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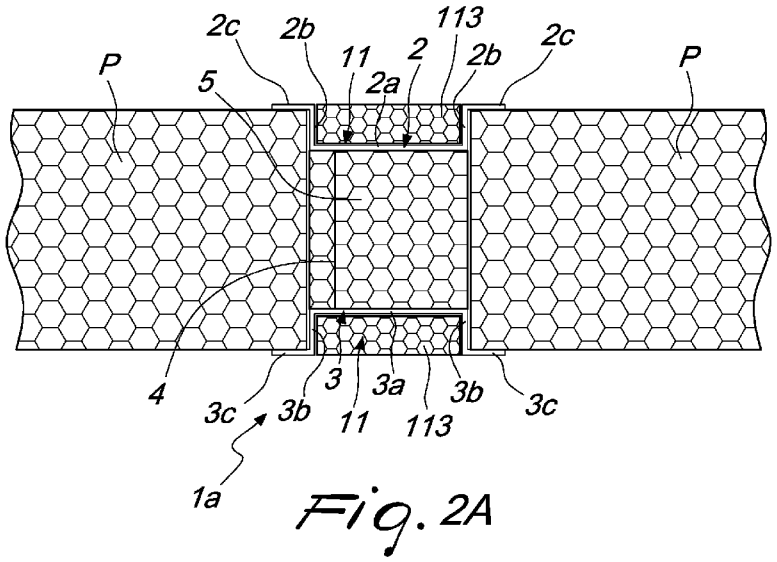

Fig. 2A

(57) Abstract: A prefabricated structural element (1a, 1b, 1c) for constructing building structures, comprising two profiled members (2, 3), each having a respective core (2a, 3), which are mutually spaced apart and rigidly connected by way of a plurality of connector elements (4) arranged transversely to their longitudinal extension, a filler material (5) being accommodatable between the cores (2a, 3a) of the profiled members (2, 3).

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PREFABRICATED STRUCTURAL ELEMENT FOR CONSTRUCTING BUILDING STRUCTURES, AND BUILDING STRUCTURE OBTAINABLE THEREWITH

The present invention relates to a prefabricated structural element for constructing building structures and a building structure obtainable therewith.

It is known that traditional dwellings, i.e. dwellings built using common building materials of the type of reinforced concrete and bricks, suffer considerable drawbacks.

Among the drawbacks of most importance are long construction times, complex execution techniques, the high cost of the raw materials used, reduced resistance to earthquakes, low heat insulation, and the high cost of construction and purchase.

In order to overcome these drawbacks, construction systems for building structures have been devised in which the walls are substantially constituted by panels of expanded polystyrene which are coupled at their main faces to respective metallic nets which are covered with cement plaster. These construction systems involve the provision, during construction, of stiffening structures which are interposed between adjacent panels.

For example in the solution in WO2010/260857 by the same Applicant, each panel is bordered by a series of metallic profiled members with a U-shaped cross-section, so as to accommodate each side of the panel between the mutually opposite wings of a corresponding profiled member. In order to join two panels which are side by side or superimposed, for example, two metallic profiled members are positioned with the corresponding cores juxtaposed and the wings turned on opposite sides toward the respective panels, and they are mutually connected by way of welding directly during construction. Construction is then completed by overlaying the metallic nets on both faces of the panels, and on these nets a

layer of cement plaster is then applied. The mutually opposite metallic nets of each panel are connected to each other by way of elements for connection which are inserted to pass through the panel proper, and the various nets have the end flaps overlapped and are welded together so as to define a structure for containing each volume of the building, both internal and external.

However, this solution also can be improved from the point of view of simplicity of construction, by facilitating and speeding up the installation operations and avoiding performing soldering operations directly on the site, which lengthen the construction times, in addition to being difficult and hazardous for the workers and potentially damaging to the polystyrene panels.

Furthermore, the conventional solution described above can be further optimized from the point of view of structural resistance to external forces, reduction of consumption of materials, and thermal insulation.

Last but not least, according to the system of construction described above, floors and roofs are provided according to traditional methods and are then covered with sheets of polystyrene and associated metallic nets, and are then plastered.

The aim of the present invention is to eliminate the above mentioned drawbacks in the background art by providing a prefabricated structural element for constructing building structures which makes it possible to accelerate and facilitate the installation of such structures and to avoid the need to carry out welding operations directly on the site, so as to reduce the risks for the workers and for the materials in use.

Within this aim, an object of the present invention is to enable the construction of a building structure which has optimal characteristics of resistance to external forces, such as those resulting from atmospheric agents or earthquakes, and of thermal insulation, preventing "thermal bridge" effects between the inside and the outside.

Another object of the present invention is to enable the construction of a building structure that is homogeneous in all its structural parts (vertical walls, floors, roof).

Another object of the present invention is to reduce the consumption of the materials used and as a consequence the costs of construction and of purchasing building structures.

Another object of the present invention is to provide a simple structure that is easy and practical to implement, safe in use and effective in operation, and low cost.

This aim and these and other objects are achieved by the present prefabricated structural element for constructing building structures, characterized in that it comprises two profiled members, each having a respective core, which are mutually spaced apart and rigidly connected by way of a plurality of connector elements arranged transversely to their longitudinal extension, a filler material being accommodatable between the cores of the profiled members.

This aim and these objects are also achieved by a building structure as defined in claim 16.

Further characteristics and advantages of the present invention will become better apparent from the detailed description of some preferred, but not exclusive, embodiments of a prefabricated structural element for constructing building structures, which are illustrated for the purpose of non-limiting example in the accompanying drawings wherein:

Figure 1 is an exploded perspective view of a first version of a prefabricated structural element for constructing building structures, according to the invention, which constitutes a pillar, according to a first embodiment;

Figure 2 is an assembled perspective view of the pillar in Figure 1;

Figure 2a is a sectional view of a possible configuration of use of the pillar in Figure 2;

Figure 3 is an exploded perspective view of the structural element, according to the invention, in a second embodiment of a pillar;

Figure 4 is an assembled perspective view of the pillar in Figure 3;

Figures 4a and 4b are respective cross-sectional views of possible configurations of use of the pillar in Figure 4;

Figure 5 is an exploded perspective view of the structural element, according to the invention, in a third embodiment of a pillar;

Figure 6 is an assembled perspective view of the pillar in Figure 5;

Figure 6a is a sectional view of a possible configuration of use of the pillar in Figure 6;

Figure 7 is an exploded perspective view of a second version of the structural element, according to the invention, which constitutes a bond beam;

Figure 8 is an assembled perspective view of the bond beam in Figure 7;

Figure 9 is an exploded perspective view of a third version of the structural element, according to the invention, which constitutes a floor beam;

Figure 10 is an assembled perspective view of the floor beam in Figure 9;

Figure 11 is a perspective view showing the supporting structure of a cantilevered floor, obtained by way of structural elements according to the invention;

Figure 12 is a schematic cross-sectional view of a building structure obtainable by way of using the structural elements according to the invention;

Figure 13 is an enlarged-scale view of a detail of Figure 12 of the anchoring to the foundation plane of the vertical walls of the first level of the building structure;

Figure 14 is an enlarged-scale view of a detail of Figure 12 of the connecting region between the vertical walls of superimposed levels and the separating floor;

Figures 15 and 16 are respective enlarged-scale views of details in Figure 12 of the roof;

Figures 17-29 are schematic views which show successive steps of constructing a building structure by way of using structural elements according to the invention.

With reference to the figures, the reference numerals 1a, 1b, 1c generally designate a prefabricated structural element for constructing building structures and the reference numeral 100 designates a building structure obtainable by way of using the structural elements according to the invention.

Advantageously the structural element according to the invention can be assembled at a production site and supplied to the building site ready for installation.

The structural element 1a, 1b, 1c comprises two profiled members 2, 3 each of which is provided with a corresponding core 2a, 3a, which are arranged mutually spaced apart and are rigidly connected by way of a plurality of connector elements 4 which are arranged transversely to the longitudinal extension of said profiled members. Between the cores 2a, 3a of the profiled members 2, 3 a filler material can be accommodated, of differing nature according to the conditions of use.

The profiled members 2, 3 and the connector elements 4 are made of metallic material, preferably of the type of steel.

For example, each connector element 4 can be constituted by a stem, the opposite ends of which are threaded and have a reduced cross-section with respect to the central portion. Each end of the connector element 4 is inserted so as to pass through a corresponding hole 10 defined on one of the profiled members 2, 3 and is connected thereto by way of a threaded

contrast nut, not shown.

