction.

20 3. The device according to one or more of the preceding claims, characterized in that, with said joining members (2, 4) mutually coupled, the coupling teeth (2a, 4a) of each one of said joining members (2, 4) are embedded in a casting (6) for filling the interspaces (2b, 4b) comprised between said coupling teeth (2a, 4a).

25 4. The device according to one or more of the preceding claims, characterized in that said second joining member (4) can be coupled to said first joining member (2) by way of the insertion of each one of the coupling teeth (4a) of said second joining member (4) into a corresponding interspace (2b) which is defined between the coupling teeth (2a) of said first joining
30 member (2), following a sliding of the coupling teeth (4a) of said second

joining member (4) with respect to the coupling teeth (2a) of said first joining member (2) along a direction that is substantially parallel to said second direction.

5 5. The device according to one or more of the preceding claims, characterized in that said first joining member (4) has at least one abutment bracket (7), which can be engaged via resting contact by the coupling teeth (4a) of said second joining member (4) and is arranged substantially on the side of said first joining member (2) that lies opposite with respect to the side for inserting the coupling teeth (4a) of said second joining member (4)
10 into the interspaces (2b) between the coupling teeth (2a) of said first joining member (2).

6. The device according to one or more of the preceding claims, characterized in that it comprises at least one closure element (102) for closing the side of said first joining member (2) for inserting the coupling
15 teeth (4a) of said second joining member (4) into the interspaces (2b) between the coupling teeth (2a) of said first joining member (2).

7. The device according to one or more of the preceding claims, characterized in that it comprises prevention means which are adapted to prevent the disengagement of the coupling teeth (4a) of said second joining
20 member (4) from the interspaces (2b) between the coupling teeth (2a) of said first engagement member (2) by way of a movement of said second joining member (4) relative to said first joining member (2) along a direction that is substantially perpendicular to said face (3a, 5a), with said first joining member (2) and said second joining member (4) mutually
25 coupled.

8. The device according to one or more of the preceding claims, characterized in that said coupling teeth (2a, 4a) each have a plate-like body (8) and a respective widened head (9), wider than the corresponding plate-like body (8), which is arranged at the end of the respective coupling tooth
30 (2a, 4a) that is directed away from said face (3a, 5a) of the corresponding

element to be joined (3, 5), in order to define, between the widened heads (9) of the coupling teeth (2a, 4a) of each one of said members to be joined (2, 4), slits (10) which can be passed through by the plate-like bodies (8) but not by the widened heads (9) of the coupling teeth (2a, 4a) of the other joining member (2, 4), when said joining members (2, 4) are mutually coupled.

9. The device according to one or more of the preceding claims, characterized in that said widened head (9) comprises at least one lateral expansion (9a) which protrudes from the plate-like body (8) of the corresponding coupling tooth (2a, 4a) and has, on its side directed toward the corresponding element to be joined (3, 5), at least one inclined portion (9b).

10. The device according to one or more of the preceding claims, characterized in that said prevention means comprise at least one locking pin (120) which engages at least one of the coupling teeth (2a, 2c, 4a) of each one of said joining members (2, 4).

11. The device according to one or more of the preceding claims, characterized in that each one of said joining members (2, 4) comprises a respective anchoring plate (11) which can be fixed, on one of its faces (11a), to said face (3a, 5a) of the corresponding element to be joined (3, 5) and which supports, on its opposite face (11b), the corresponding coupling teeth (2a, 4a).

12. The device according to one or more of the preceding claims, characterized in that said first joining member (2) has a pair of lateral coupling teeth (2c) which are arranged, on mutually opposite sides, with respect to its other coupling teeth (2a), the coupling teeth (4a) of said second joining member (4) being interposed between said lateral coupling teeth (2c) of said first joining member (2), when said joining members (2, 4) are mutually coupled.

13. The device according to one or more of the preceding claims,

characterized in that said elements to be joined (3, 5) comprise respectively a pillar and a beam, said first joining member (2) being fixed to a face (3a) of said pillar that faces toward an end of said beam to be connected to said pillar and being arranged with its side in which said abutment bracket (7) is
5 arranged directed downward, said second joining member (4) being fixed to a face (5a) of said beam which is located at said end to be connected and faces towards said pillar, the coupling teeth (4a) of said second joining member (4) being engageable in the interspaces (2b) that are comprised between the coupling teeth (2a) of said first joining member (2) by way of a
10 movement of said beam downward from above with respect to said pillar, until contact of the coupling teeth (4a) of said second joining member (4) with said abutment bracket (7) is achieved.

14. The device according to one or more of the preceding claims, characterized in that it comprises means of adjustment or control of the
15 reciprocal mounting tolerances of said joining members (2, 4).

15. The device according to one or more of the preceding claims, characterized in that said means of adjustment or control comprise spacers which can be coupled to at least one of said joining members (2, 4).