However, alternative embodiments of the connector elements 4 are not ruled out.

Each profiled member 2, 3 is provided with at least one respective first wing 2b, 3b which is arranged adjacent to the corresponding core 2a, 3a and transversely thereto.

Preferably, each profiled member 2, 3 is provided with a pair of first wings 2b, 3b which are arranged at the opposite ends of the corresponding core 2a, 3a and transversely thereto.

If the first wings 2b, 3b of a profiled member 2, 3 are turned on the same side of the corresponding core 2a, 3a then an intrados 11 is defined in the cross-section of that profiled member, in which an insert 113 made of thermally insulating material, or the side of a panel P made of thermally insulating material of the type of polystyrene, according to the conditions of use, is accommodatable.

In a possible version, the structural element 1a constitutes a pillar (Figures 1-6), i.e. a supporting element intended to be installed vertically in the connecting region between two or more vertical walls which are defined by respective panels P.

In this case the first wings 2a, 3a of each profiled member 2, 3 are turned on the same side of the corresponding core 2a, 3a so that a corresponding insert 113 or the side of a panel P can be accommodated in the intrados 11 of each profiled member.

Preferably the first wings 2b, 3b are perpendicular to the corresponding core 2a, 3a, defining a U-shaped cross-section.

Furthermore, the pillar 1a has a post 5 of thermally insulating material, of the type of polystyrene, which is interposed between the cores 2a, 3a and in which the connector elements 4 are inserted so as to pass through.

Preferably the connector elements 4 are distributed in an offset

arrangement along the longitudinal extension of the profiled members 2, 3, i.e. in a zigzag arrangement.

Furthermore, the pillar 1a has a pair of end plates 6 for connection by way of threaded elements to the foundation plane or between superimposed levels.

In this version (Figures 5-6) the pillar 1a acts as a continuity element between two consecutive vertical panels P, with no transverse walls being provided (Figure 6a).

Moreover, the profiled members 2, 3 can each have at least one second wing 2c, 3c which is consecutive to a respective first wing 2b, 3b and is arranged transversely thereto on the opposite side of the corresponding core 2a, 3a, so that the edge of a further panel P is accommodatable between the second wings 2c, 3c.

Preferably the second wings 2c, 3c are perpendicular to the first wings 2b, 3b and therefore they extend parallel to the corresponding core 2a, 3a.

In this case (Figures 3-4), the pillar 1a is adapted to be arranged in a corner in the connecting region of two or three vertical walls.

Figure 4a shows the use of the pillar 1a provided with second wings 2c, 3c for the connection of two vertical and mutually perpendicular panels P, one of which is arranged with a corresponding edge between the second wings and the other with a corresponding edge at the intrados 11 of the panel P. The intrados of the profiled member 3 can be filled with an insert 113.

Figure 4b shows the use of the pillar 1a provided with second wings 2c, 3c for the connection of three vertical panels P arranged in a T-shape, one of which is accommodated with a corresponding edge between the second wings 2c, 3c and the other two in the intradoses 11 of the profiled members 2, 3.

Again, each profiled member 2, 3 can have a pair of second wings 2c, 3c, of which each one is consecutive to a respective first wing 2b, 3b and is

arranged transversely thereto on the opposite side of the corresponding core 2a, 3a. The edge of a respective panel P is accommodatable between each pair of mutually opposite second wings 2c, 3c.

In this case (Figures 1-2) the pillar 1a makes it possible to connect up to four panels P arranged in a cross-shape.

Figure 2A shows the use of the pillar 1a provided with two pairs of second wings 2c, 3c to connect two consecutive panels P and the intradoses 11 are engaged by corresponding inserts 113. Alternatively, one or both of the intradoses could accommodate the respective edge of the panel P.

In a variation (Figures 7-8), the structural element 1b constitutes a bond beam, i.e. a supporting element intended to be installed horizontally to connect the superimposed levels of the building structure 100.

In this version both of the first wings 2b, 3b of each profiled member 2, 3 are turned on the same side of the corresponding core 2a, 3a so as to define respective intradoses 11, and a concrete casting G made during construction is accommodatable between the cores 2a, 3a.

Figure 14 shows a bond beam 1b for the connection of vertical walls of superimposed levels of the building structure, while Figure 15 shows a bond beam 1b for connecting a vertical wall to the roof of the structure proper.

For the connection of vertical walls of superimposed levels (Figures 7, 8, 14), advantageously, one of the profiled members 2 has a third wing 2d which is consecutive to a respective first wing 2b and is arranged transversely thereto on the opposite side of the corresponding core 2a.

In use the third wing 2d is arranged in an upward region on the outer side of the building and acts as a shoulder to contain the concrete casting to provide the upper screed of the floor.

Preferably the third wing 2d extends perpendicularly with respect to the adjacent first wing 2b, 3b and, therefore, parallel to the core 2a.

Furthermore, the elements for providing the floor are accommodated

in the intrados 11 of the profiled member 3 that faces inwardly into the building, as will be explained below, while an insert 111 made of thermally insulating material, of the type of polystyrene (Figure 14), can be accommodated in the intrados 11 of the profiled member 2 that faces outwardly from the building.

Preferably the connector elements 4 are distributed in aligned pairs transversely to the direction of longitudinal extension of the profiled members 2, 3.

In a further version (Figures 9-11) the structural element 1c constitutes a floor beam and is intended to be laid horizontally or inclined.

Based on the installation point, the profiled members 2, 3 can have one or two first wings 2b, 3b each.

Figure 16, for example, shows a special case of a beam 1c for connecting the inclined pitches of the roof of the building in which each profiled member 2, 3 has a single first wing 2b, 3b which is inclined with respect to the corresponding core 2a, 3a. The edge of a corresponding panel P is arranged to rest on each first wing 2b, 3b.

More generally, the beam 1c has one of the profiled members 2 with both of the first wings 2b turned on the same side of the core 2a so as to define a U-shaped cross-section with corresponding intrados 11, and the other profiled member 3 with the first wings 3b arranged on opposite sides of the core 3a so as to define a Z-shaped cross-section.

A joist 7 is accommodated between the cores 2a, 3a and is made of thermally insulating material, of the type of polystyrene, in which the connector elements 4 are inserted so as to pass through.

Preferably the connector elements 4 are distributed in aligned pairs transversely to the direction of longitudinal extension of the profiled members 2, 3.

Furthermore, an angular plate 8 is associated with each end of the profiled members 2, 3 for connection to bond beams 1b or other end

elements 114.

When used to provide a floor, the beams 1c are arranged spaced apart and are interspersed by panels P. The particular Z-shaped cross-section of the profiled member 3 enables the insertion of the panels P between two consecutive beams 1c.

The ends of the beams 1c and of the panels P are accommodated in the intrados 11 of the profiled member 3 which faces inwardly into the building of the bond beam 1b.

Figure 11 shows the use of beams 1c interposed between a bond beam 1b and an end element 114 in order to provide the supporting structure of a cantilevered floor.

By way of using structural elements 1a, 1b, 1c it is possible to provide buildings 100 in which vertical walls 101, floor 102 and roofs 103 are obtained by way of the alternating juxtaposition of the elements and of panels P, the whole being covered by metallic nets 104 and covered by grout 105 both on the inner side, and on the outer side, according to a conventional method of working.

Obviously the plan and the number of levels of the building structure 100 can be varied according to requirements.

Figure 11 shows the cross-section of a possible building structure 100 obtainable according to the invention with two superimposed levels.

Advantageously a plurality of bars 106 is provided for anchoring the vertical walls 101 of the first level to the foundation plane F, which protrude from that plane at both of the main faces of the panels P and are connected to the nets 104 (Figures 13, 17, 18).

Furthermore, there are also bars 107 (Figures 14, 26) for connecting the vertical walls 101 of superimposed levels, which are inserted so as to pass through the panels P of the separation floor 102 at the internal main face of the panels P which make up the walls 101 and are connected to the nets 104.

In this manner the rigidity of the structure 100 is increased and made uniform on the perimeter, instead of being concentrated at the pillars 1a.

In order to further optimize the strength of the building structure 100 at the bond beams 1b, stiffening bars 108 are arranged resting on the connector elements 4, preferably four arranged in superimposed pairs for each bond beam 1b, which constitute a reinforcement for the concrete casting subsequently carried out in order to provide the floor 103 (Figures 14, 15, 27).