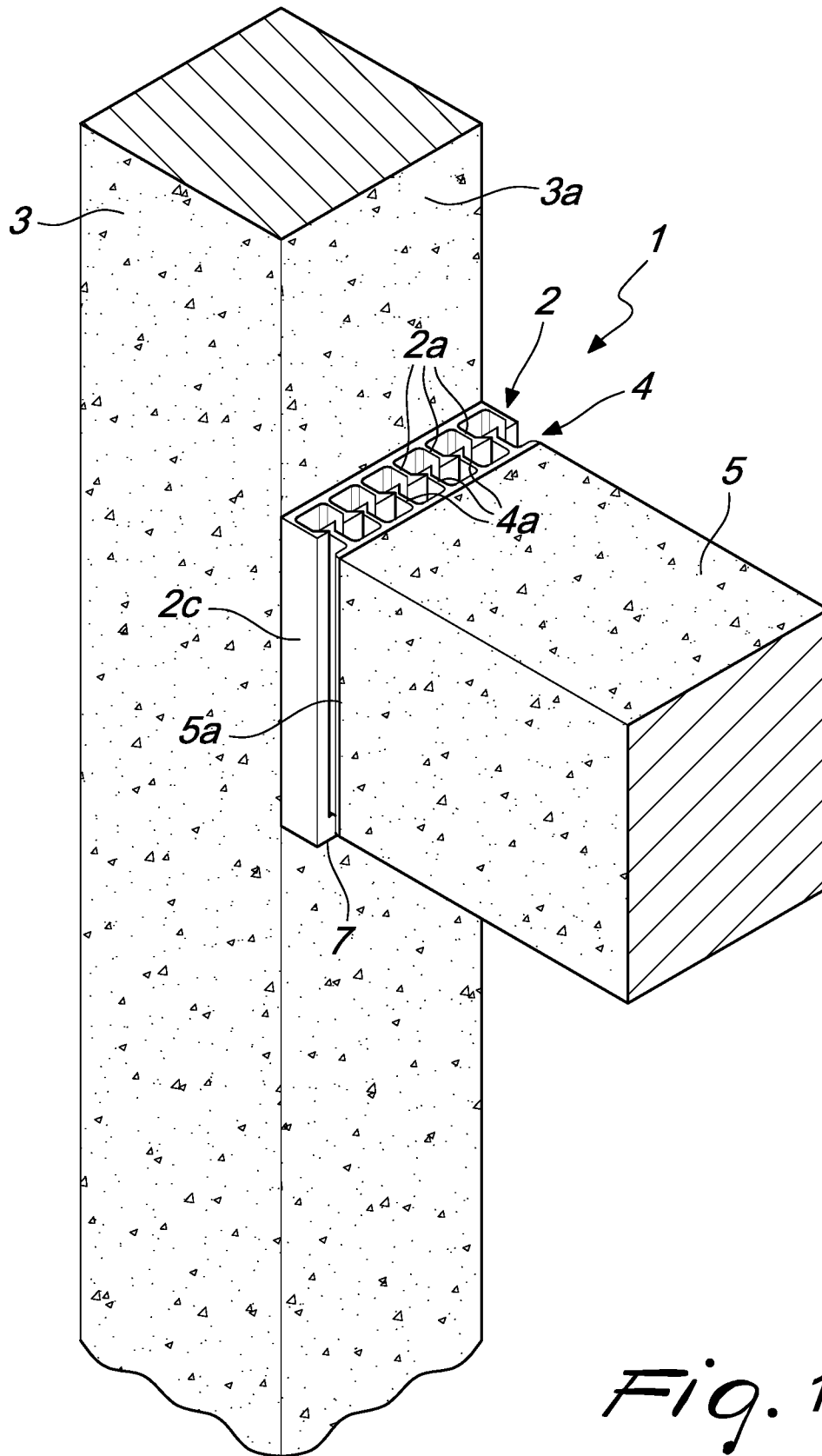


Fig. 1

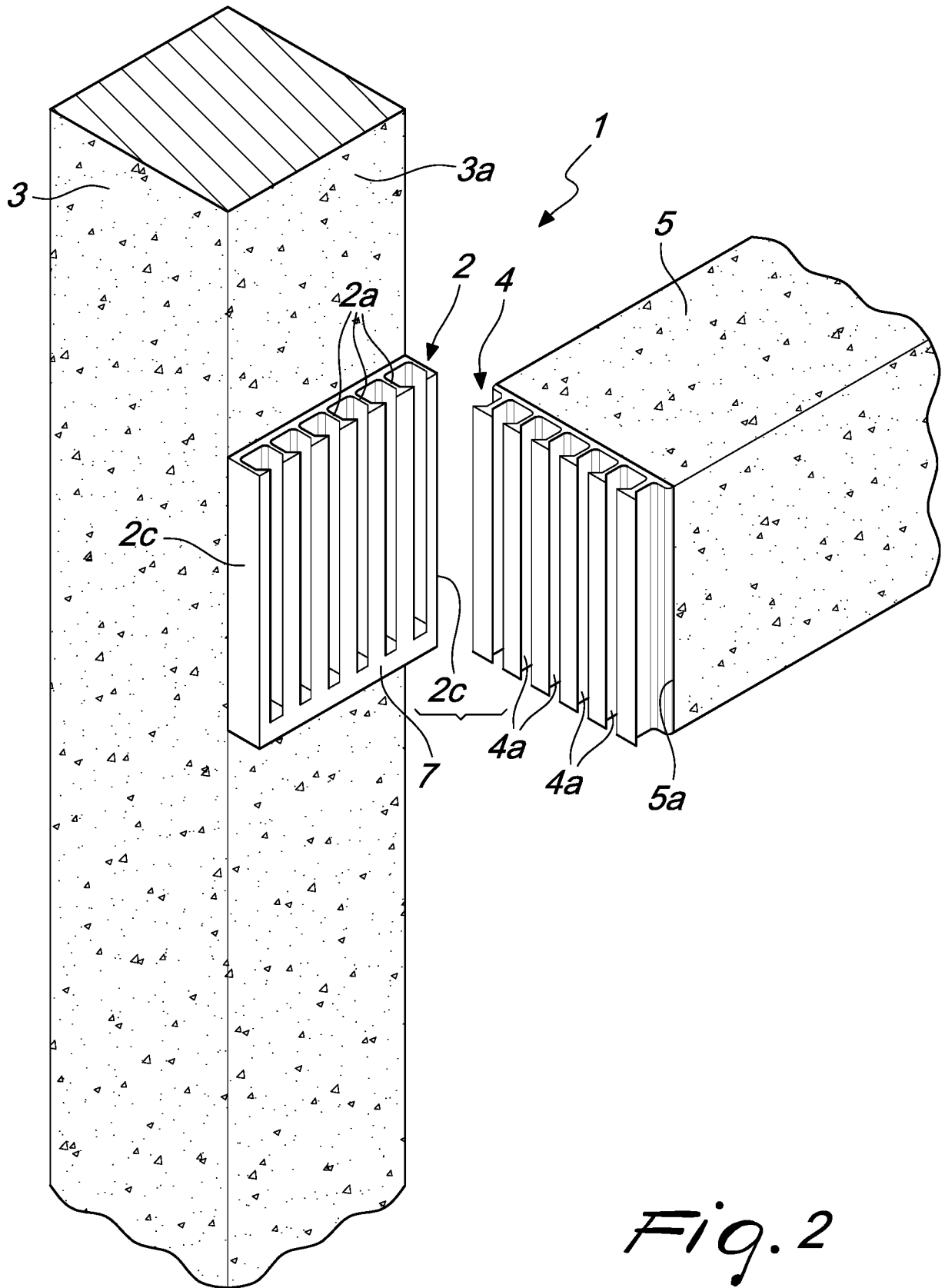


Fig. 2

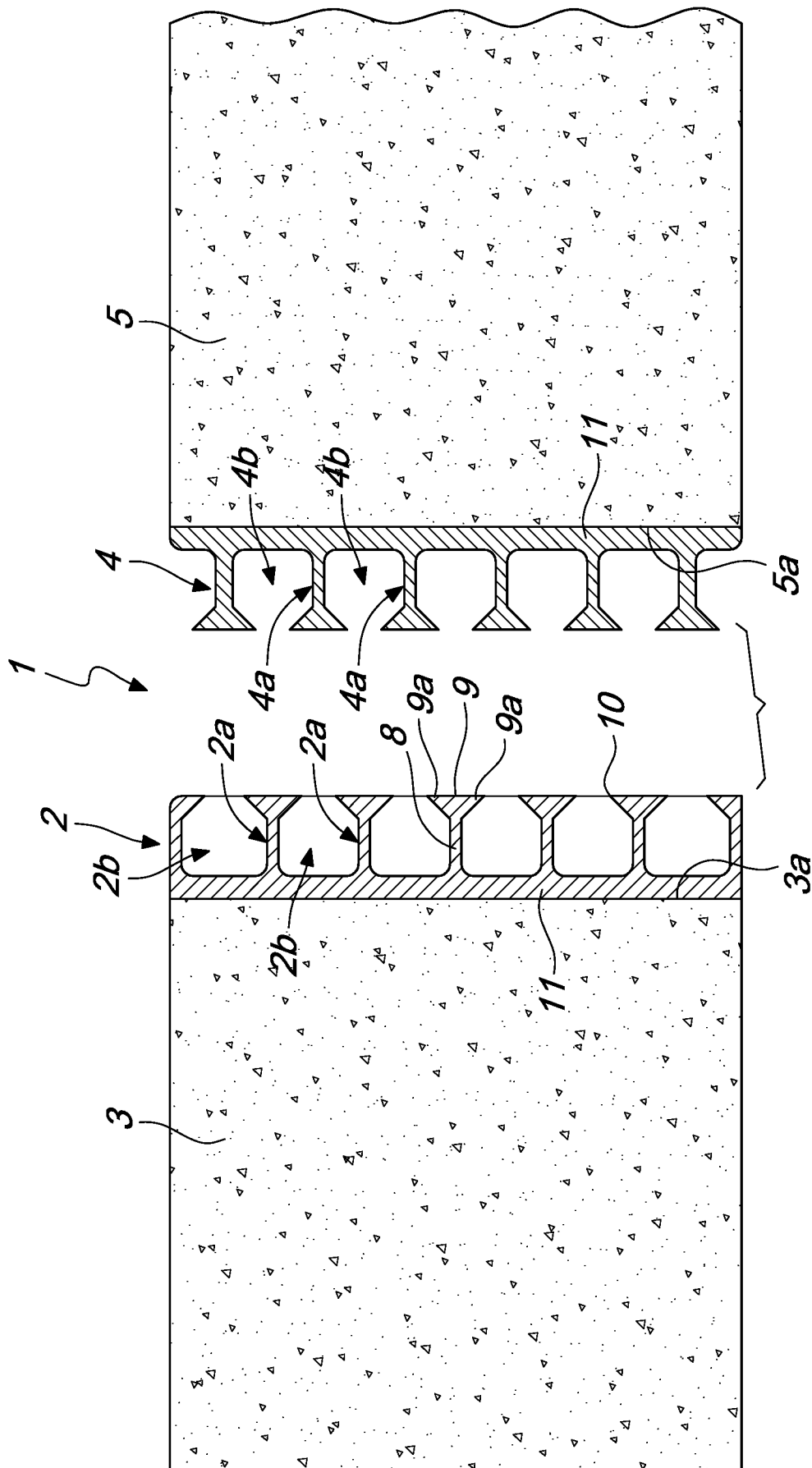


Fig. 3

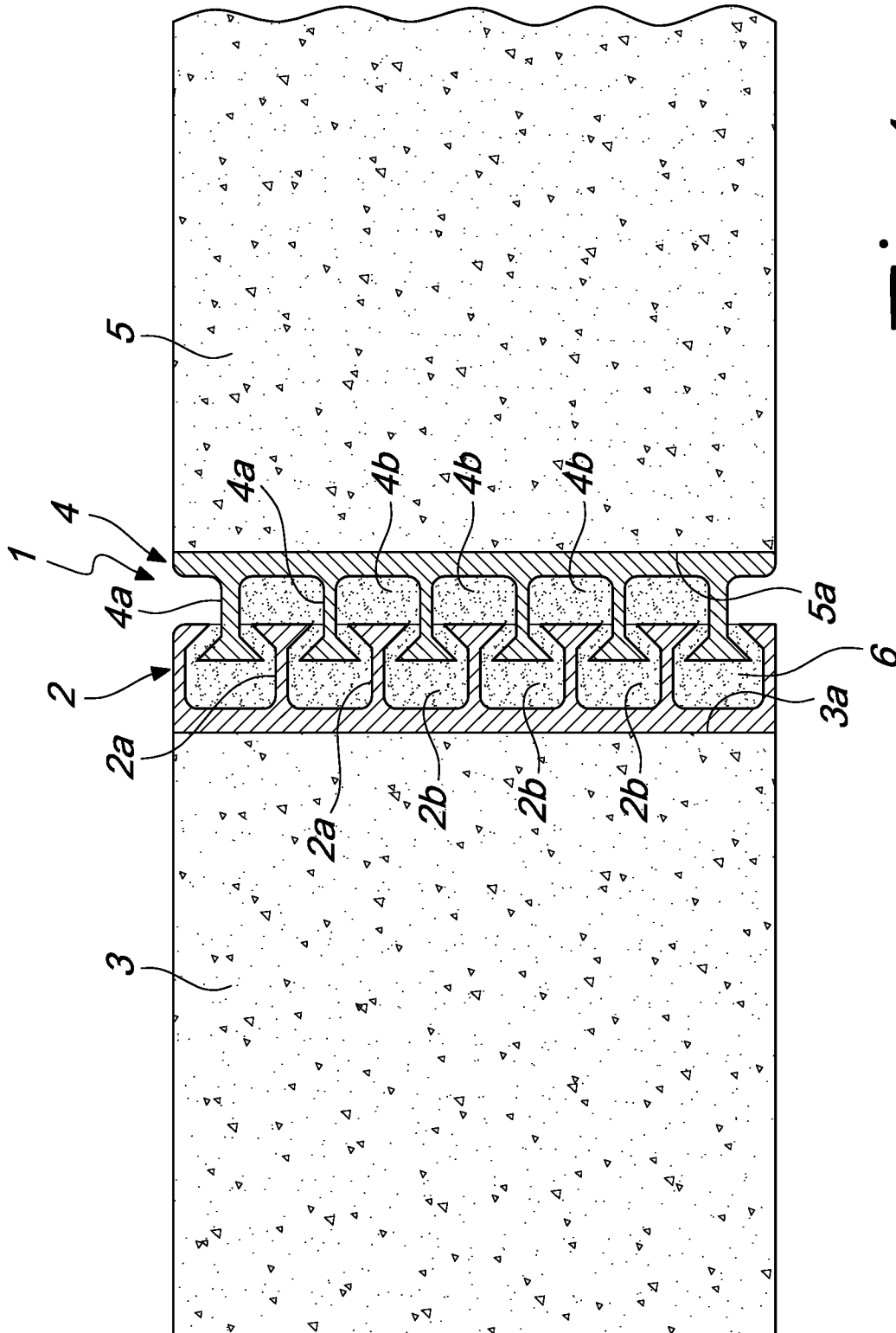


Fig. 4

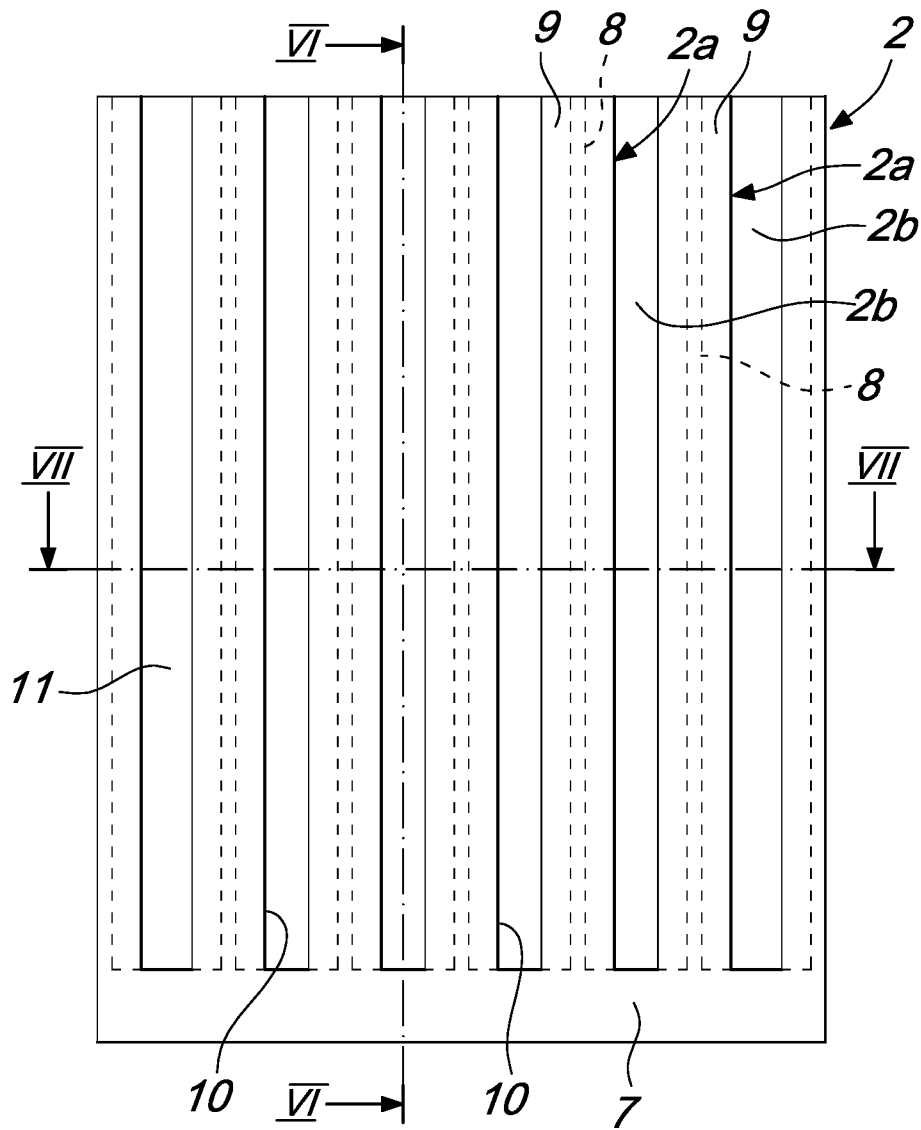


Fig. 5

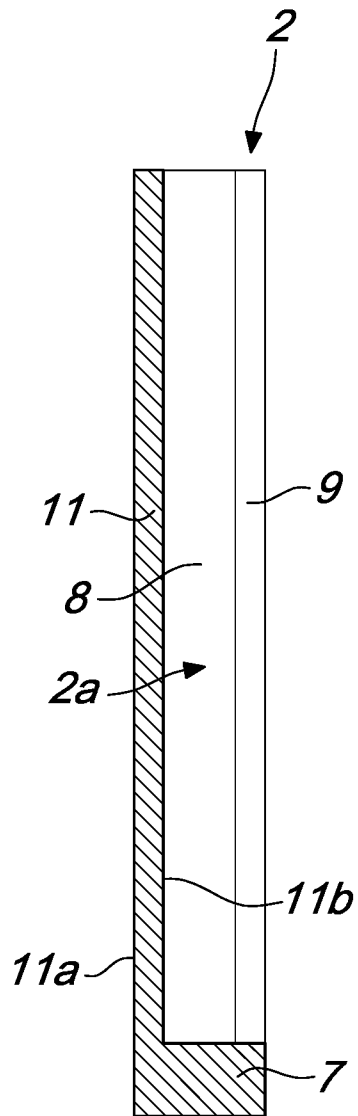


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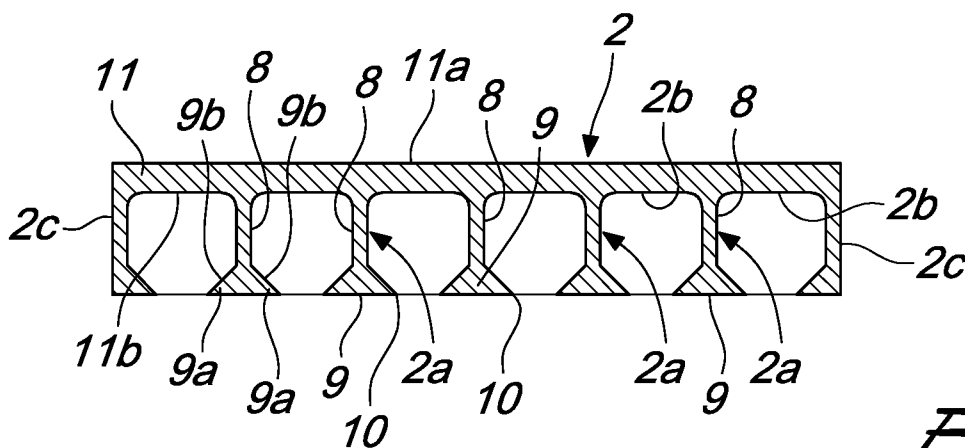
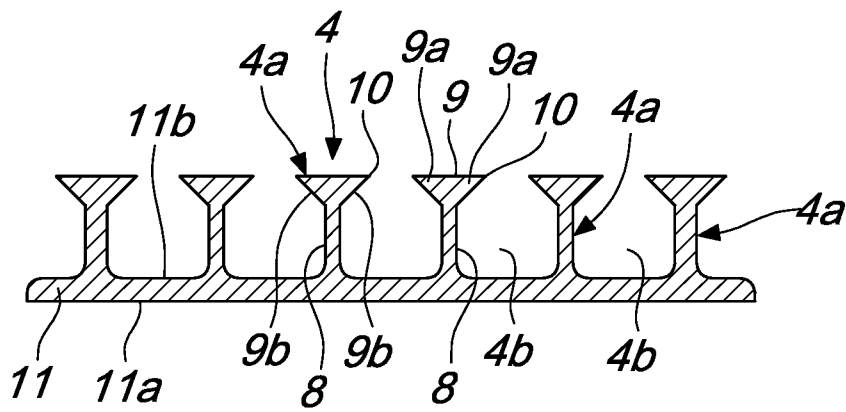
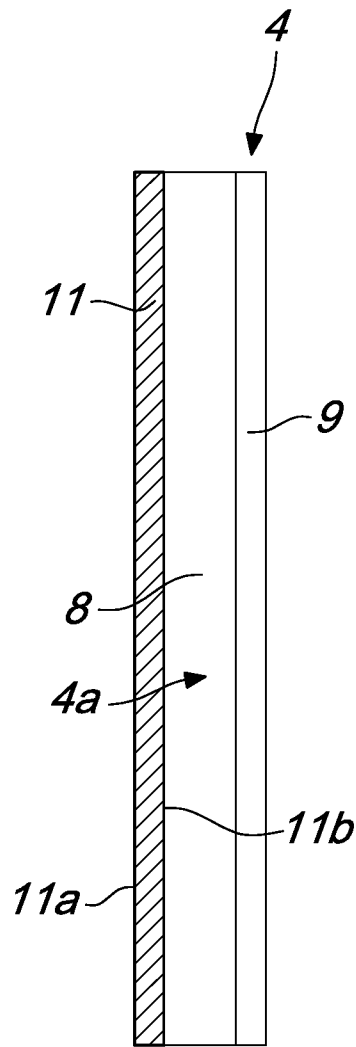