Furthermore, there are contoured plates 109 for connecting the nets 104 to the profiled members 2, 3. The plates 109 have a recess for accommodating a metallic wire of the nets 104 and one or two side bands for connection to the profiled members 2, 3 by way of threaded connection elements, not shown.

In order to provide a building structure 100, first of all the vertical walls 101 of the first level are installed. To this end the anchoring bars 106 are arranged, directly in the foundation plane F, along the perimeter of the structure and the pillars 1a are mounted, by fixing the corresponding lower end plates 6 to the foundation plane F with threaded elements, not shown (Figure 17). Subsequently (Figure 18) the panels P are positioned between the pillars 1a. The openings, such as doors and windows, are framed with suitable conventional profiles 110.

Above the walls 101 a perimetric frame is provided by juxtaposing a plurality of bond beams 1b, which are connected to the pillars 1a at the corresponding upper end plates 6 with threaded connection elements (Figure 19). The first wings 2b, 3b which are arranged below the bond beams 1a rest on the upper edge of the panels P of the first level and on the end plates 6 to which they are connected. Above the bond beams 1b, plates 115 are arranged, above the lower end plates 6 of the pillars 1a of the second level.

An insert 111 made of thermally insulating material, of the type of polystyrene, can be accommodated in the intrados 11 of the profiled member 2 arranged on the outer side of the structure 100 (Figure 20).

Subsequently the nets 104 are positioned to cover the walls 101 on both sides (Figures 21 and 22). The nets 104 are fixed to the profiled members 2, 3 by way of the plates 109. Subsequently the walls 101 are covered with grout 106 (Figure 23).

In order to provide the floor 102 (Figures 24 and 25), a plurality of beams 1c are arranged in the intrados 11 of the profiled member 3 of the bond beams 1b that face inwardly into the structure 100. The beams 1c are connected to the bond beams 1b by way of threaded elements which are engaged in the angular plates 8. Panels P are interposed between the beams 1c.

Then, the bars 107 are arranged for connecting with the walls 101 of the upper floor (Figure 26), the nets 104 are positioned above and under the floor 102 and the casting is carried out of the concrete 112 that makes up the screed of the level and fills the internal space of the bond beams 1b (Figure 27).

Construction can then proceed with providing the upper floor, starting by positioning the pillars 1a at the plates 115 and going through the operations described above (Figure 28).

Provision of the roof 103 is entirely similar to what is described above for the floor 102 with the difference that the beams 1c and the panels P are arranged inclined (Figure 29).

In practice it has been found that the invention as described achieves the intended aim and objects and, in particular, attention is drawn to the fact that the prefabricated structural elements according to the invention make it possible to accelerate and facilitate the execution of the operations on the building site in that such elements are ready for installation and need only to be connected to the supporting structure of the building by way of tightening threaded elements.

Furthermore such system of construction makes it possible to obtain building structures that are stronger and with better thermal insulation

characteristics, and which are also made with homogeneous materials and methods.

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.

In practice the materials employed, as well as the contingent dimensions and shapes, may be any according to requirements without for this reason departing from the scope of protection claimed herein.

The disclosures in Italian Patent Application No. MO2014A000193 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 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 prefabricated structural element (1a, 1b, 1c) for constructing building structures, characterized in that it comprises two profiled members (2, 3), each having a respective core (2a, 3a), which are mutually spaced apart and rigidly connected by way of a plurality of connector elements (4) arranged transversely to their longitudinal extension, a filler material (5, G, 7) being accommodatable between the cores (2a, 3a) of the profiled members (2, 3).

2. The element (1a, 1b, 1c) according to claim 1, characterized in that each one of said connector elements (4) is constituted by a respective stem, the opposite ends of which are threaded and have a reduced cross-section with respect to the central portion, each end being inserted so as to pass through a respective hole (10) defined in the core (2a, 3) of a corresponding profiled member (2, 3) and being connected thereto by way of a threaded contrast nut.

3. The element (1a, 1b, 1c) according to one or more of the preceding claims, characterized in that each one of said profiled members (2, 3) is provided with at least one first wing (2b, 3b) which is arranged adjacent to the corresponding core (2a, 3a) and extends transversely thereto.

4. The element (1a, 1b, 1c) according to claim 3, characterized in that each one of said profiled members (2, 3) comprises a pair of said first wings (2b, 3b) which are arranged at the opposite ends of the corresponding core (2a, 3a).

5. The element (1a, 1b, 1c) according to claim 4, characterized in that the first wings (2b, 3b) of at least one of said profiled members (2, 3) are turned on the same side of said core (2a, 3a), an insert (111, 113) made of thermally insulating material or a perimetric edge of a panel (P) made of thermally insulating material being accommodatable in the intrados (11) of the cross-section of said profiled member (2, 3).

6. The element (1a) according to one or more of the preceding claims,

characterized in that it is a pillar and in that the first wings (2b, 3b) of each one of said profiled members are turned on the same side of the corresponding core (2a, 3a), a post (5) made of thermally insulating material being further comprised which is interposed between the cores (2a 3a) of said profiles (2, 3) and through which the connector elements (4) are inserted so as to pass through.

7. The element (1a) according to claim 6, characterized in that each one of said profiled members (2, 3) comprises at least one second wing (2c, 3c) which is consecutive to a respective first wing (2b, 3b) and is arranged transversely thereto on the opposite side of the corresponding core (2a, 3), a perimetric edge of a panel (P) made of thermally insulating material being accommodatable between the second wings (2c, 3c) of the two profiled members (2, 3).

8. The element (1a) according to claim 7, characterized in that each one of said profiled members (2, 3) comprises two of said second wings (2c, 3c), each of which is consecutive to a respective first wing (2b, 3b) and is arranged transversely thereto on the opposite side of the corresponding core (2a, 3a), a perimetric edge of a respective panel (P) made of thermally insulating material being accommodatable between each pair of mutually opposite second wings (2c, 3c).

9. The element (1a) according to one or more of claims 6 to 8, characterized in that said connector elements (4) are distributed in an offset arrangement along the longitudinal extension of said profiled members (2, 3).

10. The element (1a) according to one or more of claims 6 to 9, characterized in that it comprises respective connecting end plates (6) associated with the mutually opposite ends of said profiled members (2, 3).

11. The element (1b) according to one or more of claims 1 to 5, characterized in that it is a bond beam and in that the first wings (2b, 3c) of each one of said profiled members (2, 3) are turned on the same side of the corresponding core (2a, 3a), a concrete casting (G) being accommodatable

between the cores (2a, 3a) of the profiled members (2, 3).

12. The element (1b) according to claim 11, characterized in that one of said profiled members (2) comprises a third wing (2d) which is consecutive to a respective first wing (2b) and is arranged transversely thereto on the opposite side of the corresponding core (2a) so as to define a shoulder for the containment of said concrete casting (G).

13. The element (1c) according to one or more of claims 1 to 3, characterized in that it is a floor beam, a joist (7) made of thermally insulating material being further comprised and interposed between the cores (2a, 3a) of said profiled members (2, 3) and through which the connector elements (4) are inserted so as to pass through.

14. The element (1c) according to claims 4 and 13, characterized in that one of said profiled members (2) has the first wings (2b) turned on the same side of the corresponding core (2a) and the other one (3) on opposite sides.

15. The element (1c) according to claim 13 or 14, characterized in that it comprises an angular connecting plate (8) associated with each end of said profiled members (2, 3).

16. A building structure (100), characterized in that it comprises vertical walls (101), floors (102) and roofs (103) obtained from the alternating juxtaposition of panels (P) made of thermally insulating material and of structural elements (1a, 1b, 1c) according to one or more of the preceding claims, all the surfaces being lined with metallic net (104) and covered by grout (105).

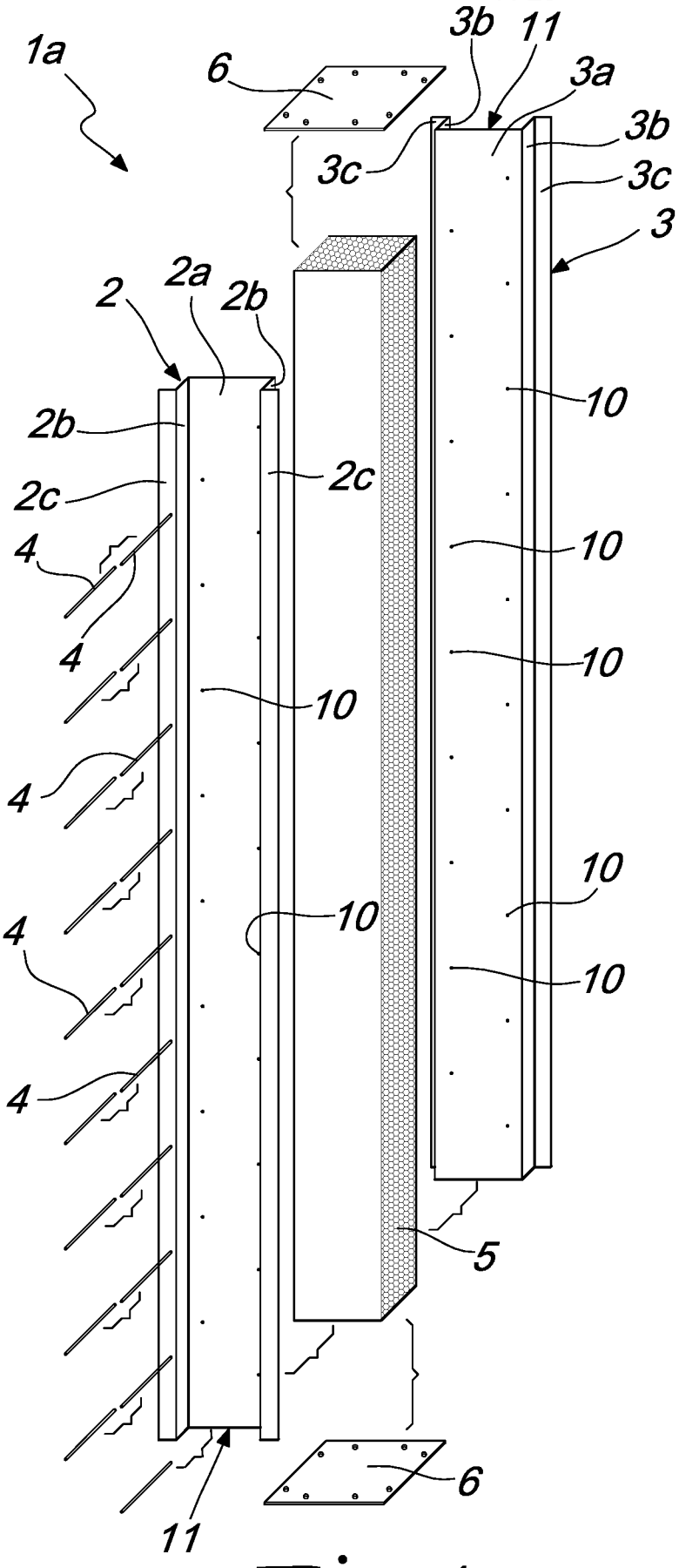
17. The building structure (100) according to claim 16, characterized in that it comprises a plurality of bars (106) for anchoring the vertical walls (101) of the first level, which protrude from the foundation plane (F) at both of the main faces of said panels (P) and are connected to said nets (104).

18. The building structure (100) according to claim 16 or 17, characterized in that it comprises at least two levels and comprises a

plurality of bars (107) for connecting the vertical walls (101) of superimposed levels, which are inserted so as to pass through the panels (P) of the floor (103) for separation at the internal main face of said walls (101) and are connected to said nets (104).

19. The building structure (100) according to one or more of claims 16 to 18, characterized in that it comprises a plurality of contoured plates (109) for the connection of said nets (104) to said profiled members (2, 3) by way of threaded elements.

20. The building structure (100) according to one or more of the preceding claims 16 to 19, characterized in that it comprises a plurality of stiffening bars (108) which are inserted in said bond beams (1b) so as to rest on the corresponding connector elements (4) before performing the concrete casting of the screed.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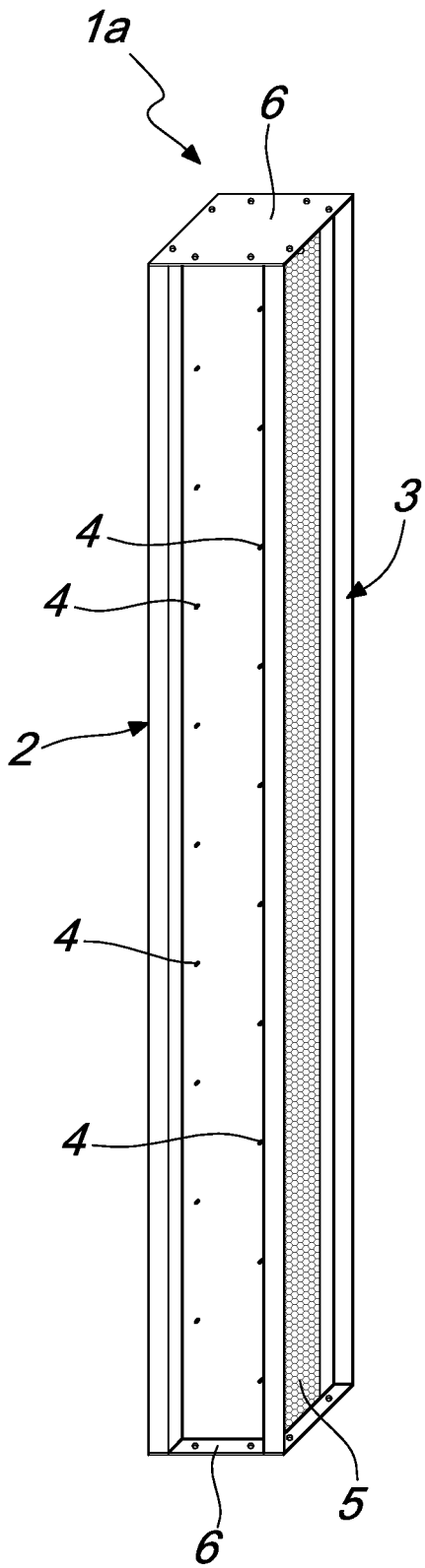
11

Fig. 1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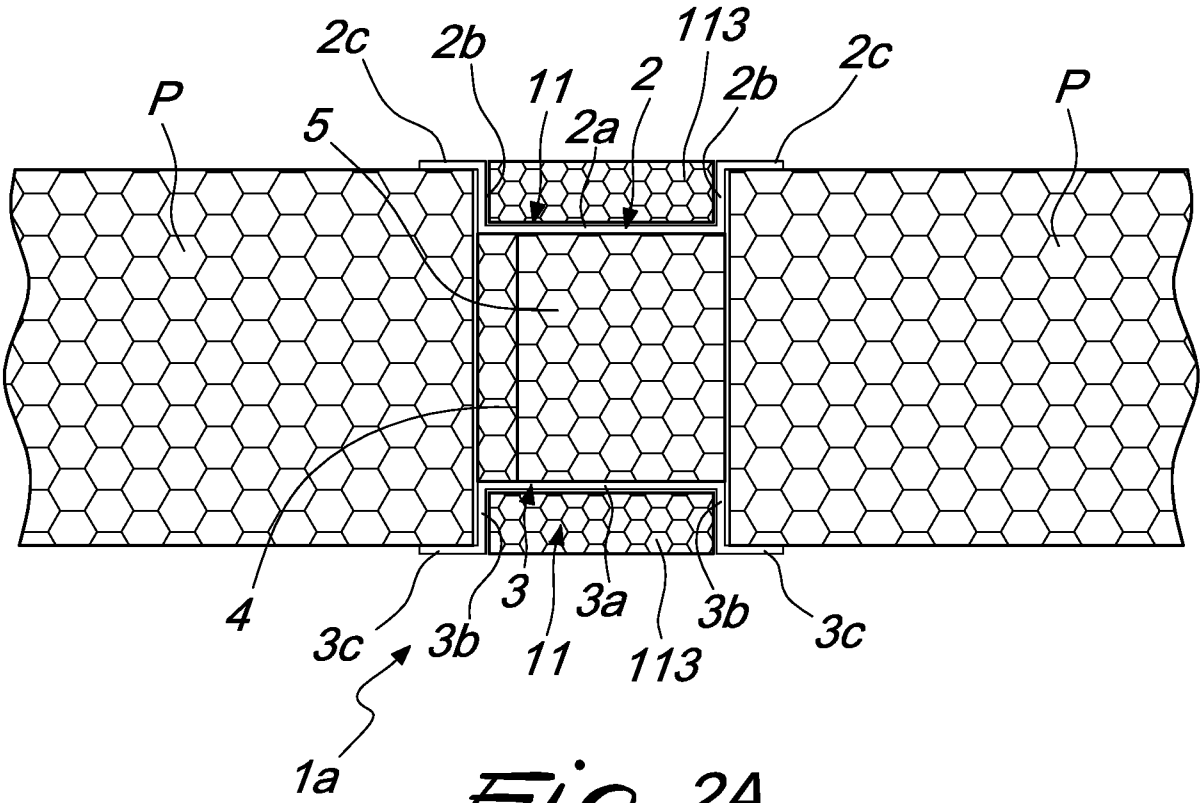
6