Fig. 7



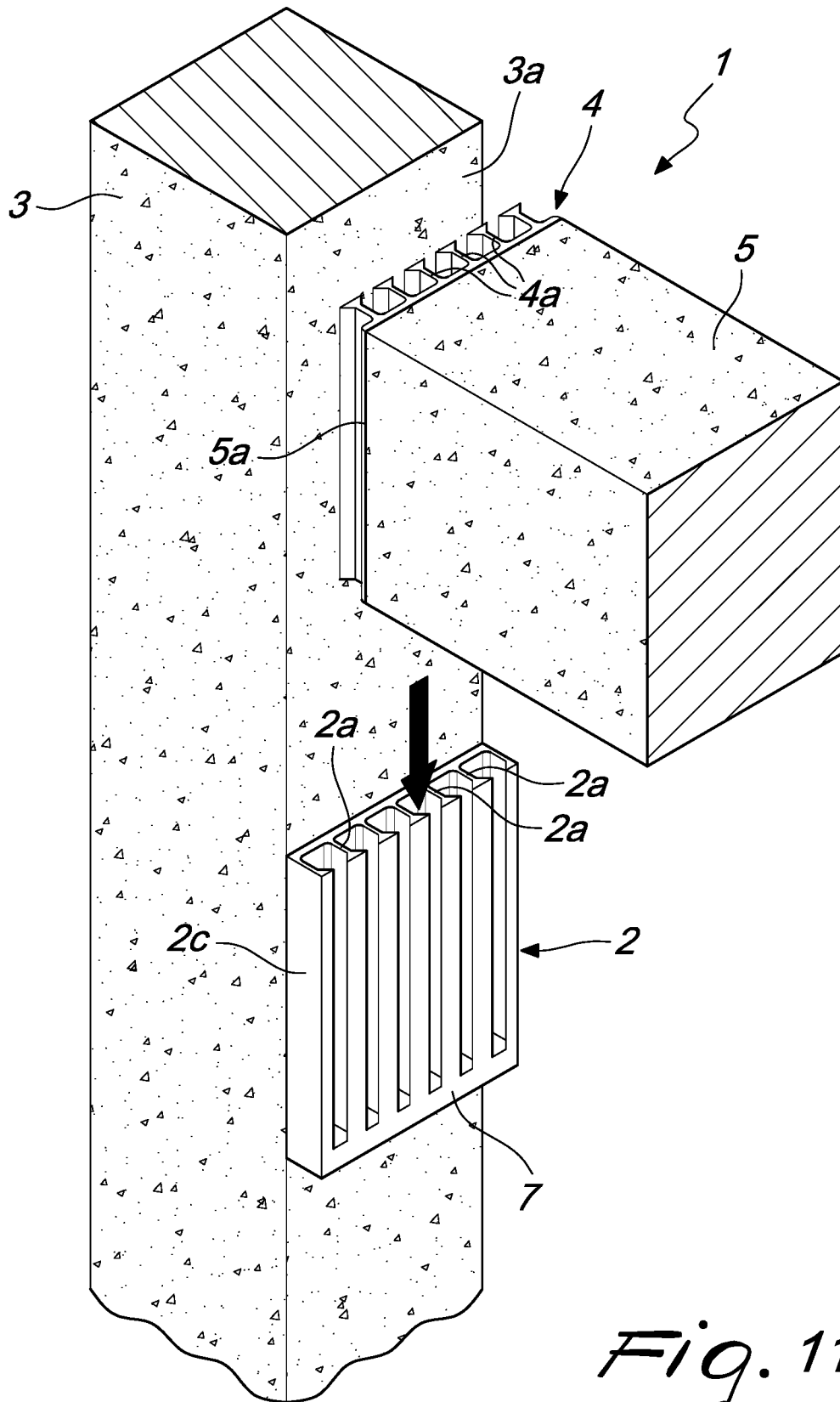


Fig. 11

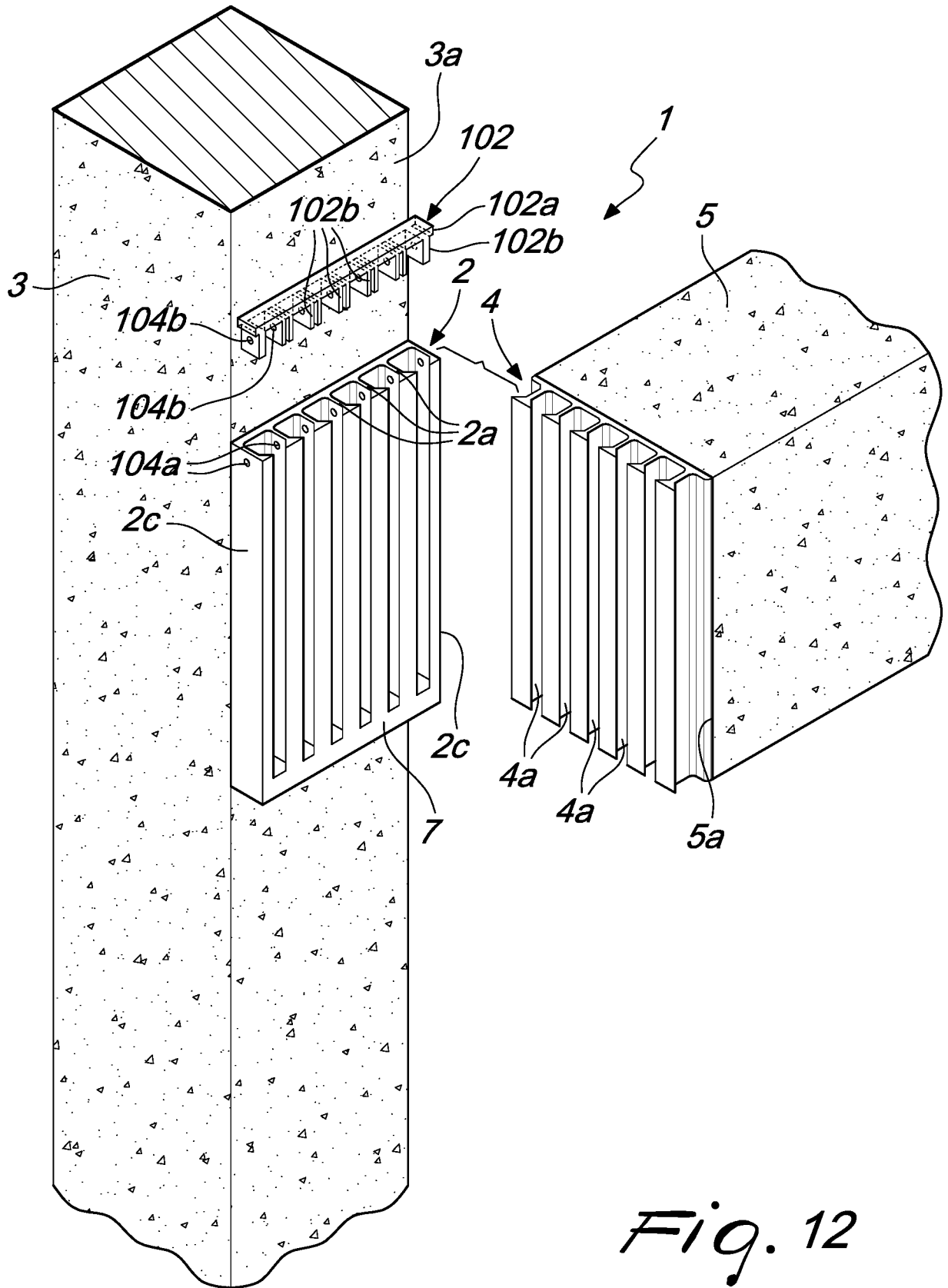


Fig. 12

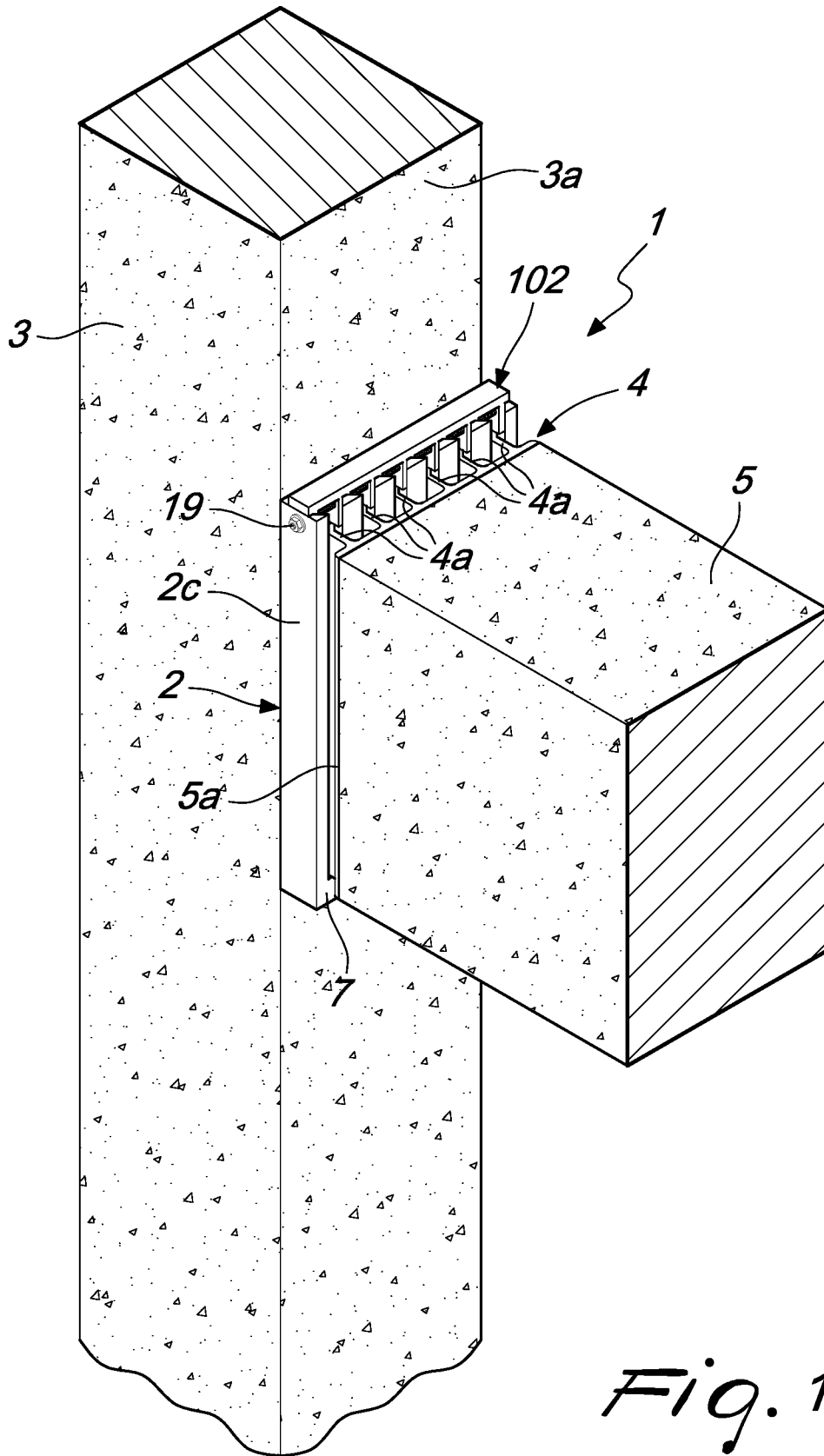


Fig. 13

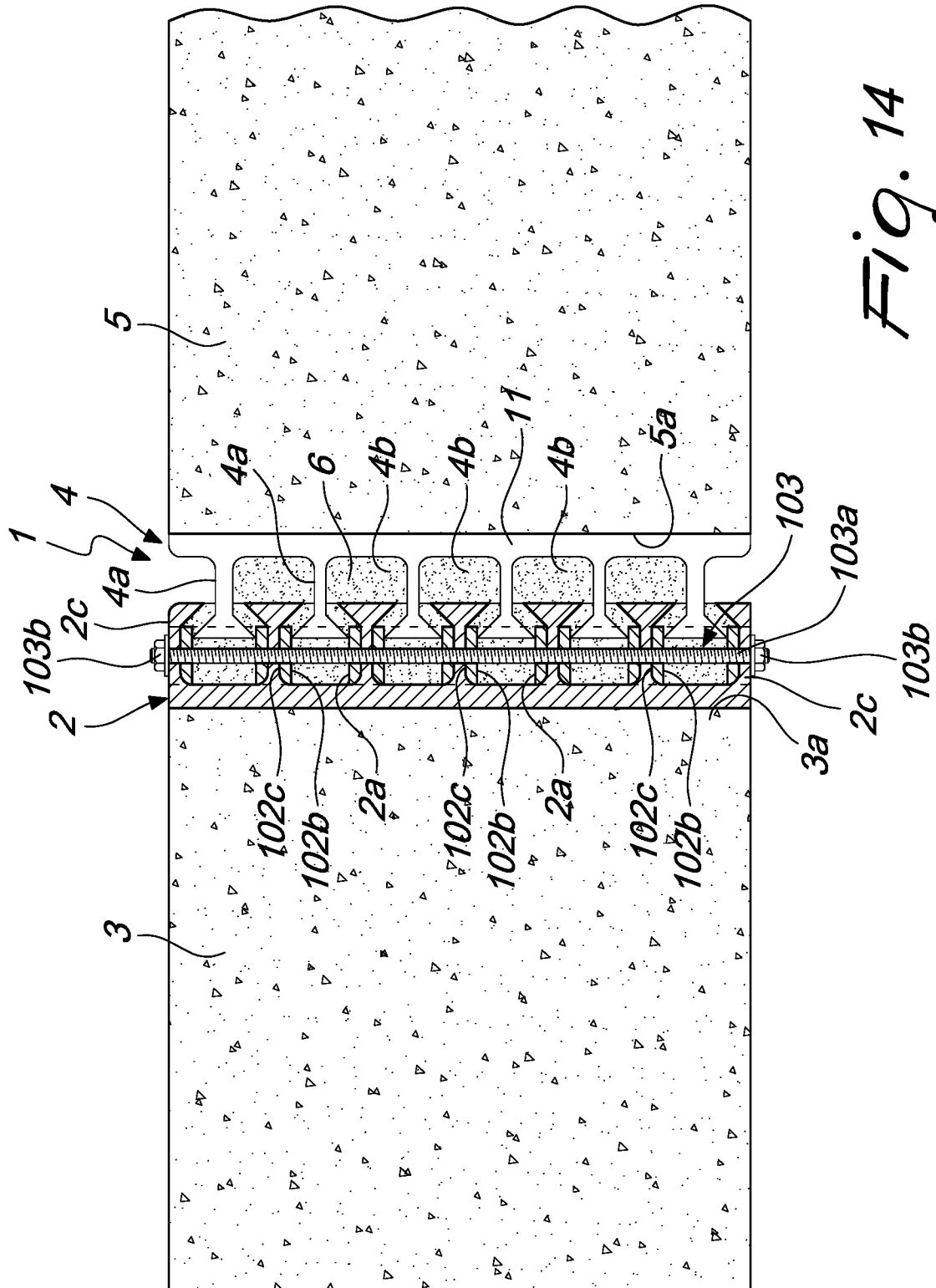


Fig. 14

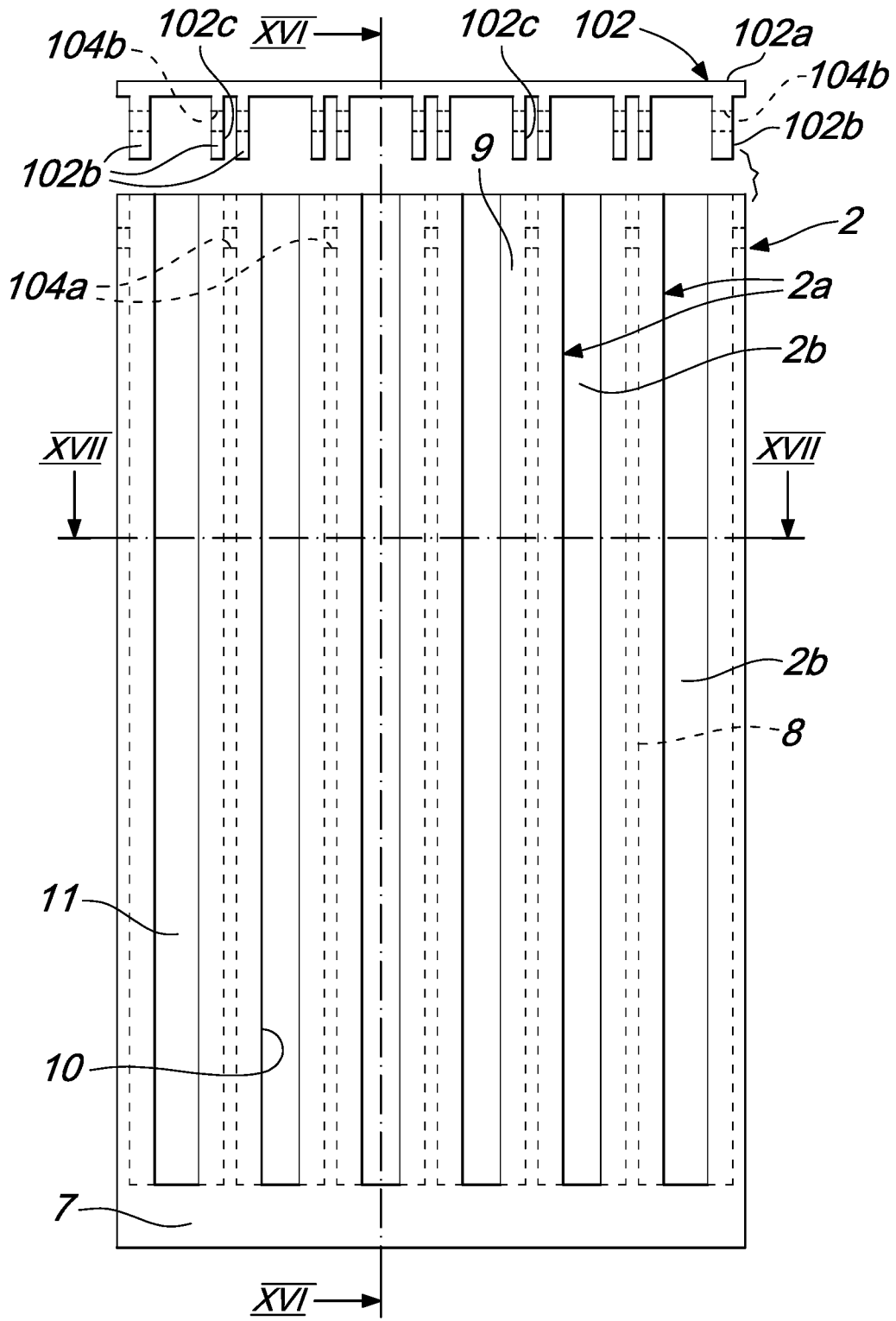


Fig. 15

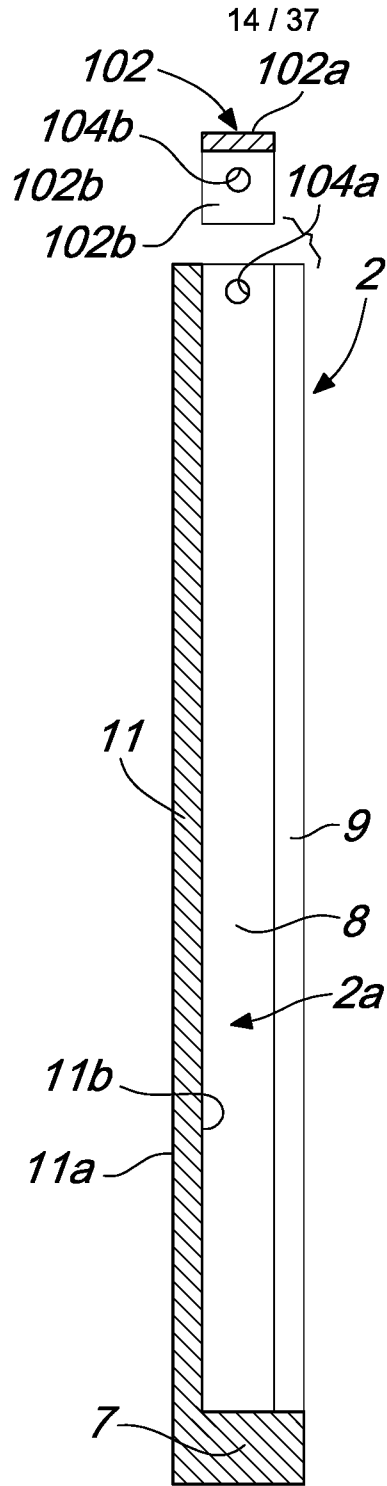