Fig. 2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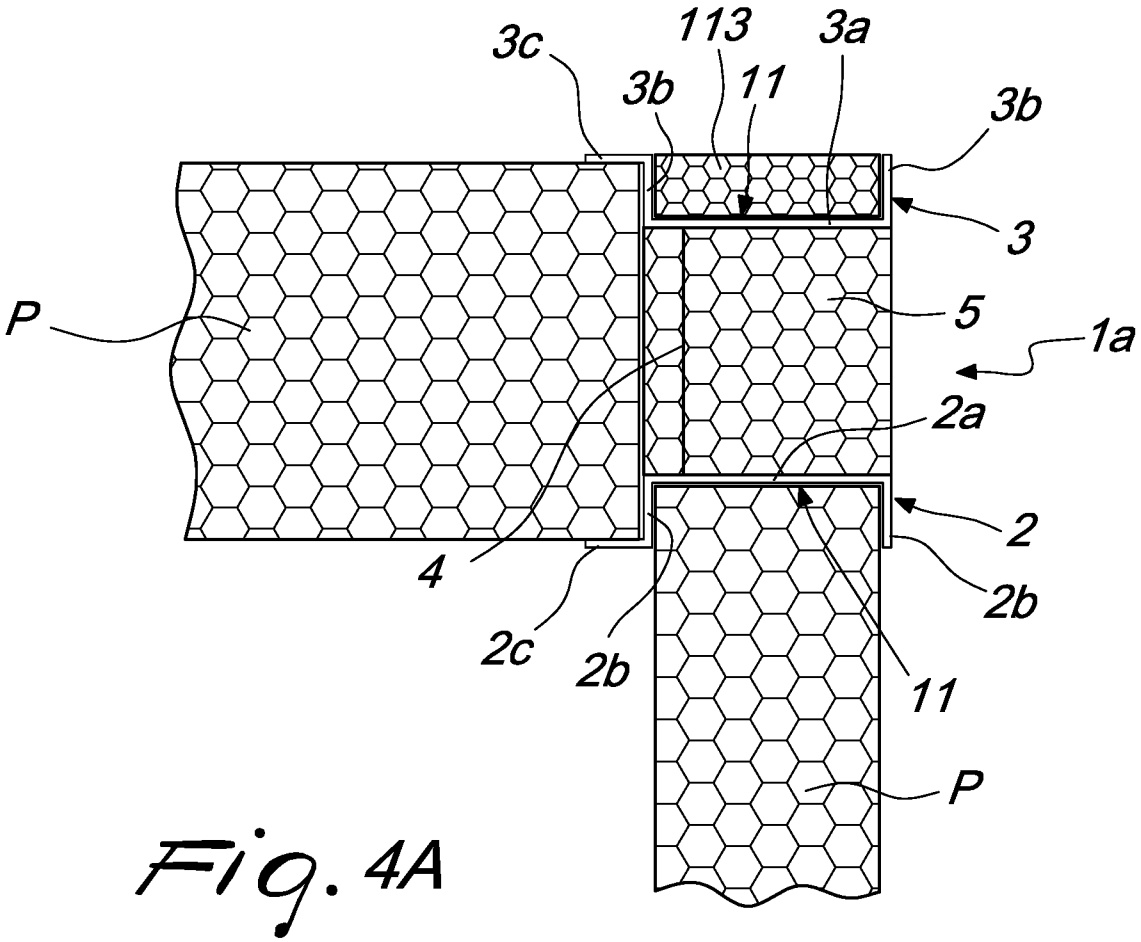
113
1a

Fig. 2A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P

Fig. 4A

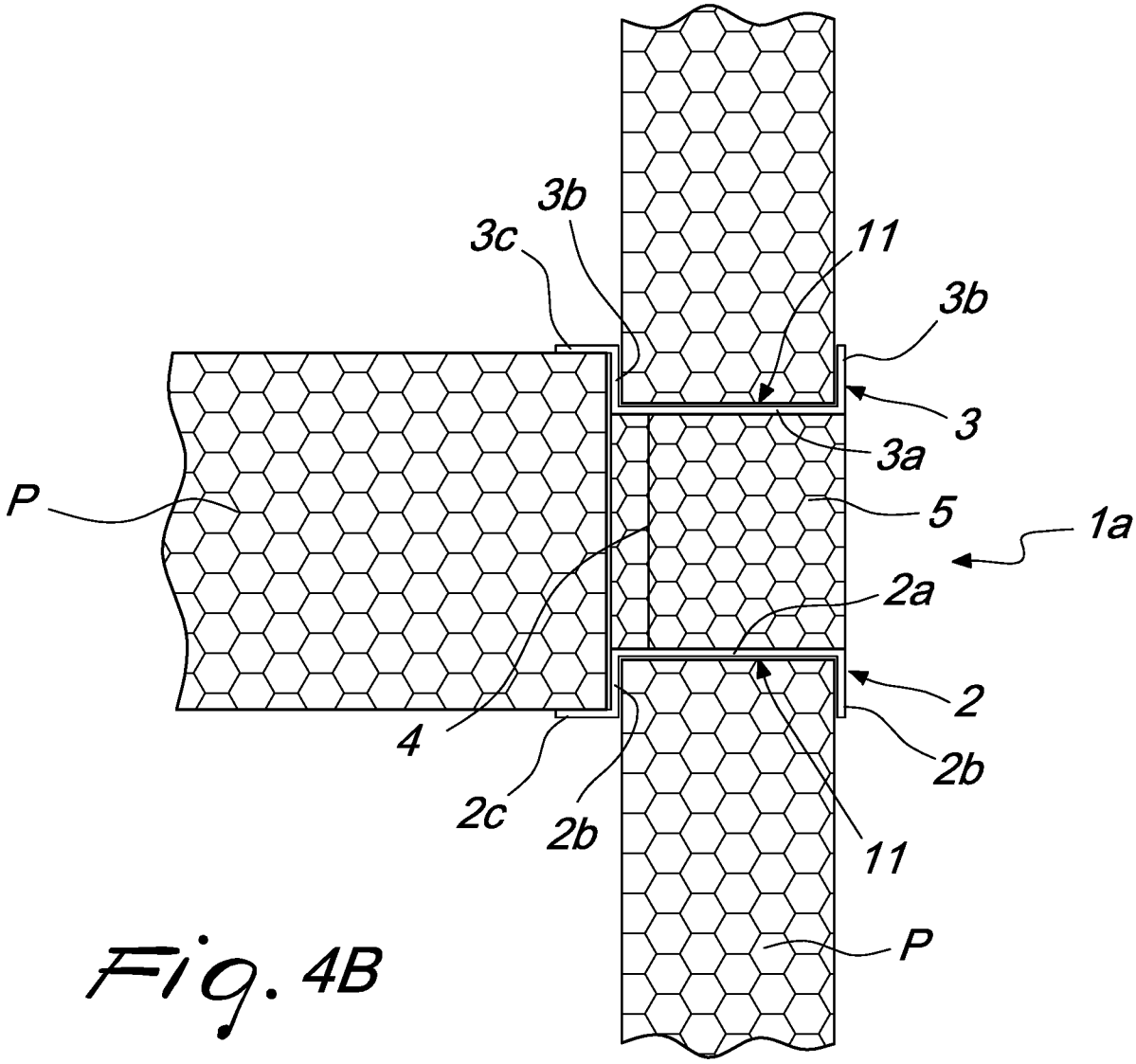
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Fig. 4B

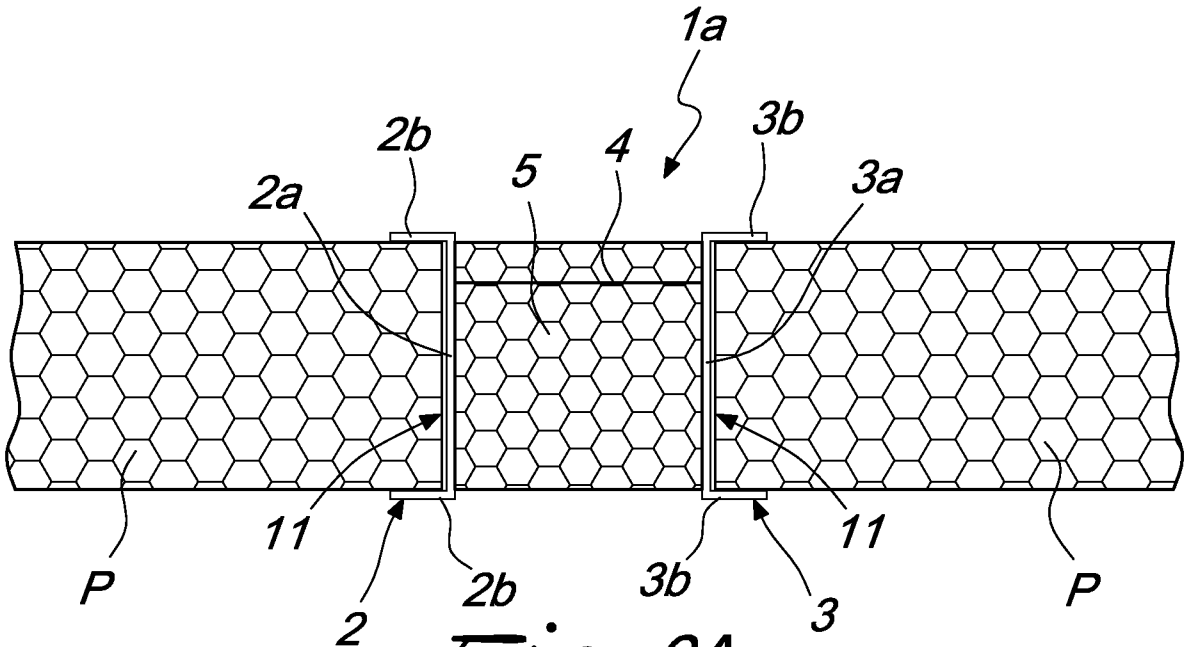
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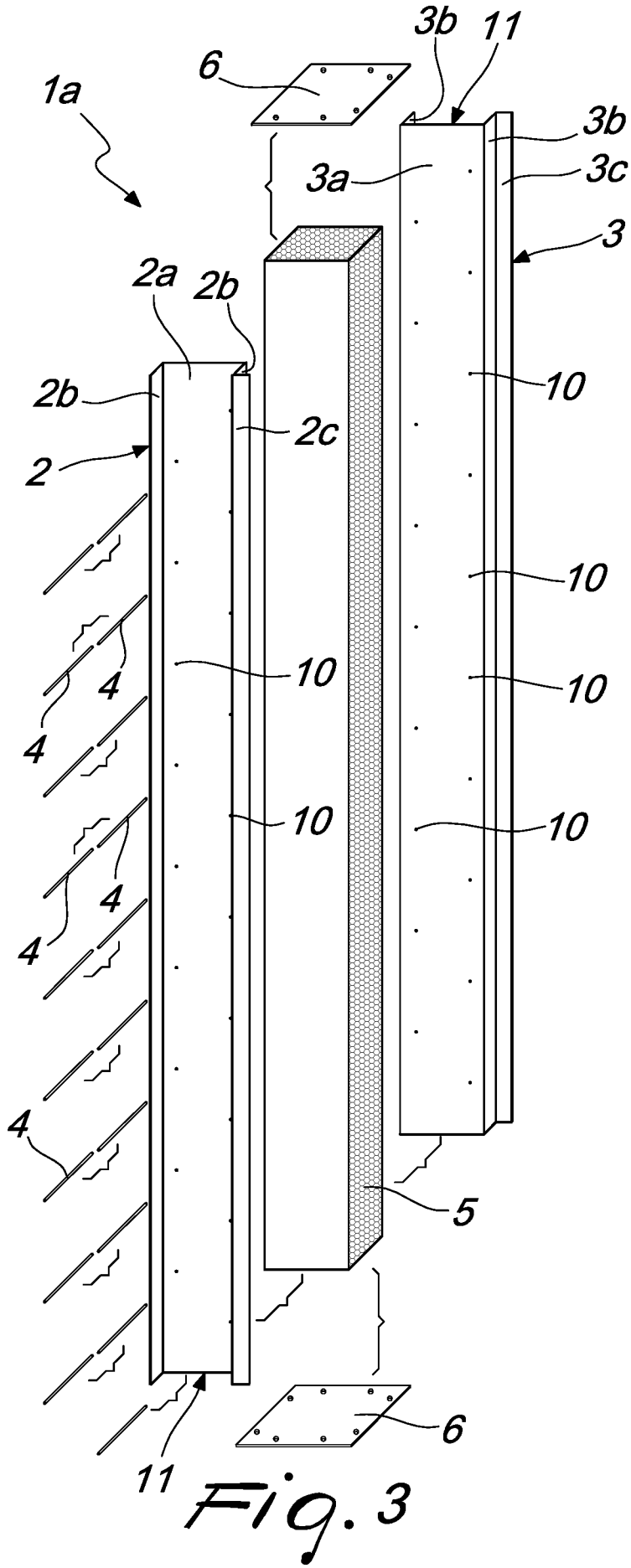
Fig. 6A



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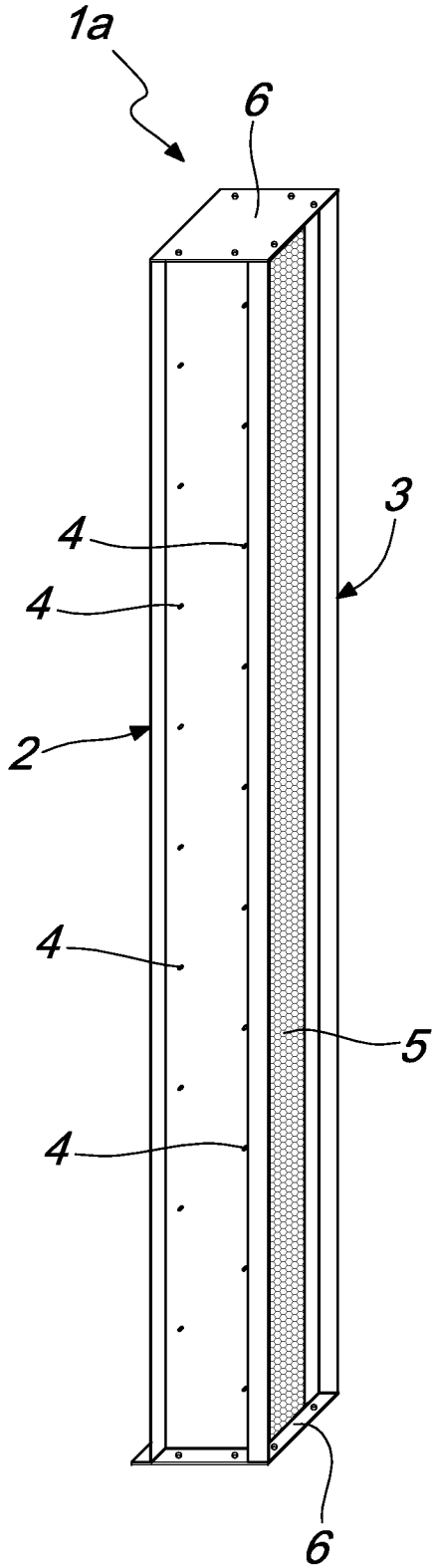