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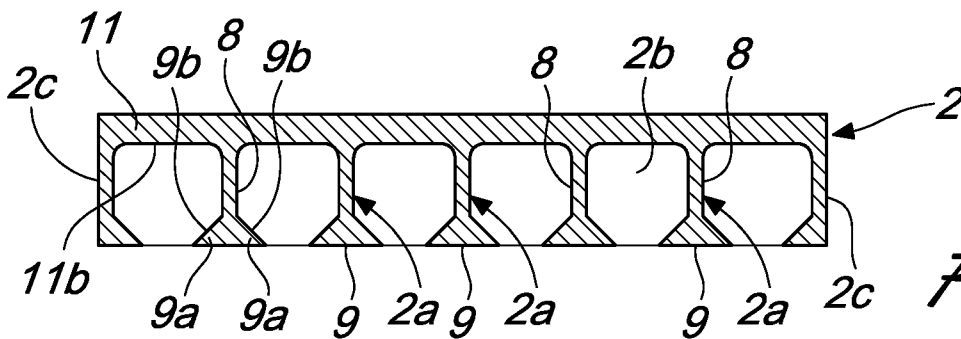
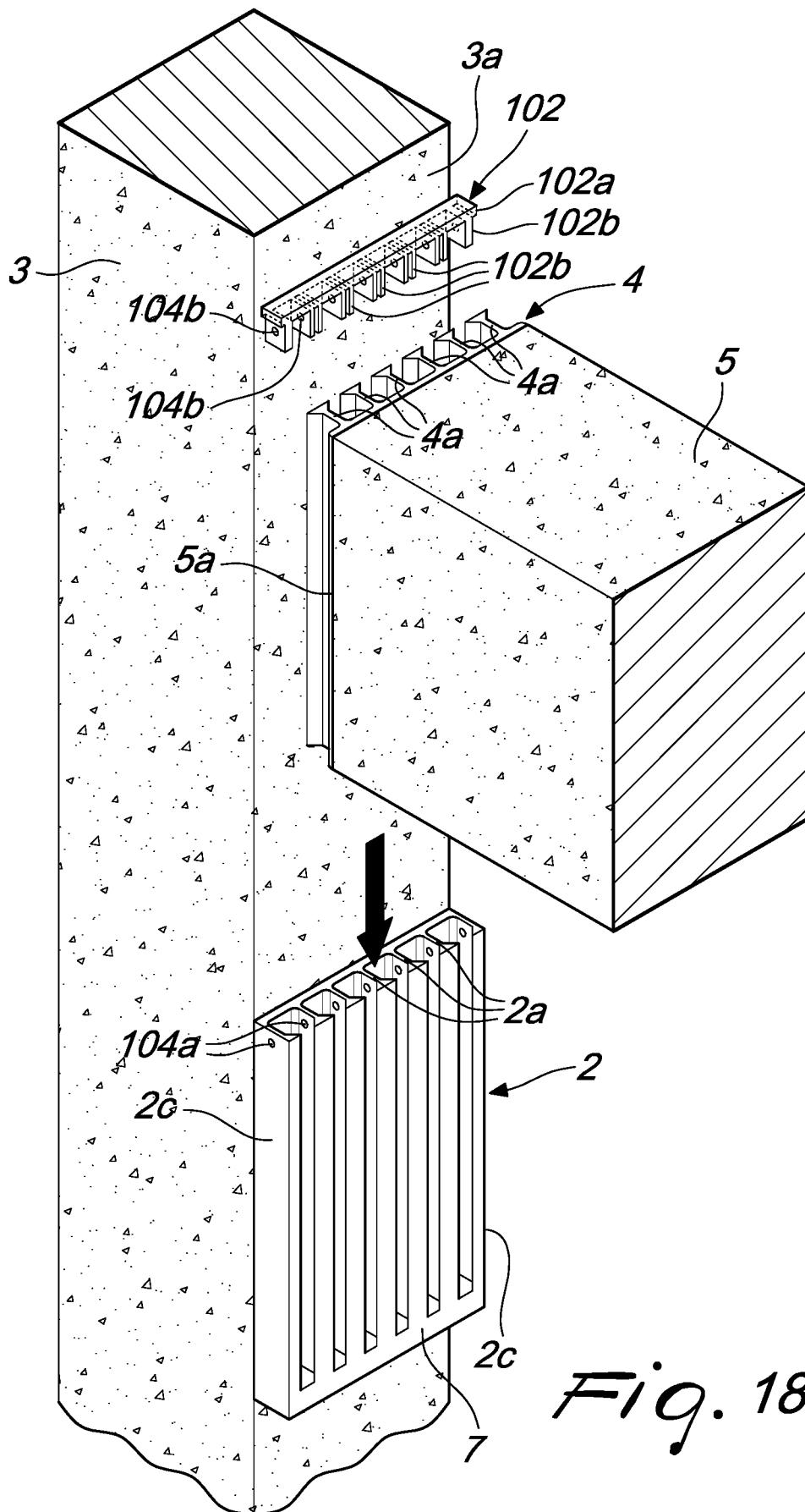


Fig. 17



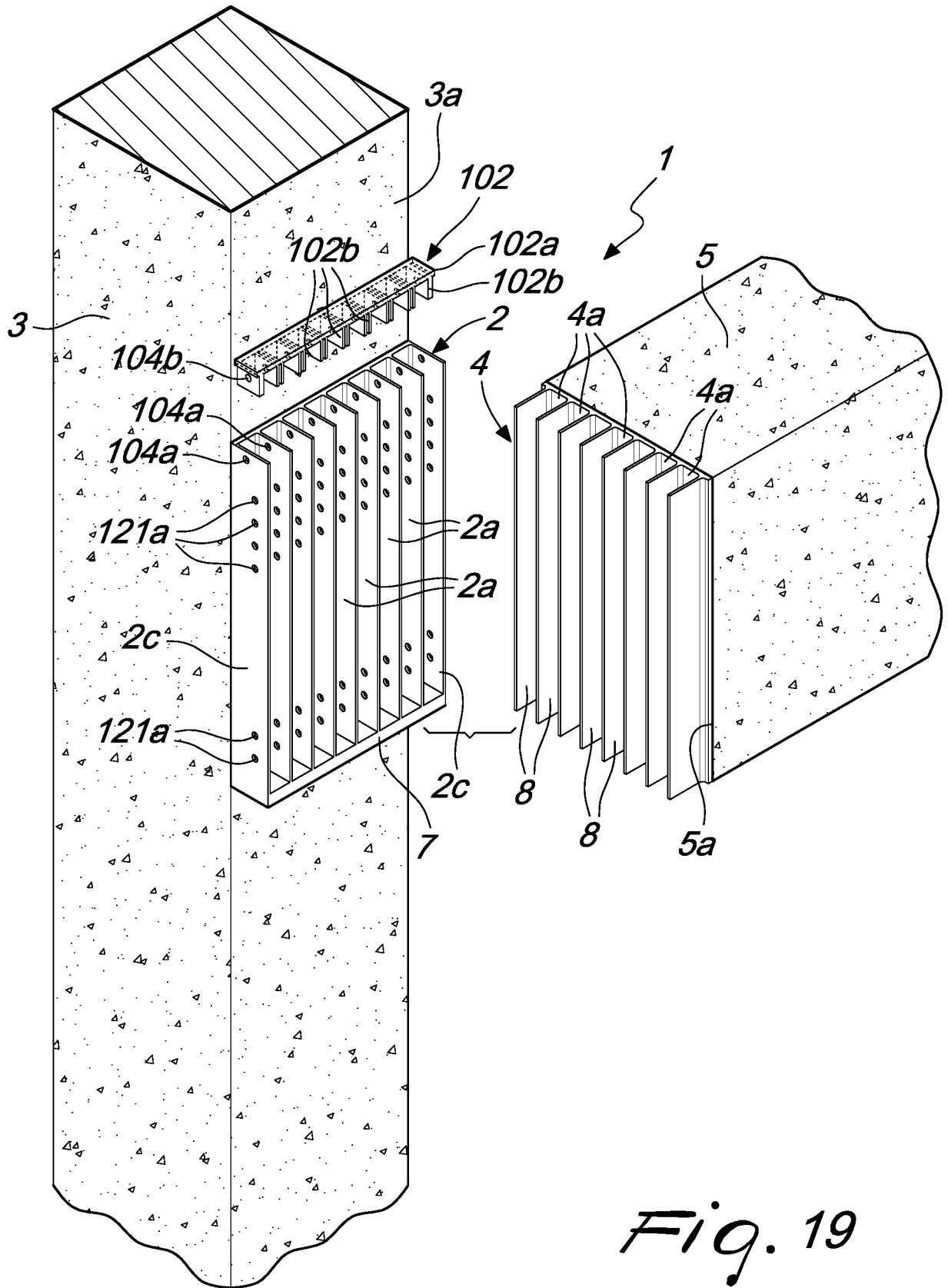


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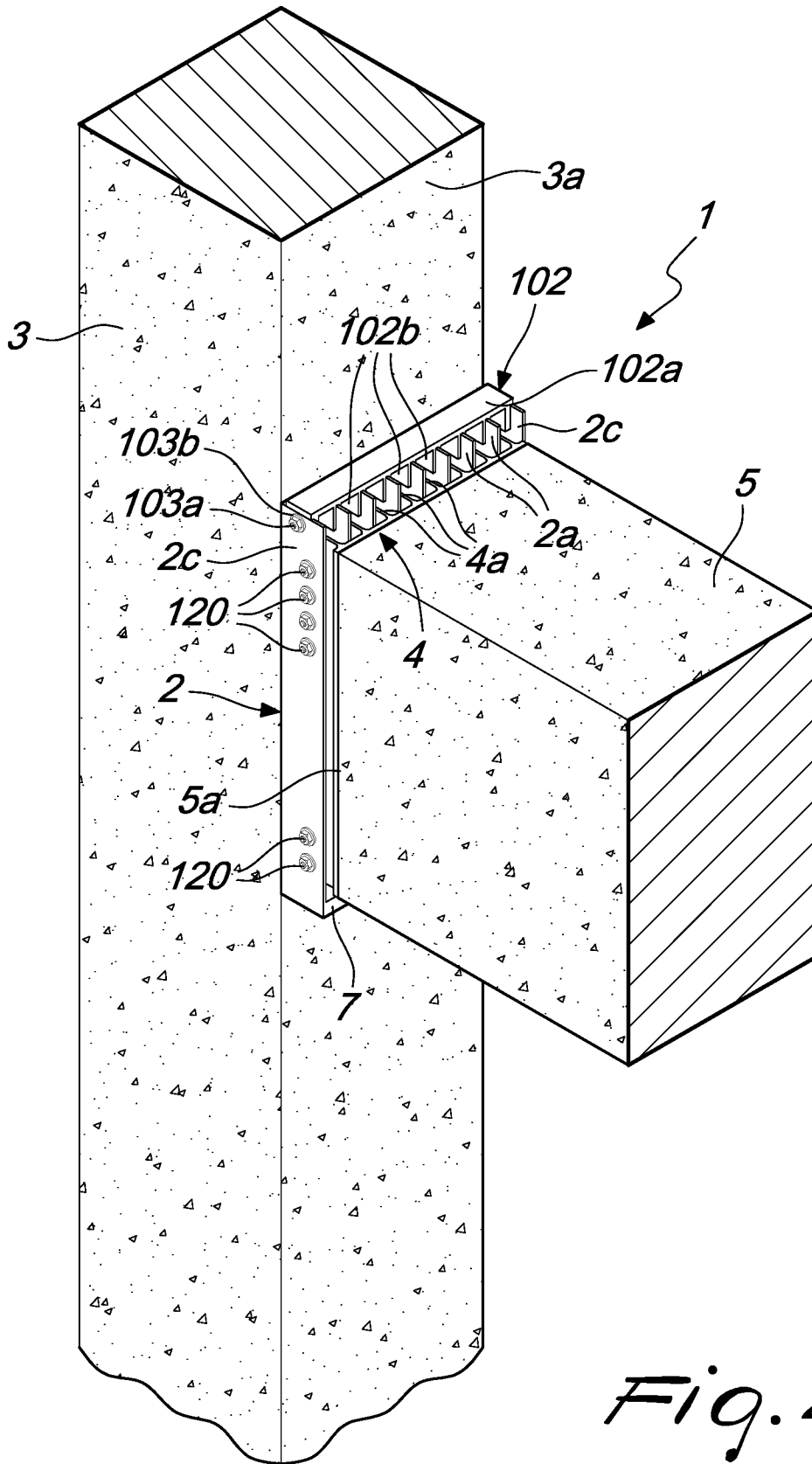


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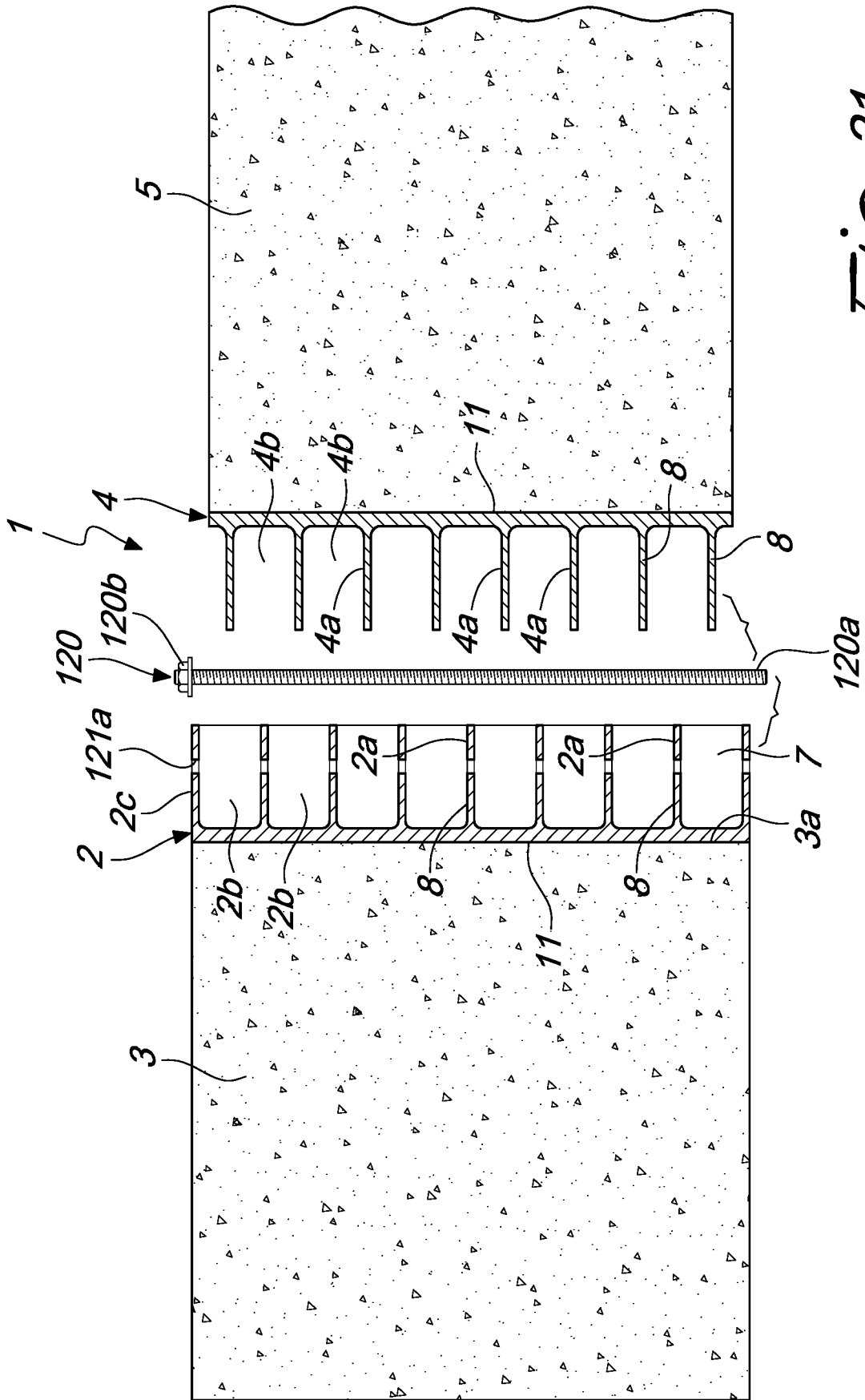