Fig. 4

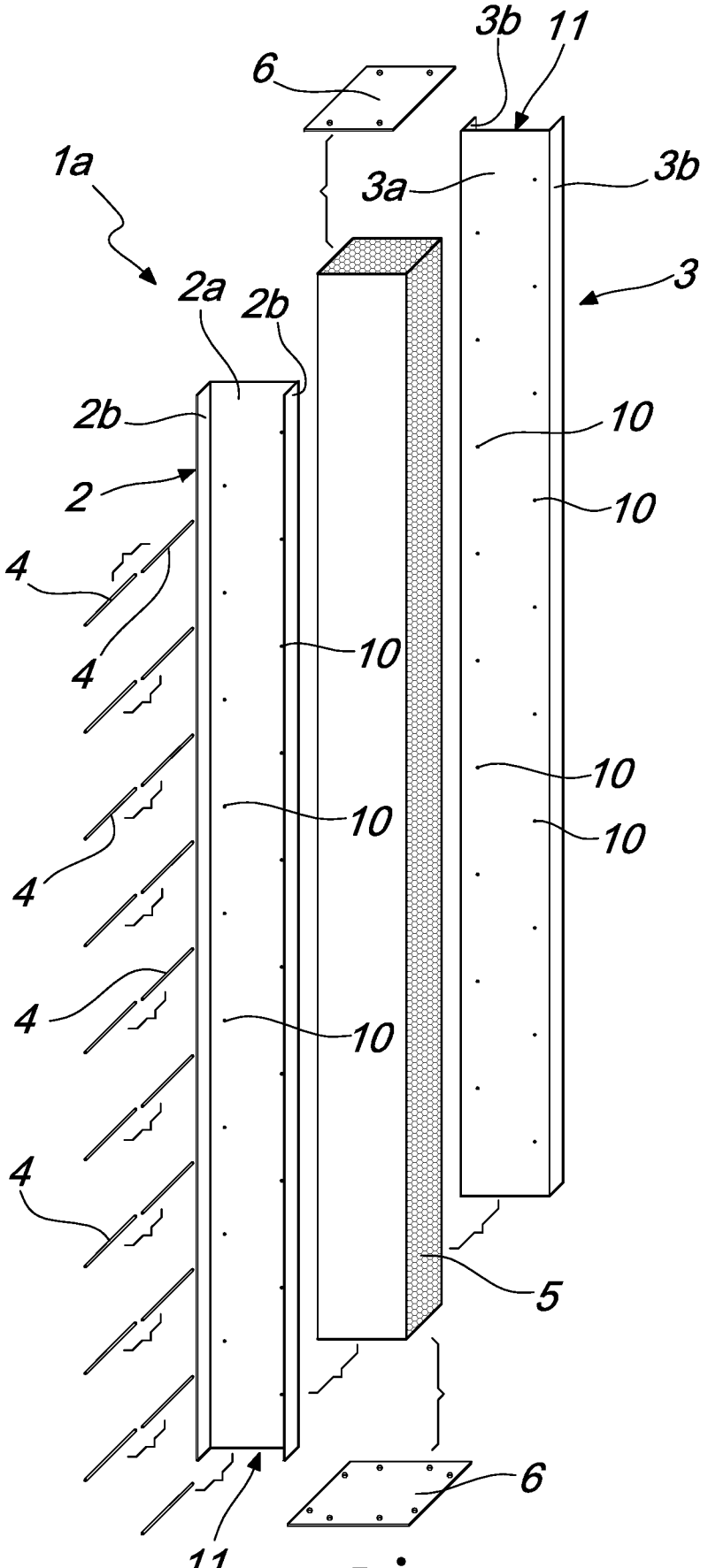
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Fig. 5

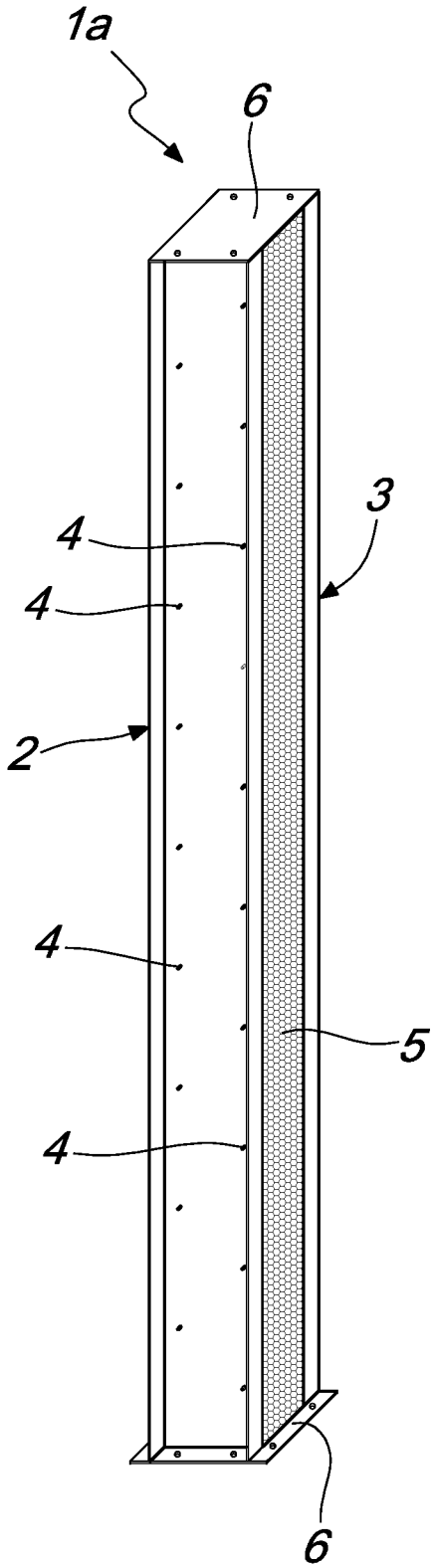
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Fig. 6

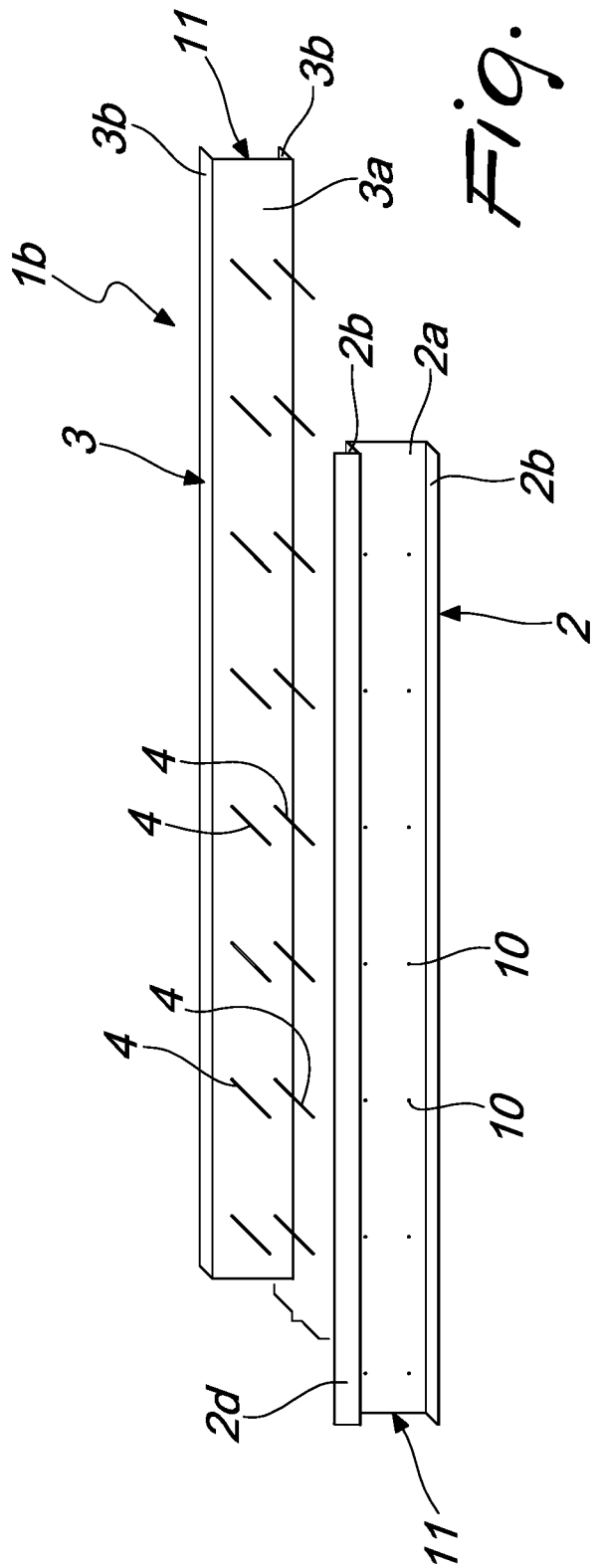
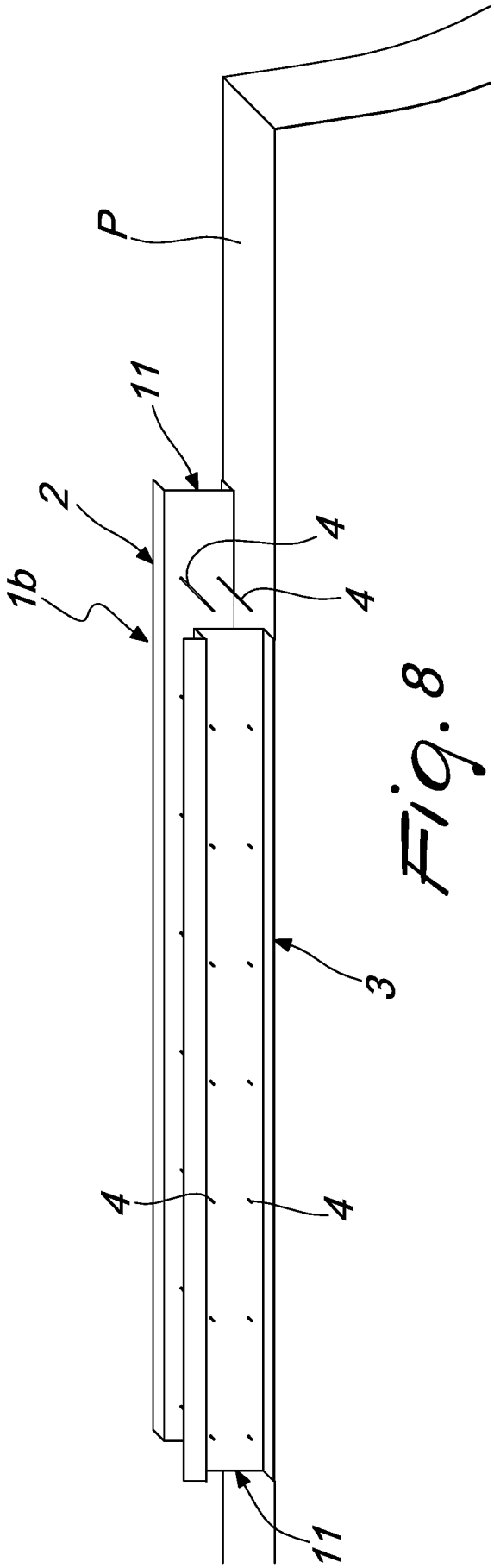