Fig. 21

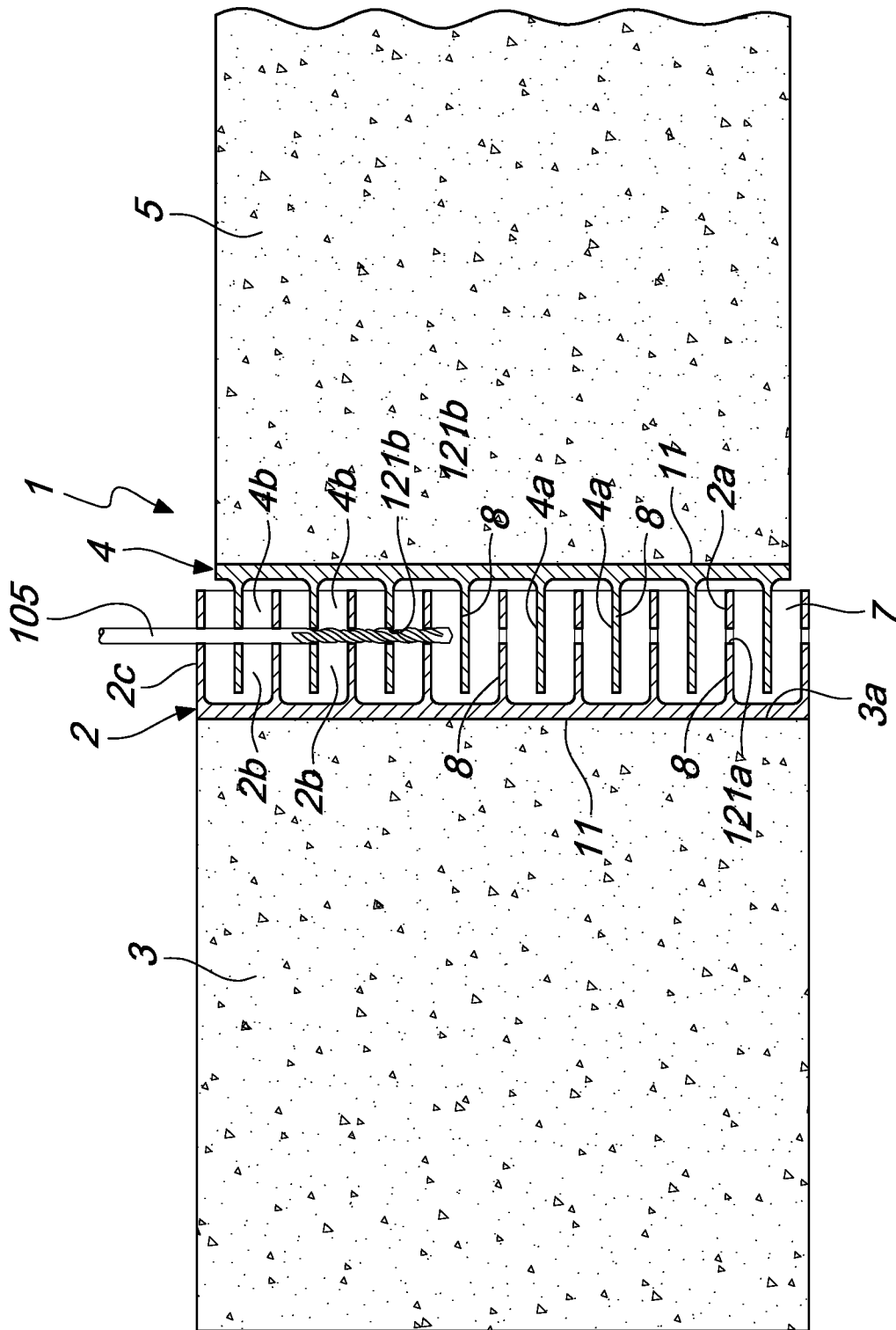


Fig. 22

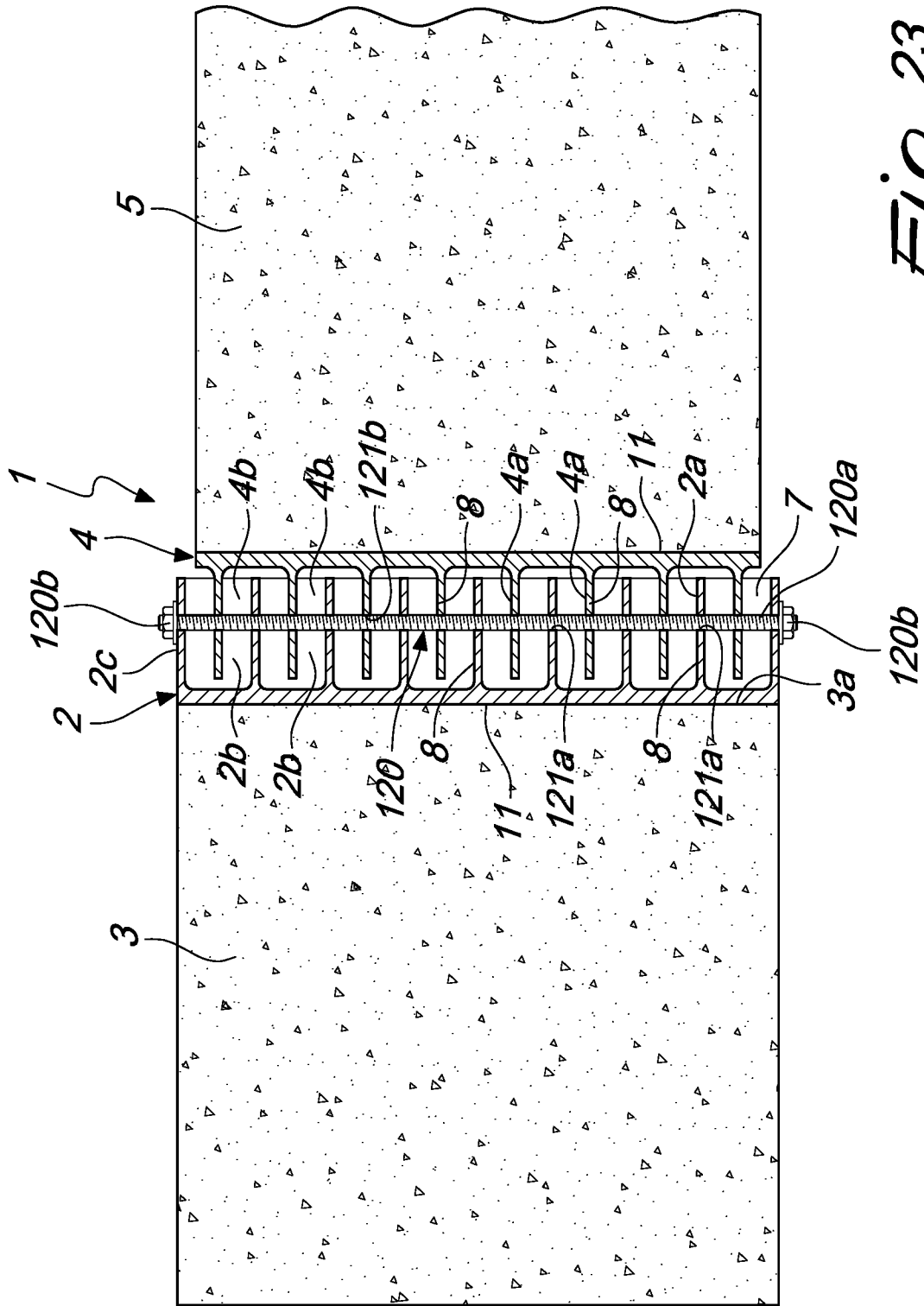


Fig. 23

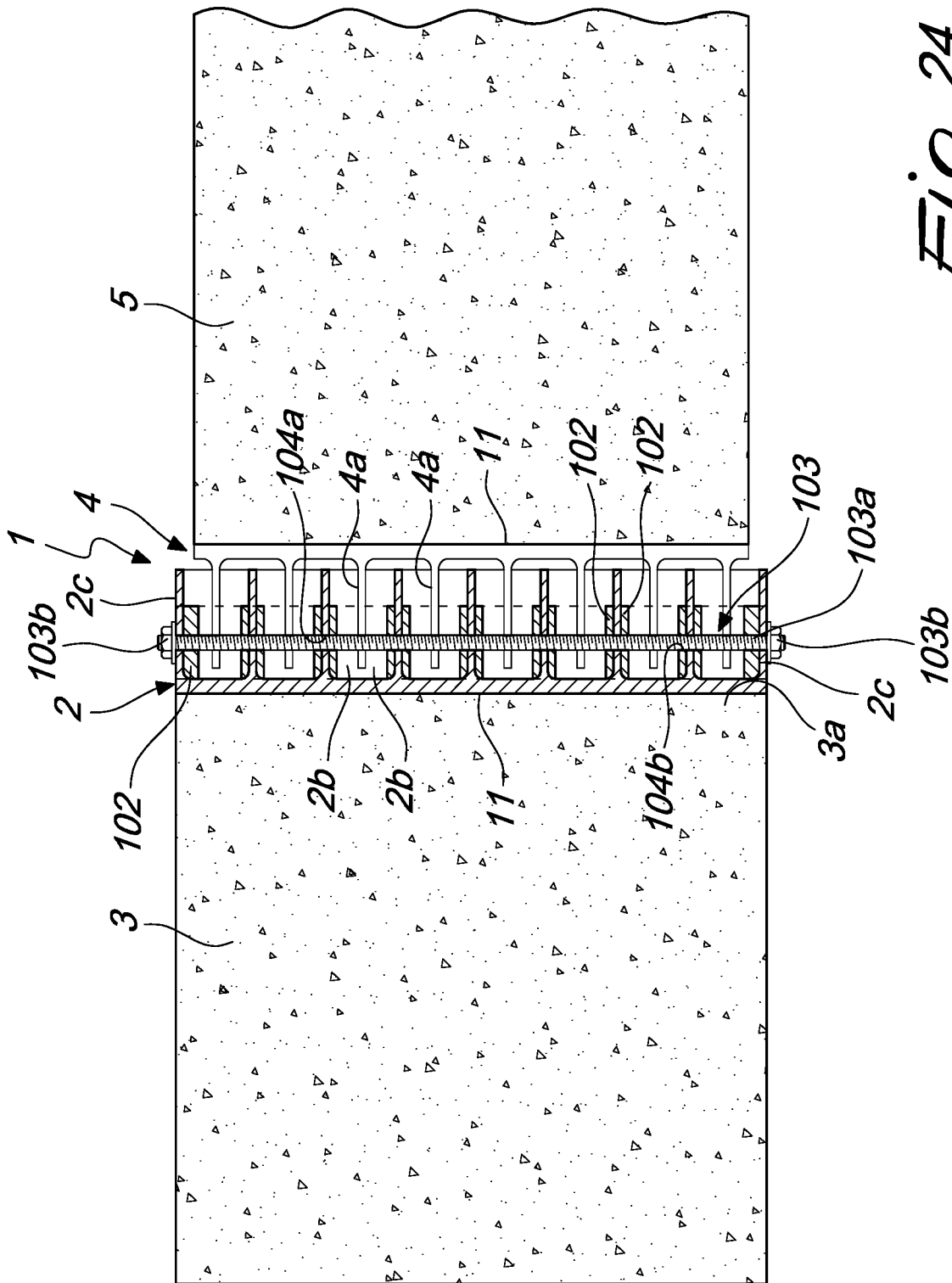


Fig. 24

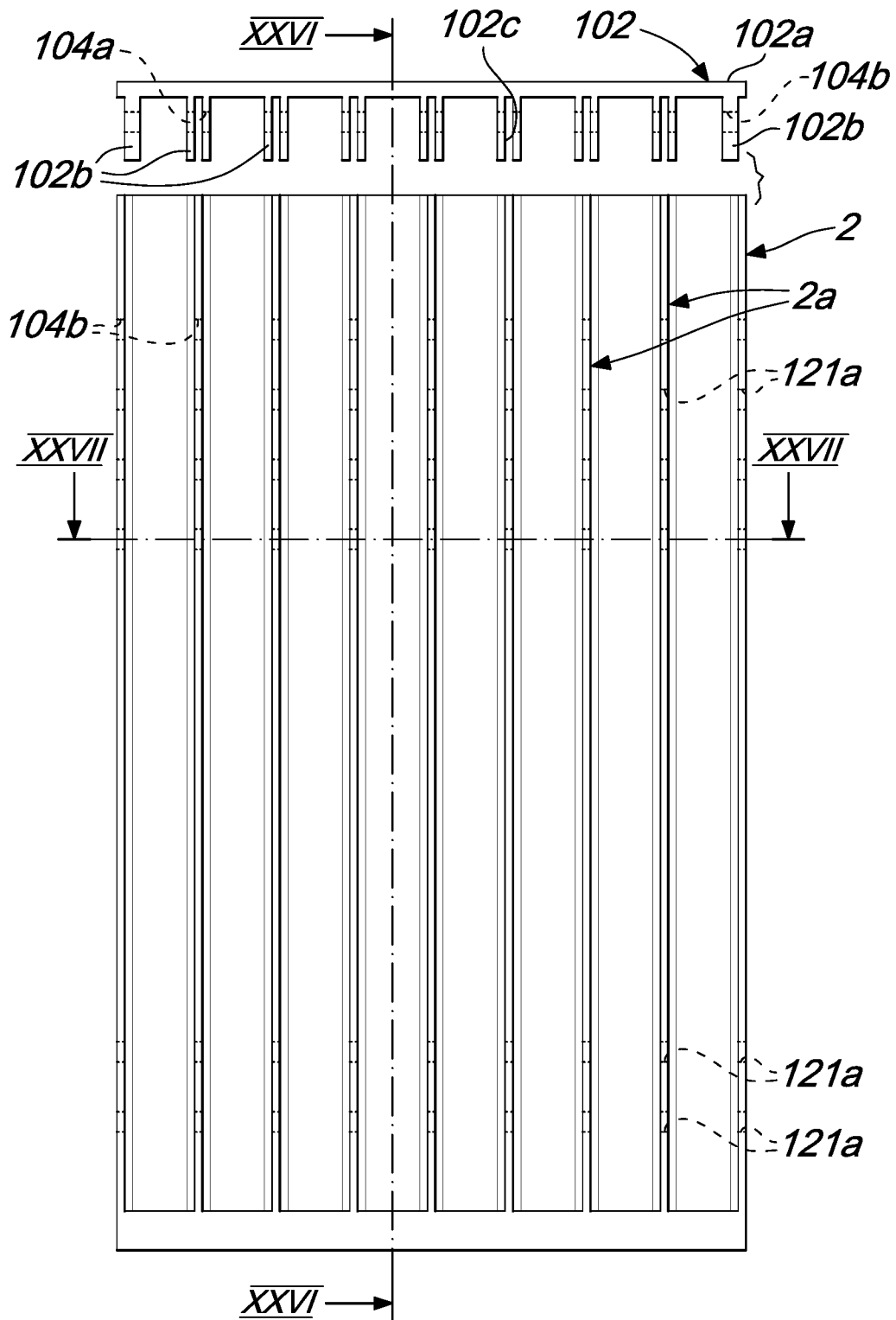


Fig. 25

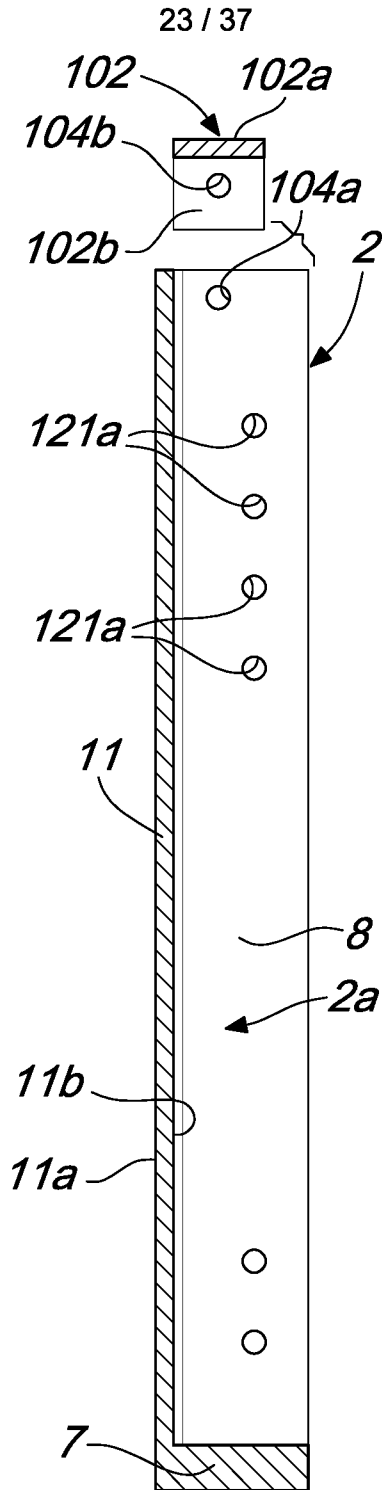


Fig. 26

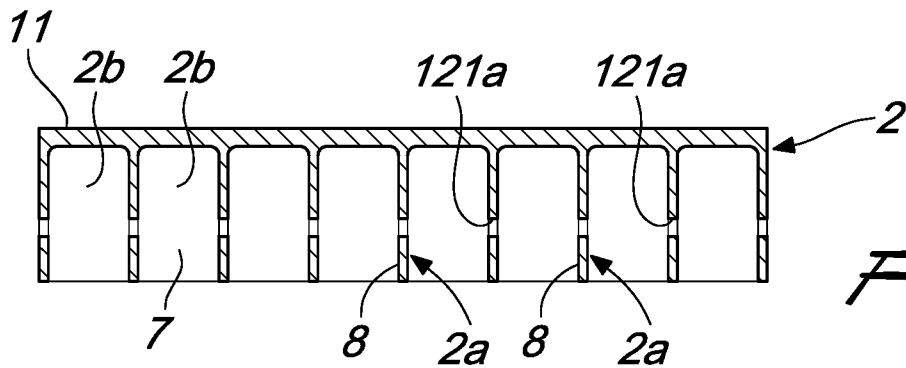


Fig. 27

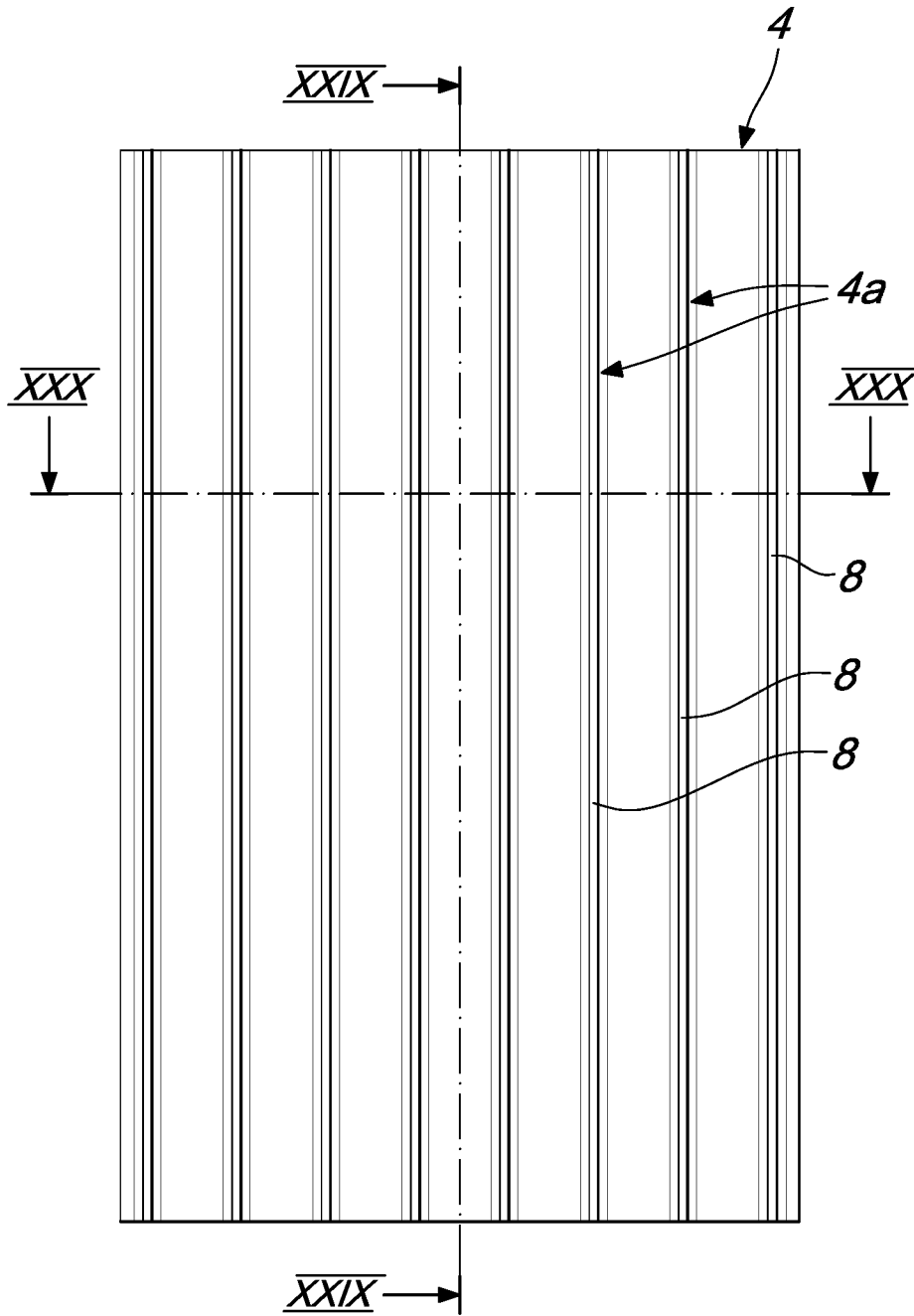


Fig. 28

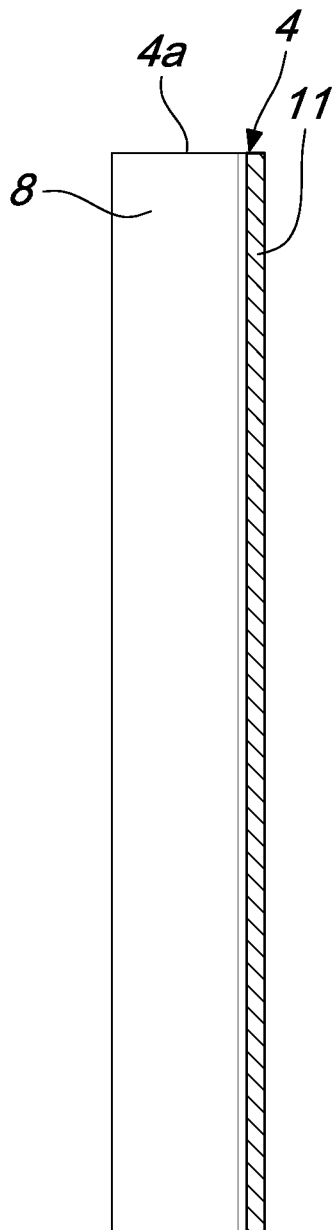


Fig. 29

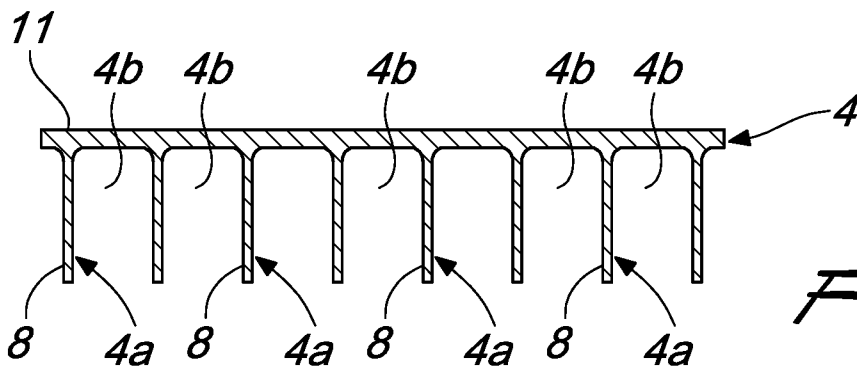
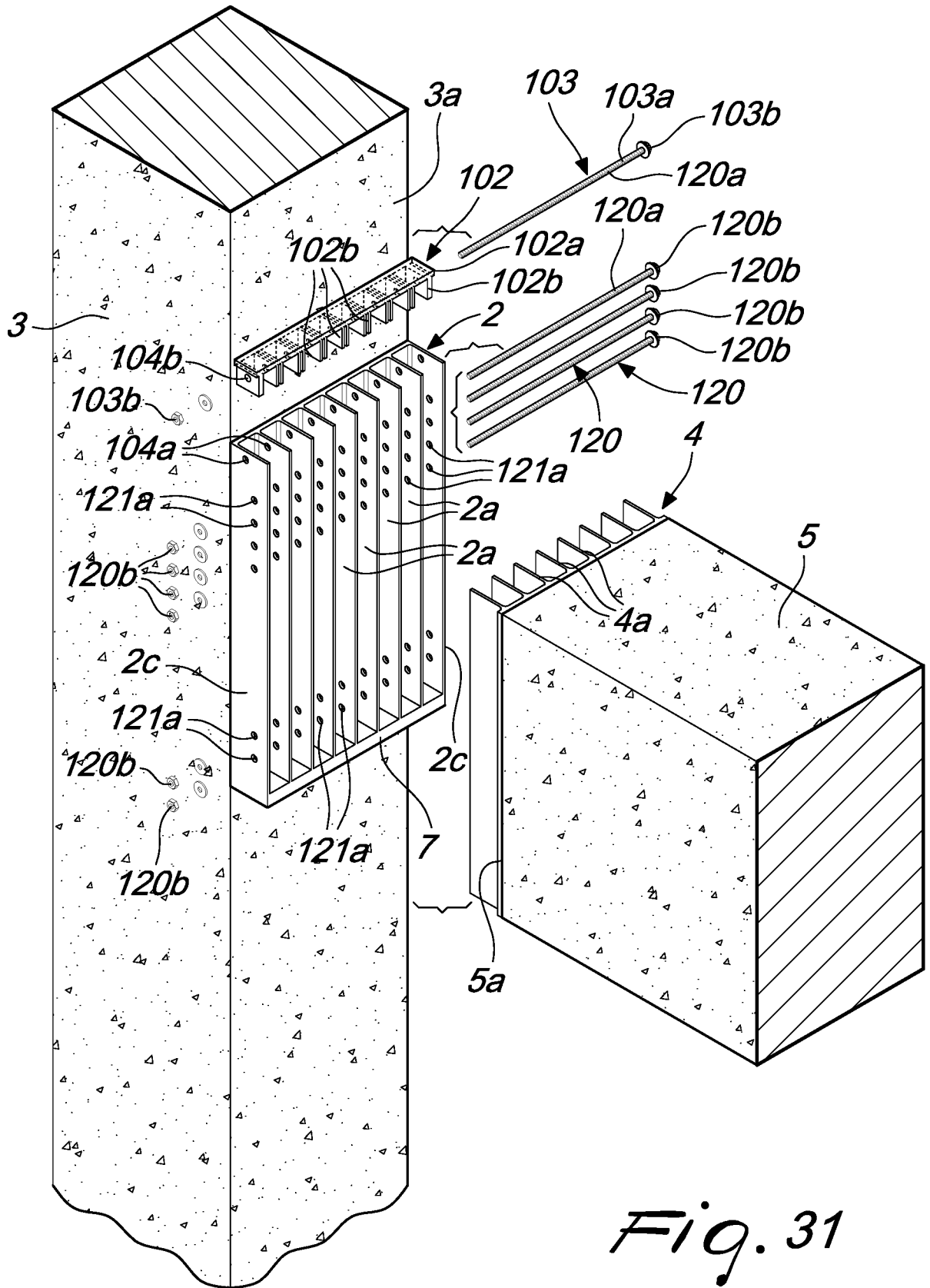


Fig. 30



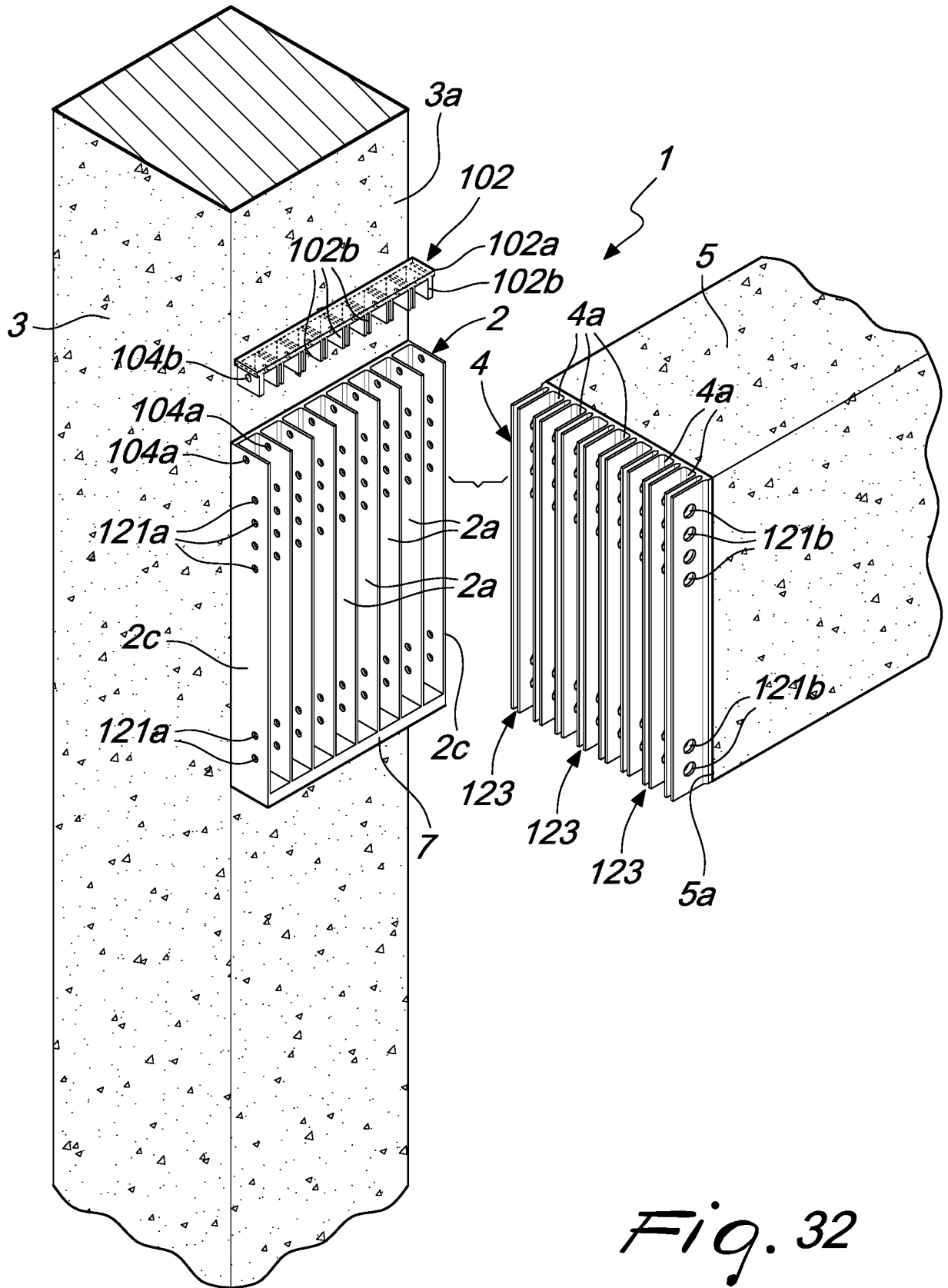


Fig. 32

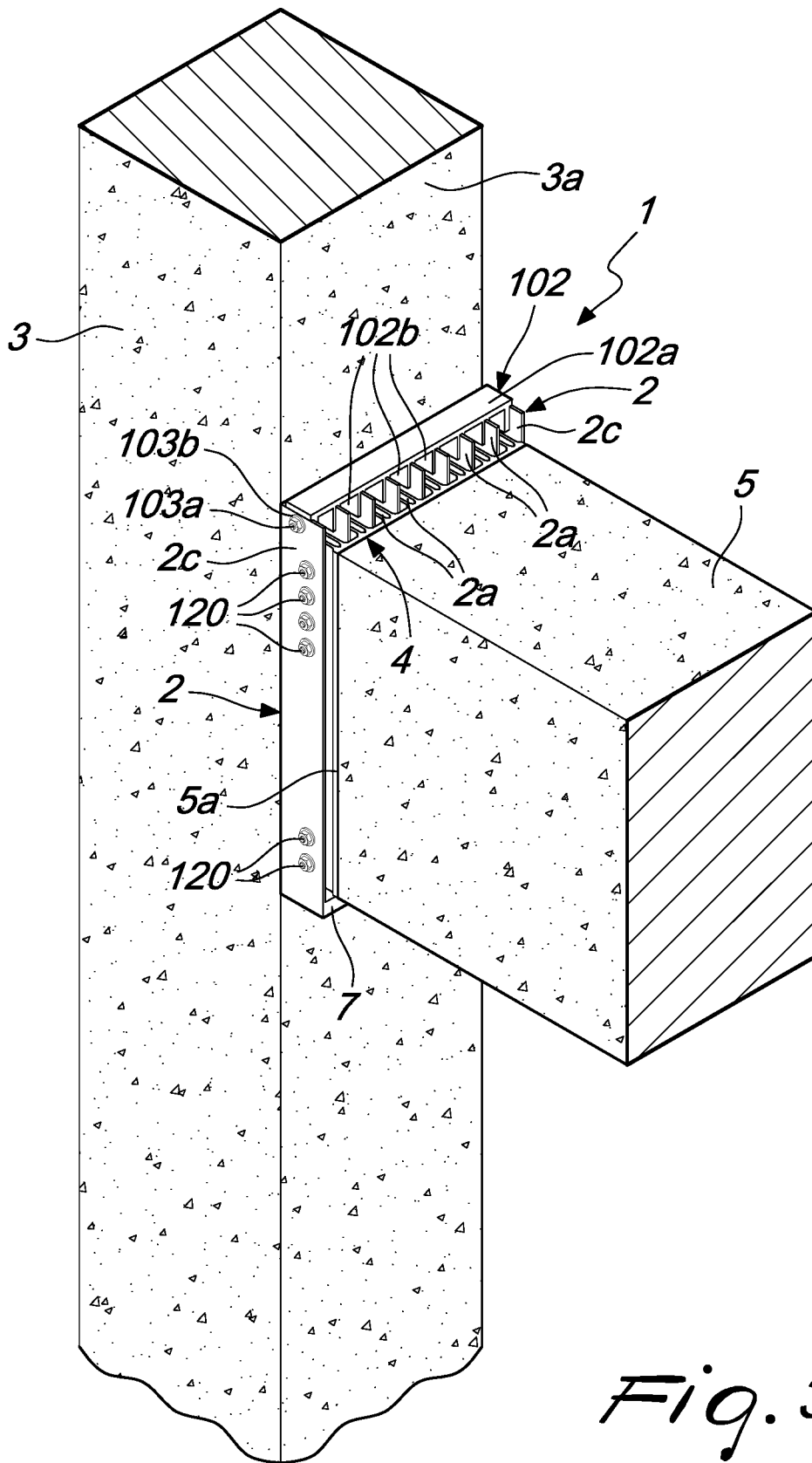


Fig. 33

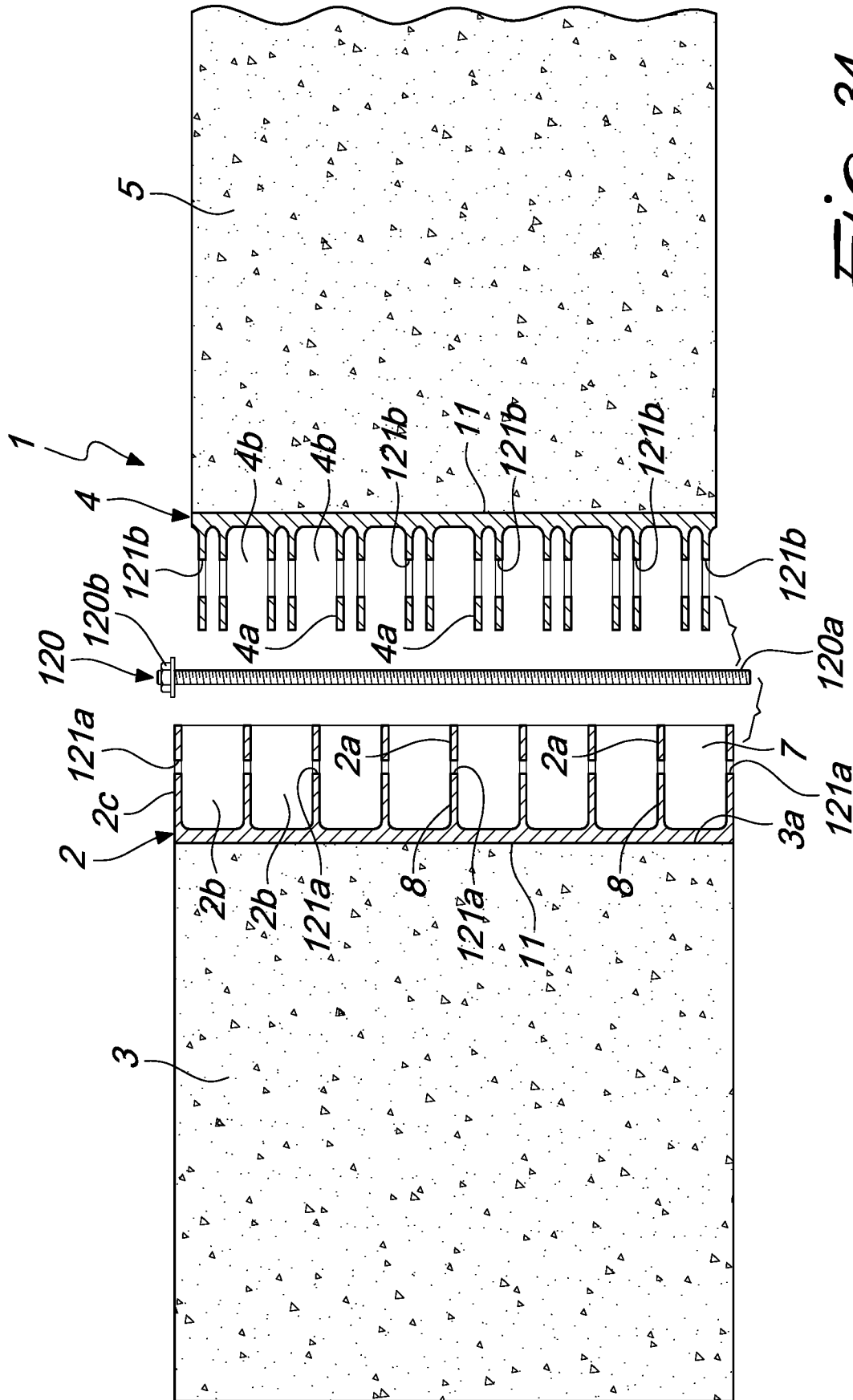


Fig. 34

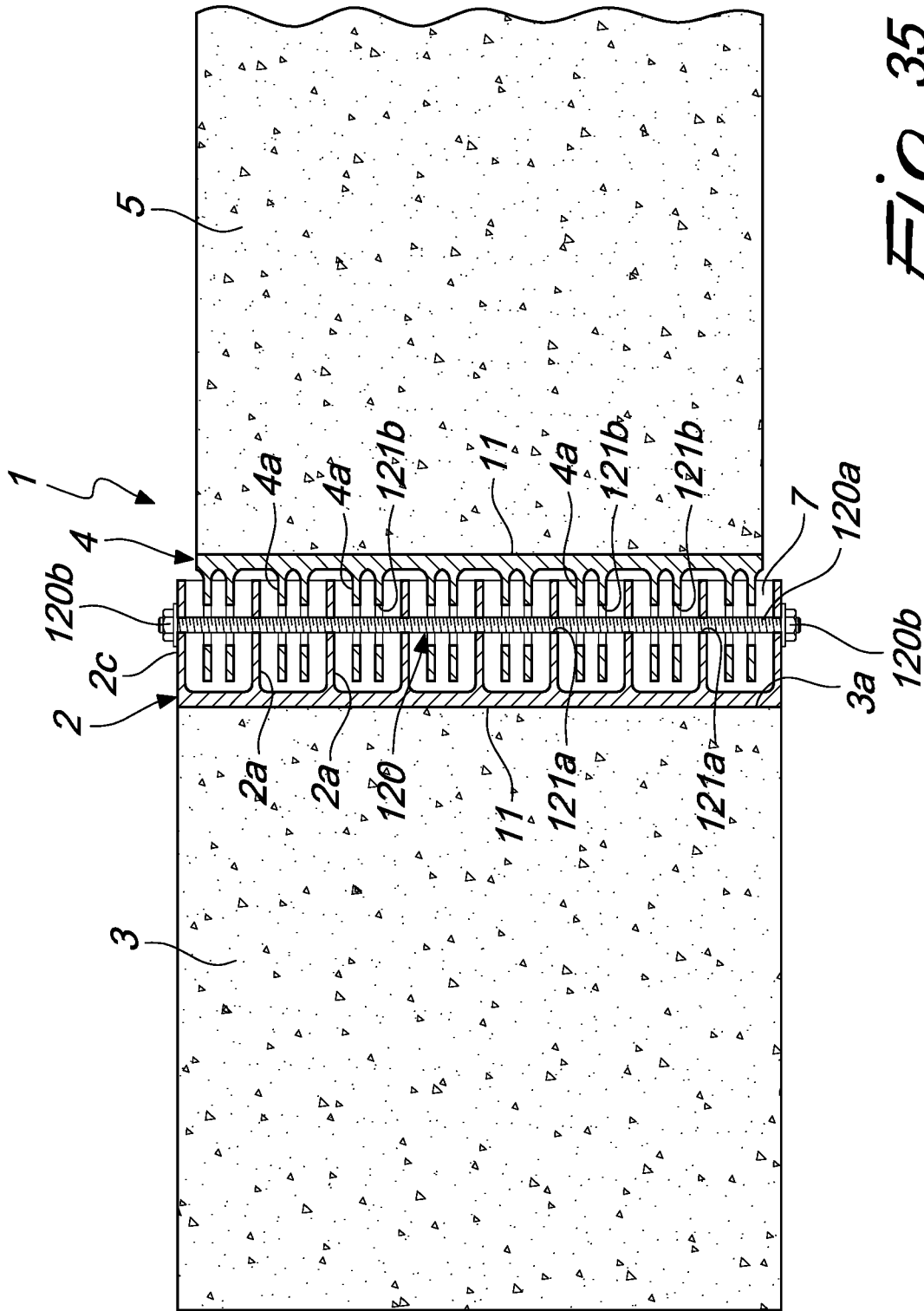


Fig. 35

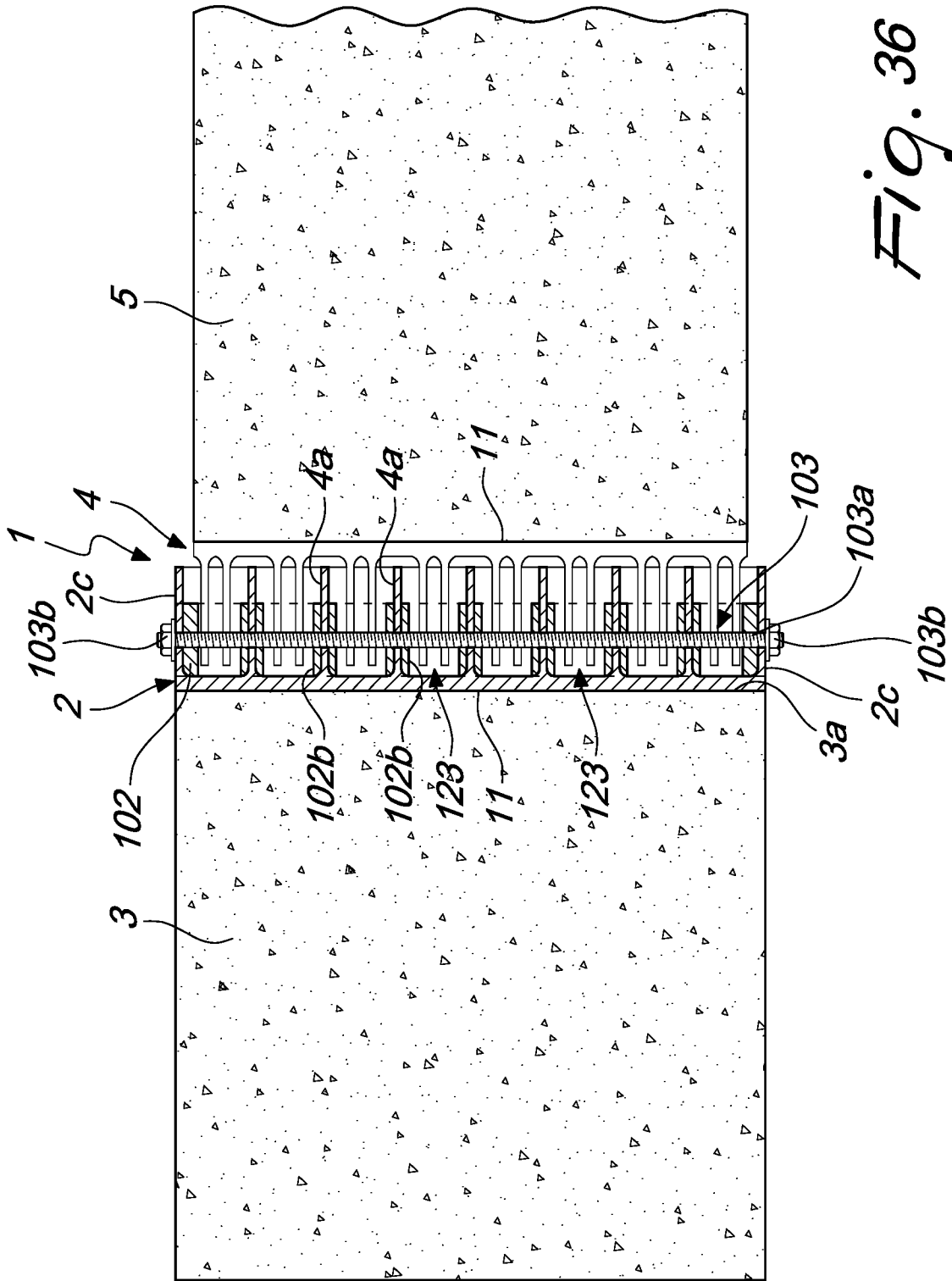


Fig. 36

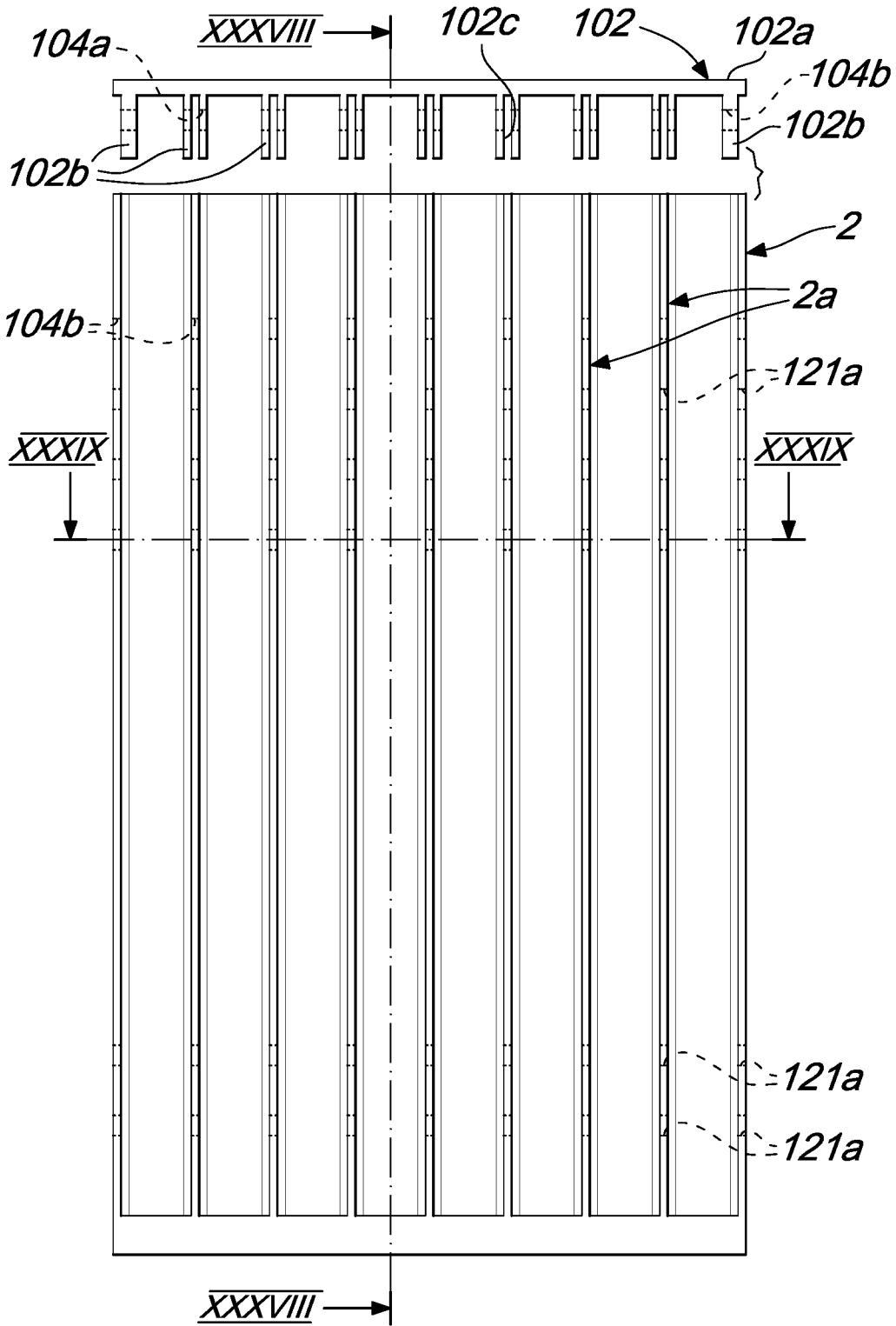


Fig. 37

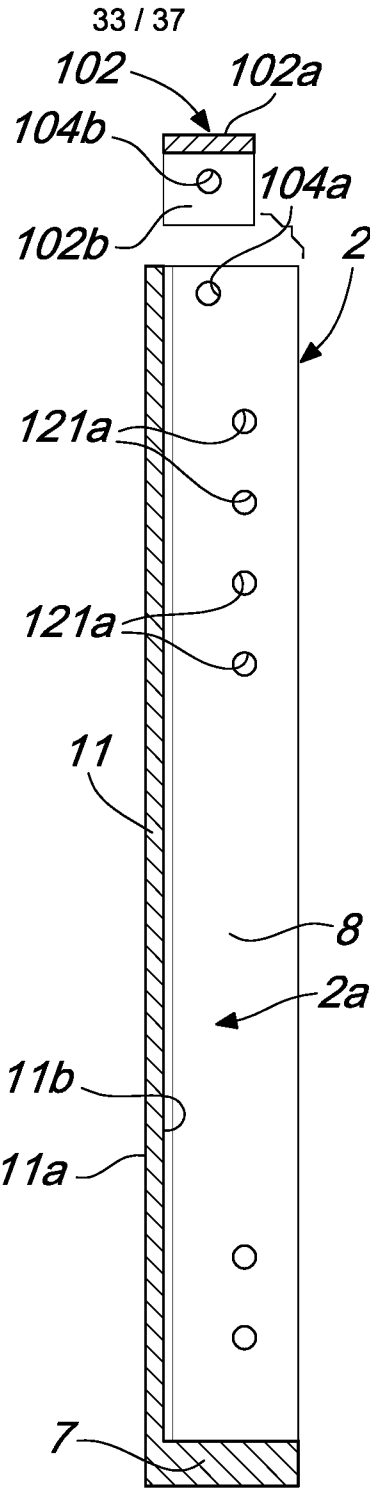


Fig. 38

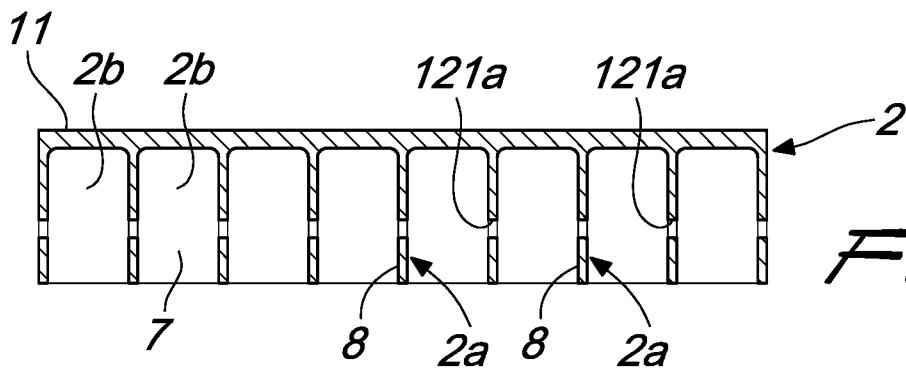


Fig. 39

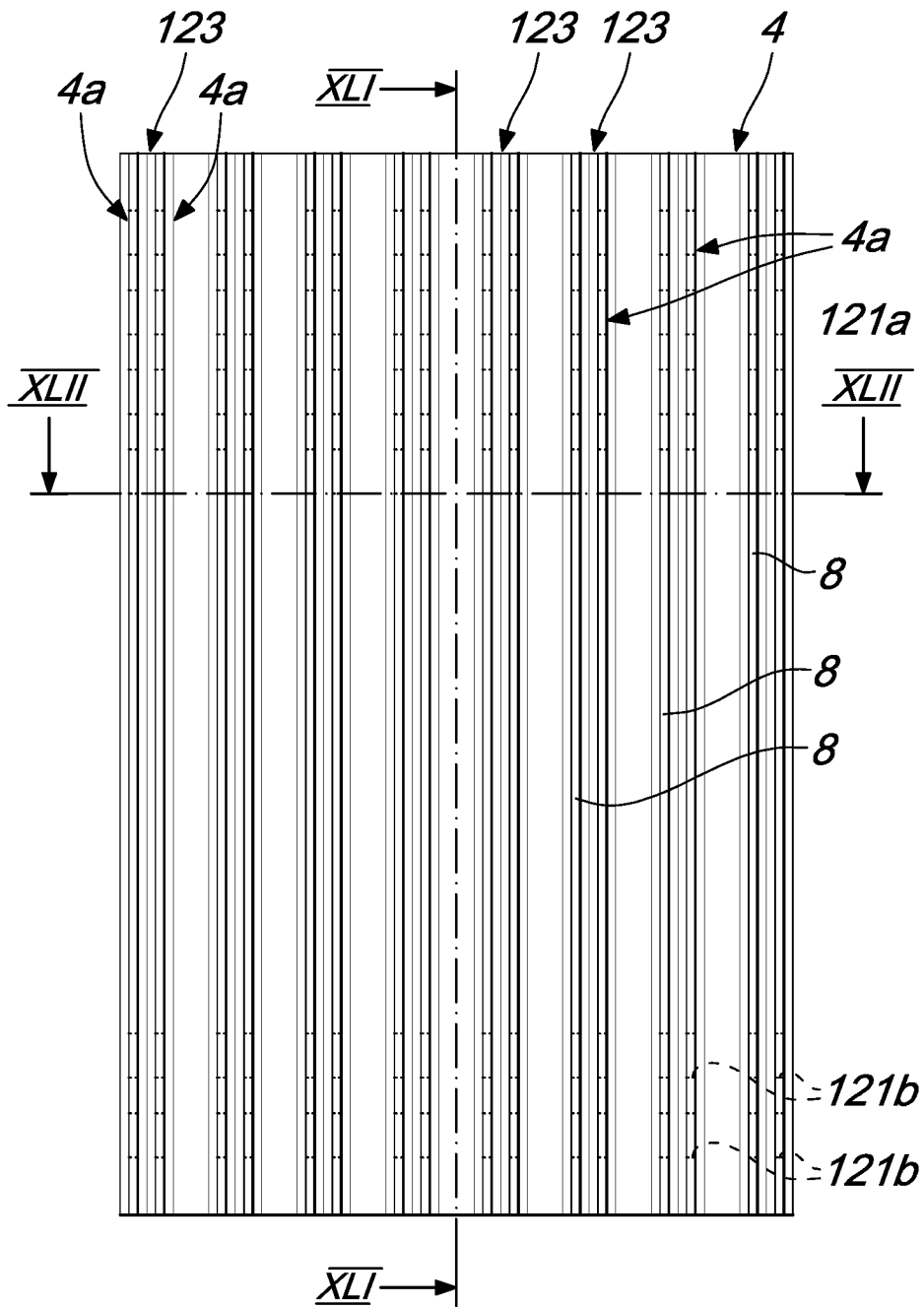


Fig. 40

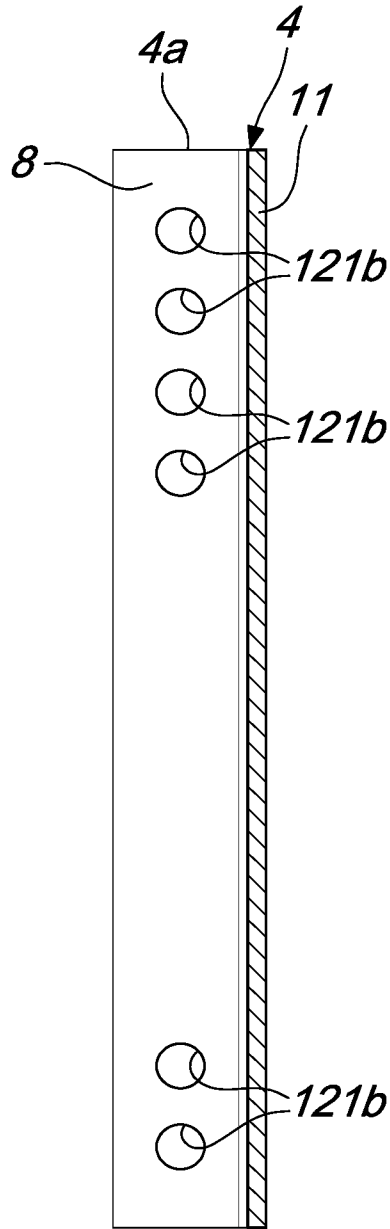


Fig. 41

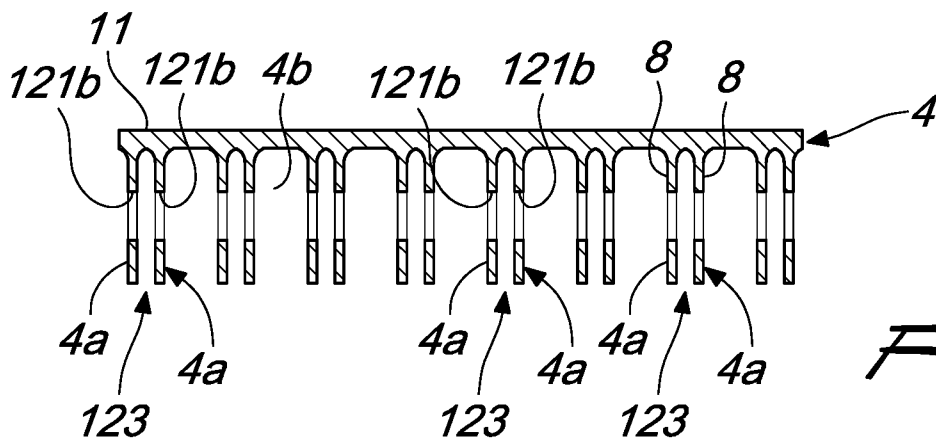


Fig. 42

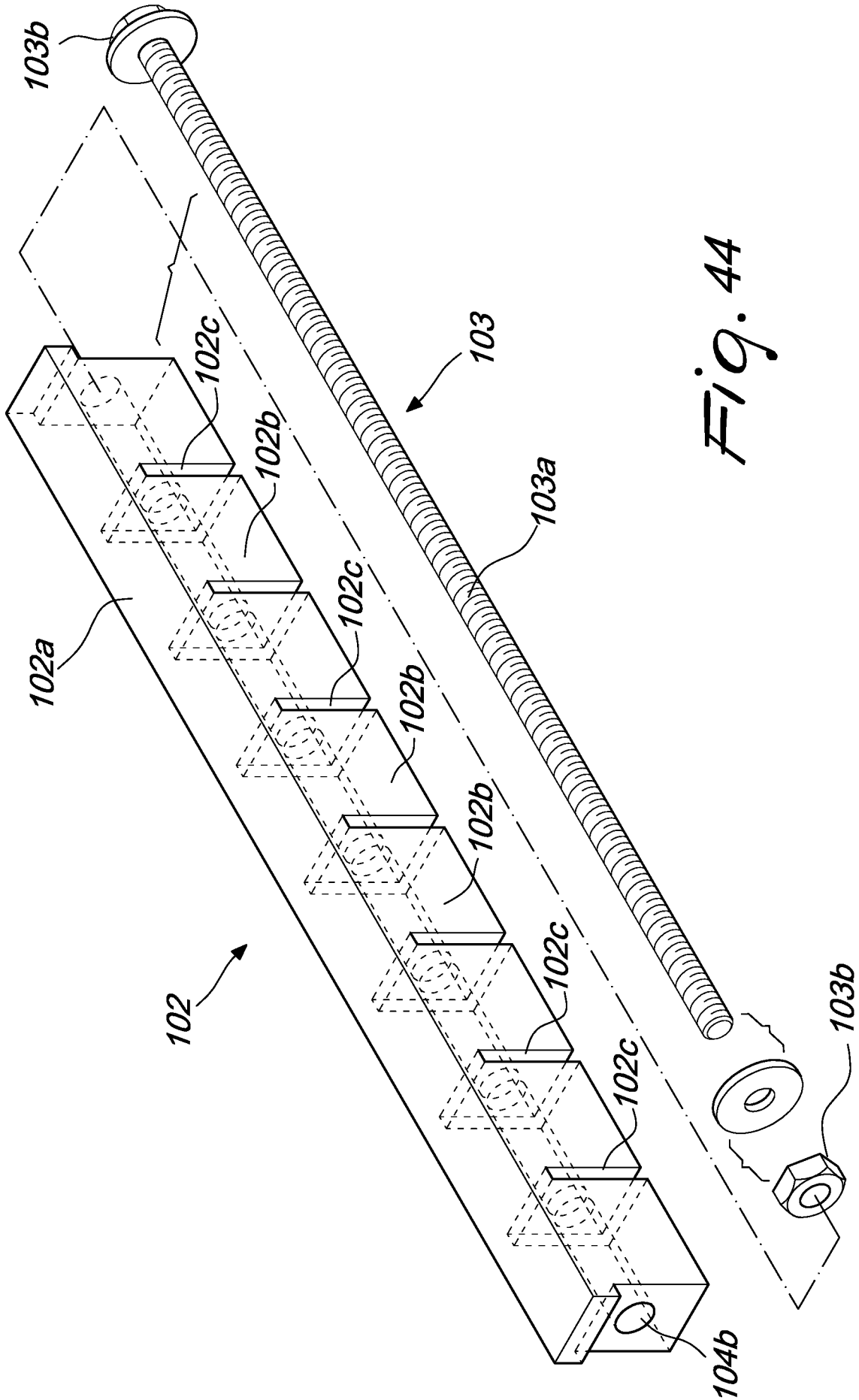


Fig. 44

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2020/063470

A. CLASSIFICATION OF SUBJECT MATTER
 INV. E04B1/18 E04B1/21
 ADD. E04B1/24 E04B1/26

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

B. FIELDS SEARCHED
 Minimum documentation searched (classification system followed by classification symbols)
 F16B E04B

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 10 2004 028453 A1 (BIERBACH GMBH & CO KG BEFESTIG [DE]) 5 January 2006 (2006-01-05) paragraph [0019] - paragraph [0026]; figures 1-3	1-15
X	DE 297 21 204 U1 (RUDOLSTAEDTER STAHLBAU GMBH [DE]) 7 May 1998 (1998-05-07) the whole document	1-15
X	SE 1 400 488 A1 (NEXT I AB [SE]) 21 April 2016 (2016-04-21) figures 1-6	1-15
X	EP 1 548 196 A1 (SCHOECK BAUTEILE GMBH [DE]; PEIL UND PARTNER GBR PROF [DE]) 29 June 2005 (2005-06-29) abstract; figures 2-5	1-15

Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier application or patent but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search 14 July 2020	Date of mailing of the international search report 22/07/2020
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Galanti, Flavio
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2020/063470

Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
DE 102004028453 A1	05-01-2006	AT 500444 A1 DE 102004028453 A1	15-12-2005 05-01-2006	
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SE 1400488	A1	21-04-2016	NONE	
EP 1548196	A1	29-06-2005	DE 10360258 A1 EP 1548196 A1	21-07-2005 29-06-2005