Fig. 7



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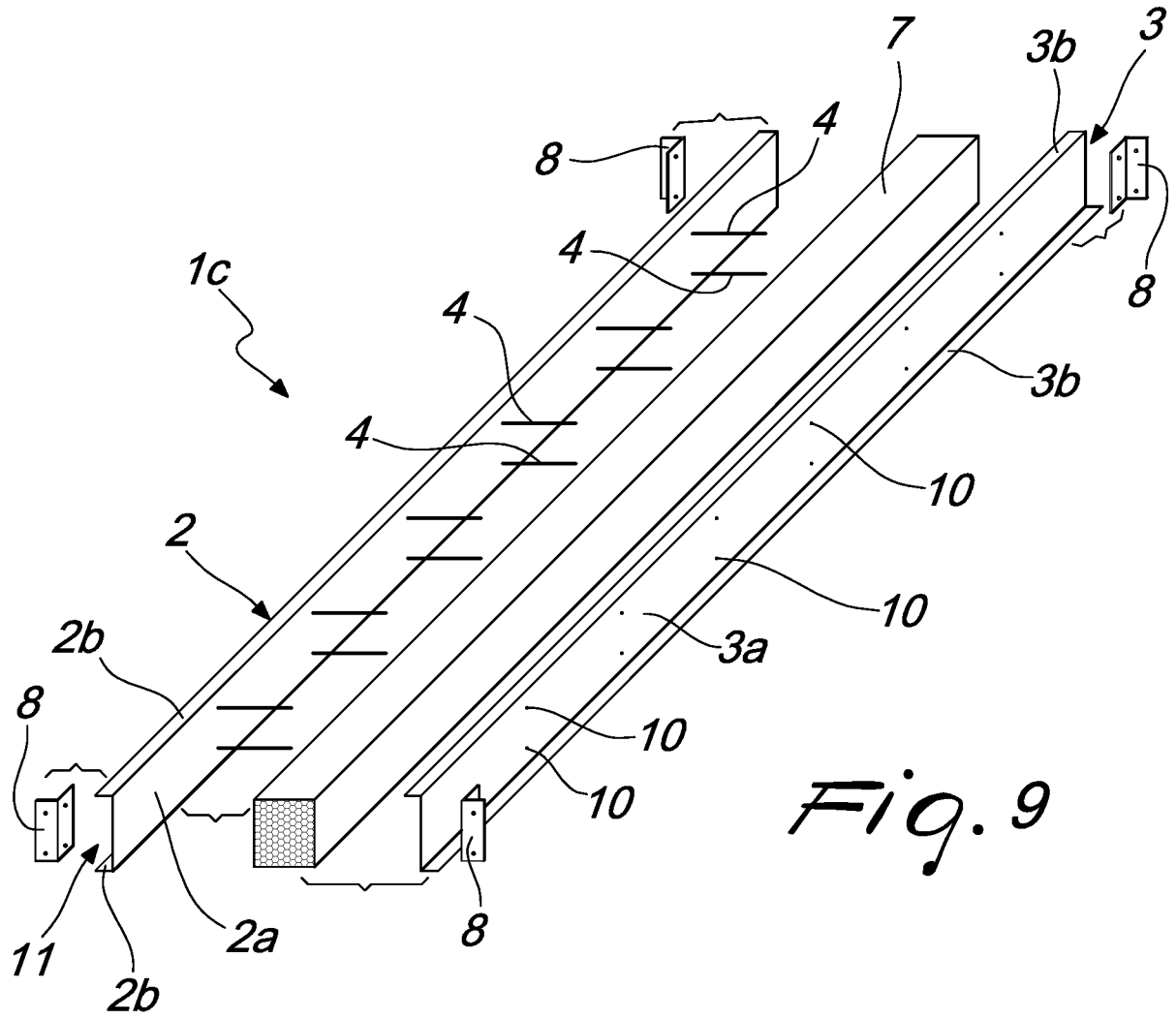
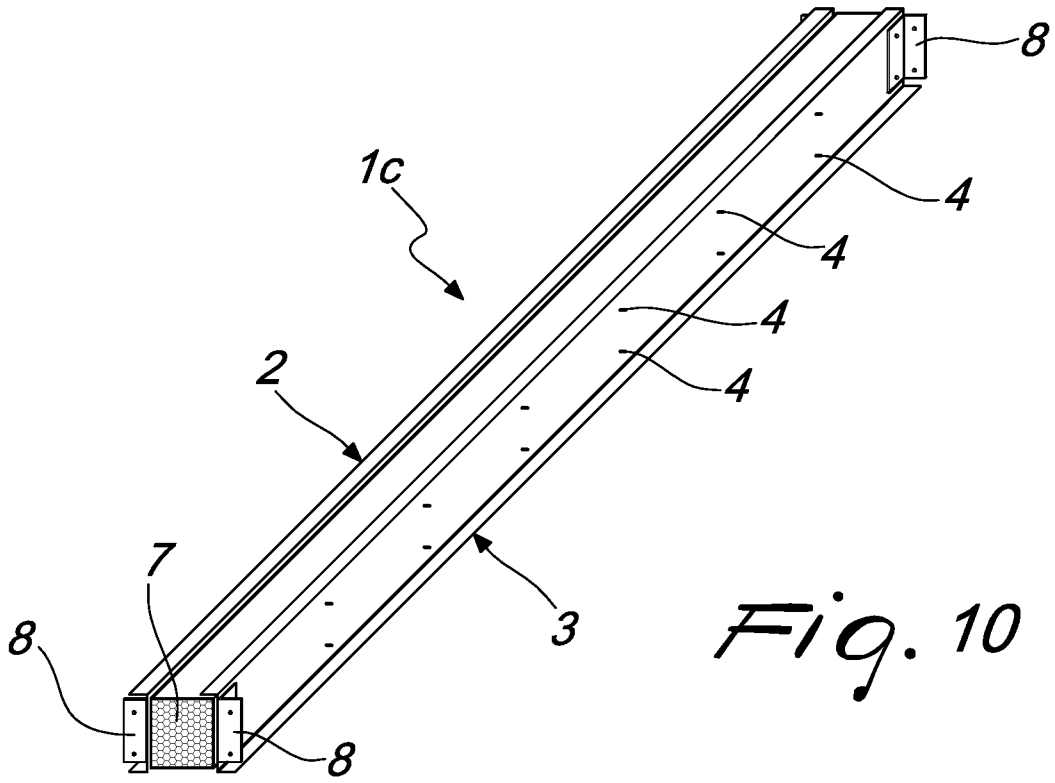


Fig. 9



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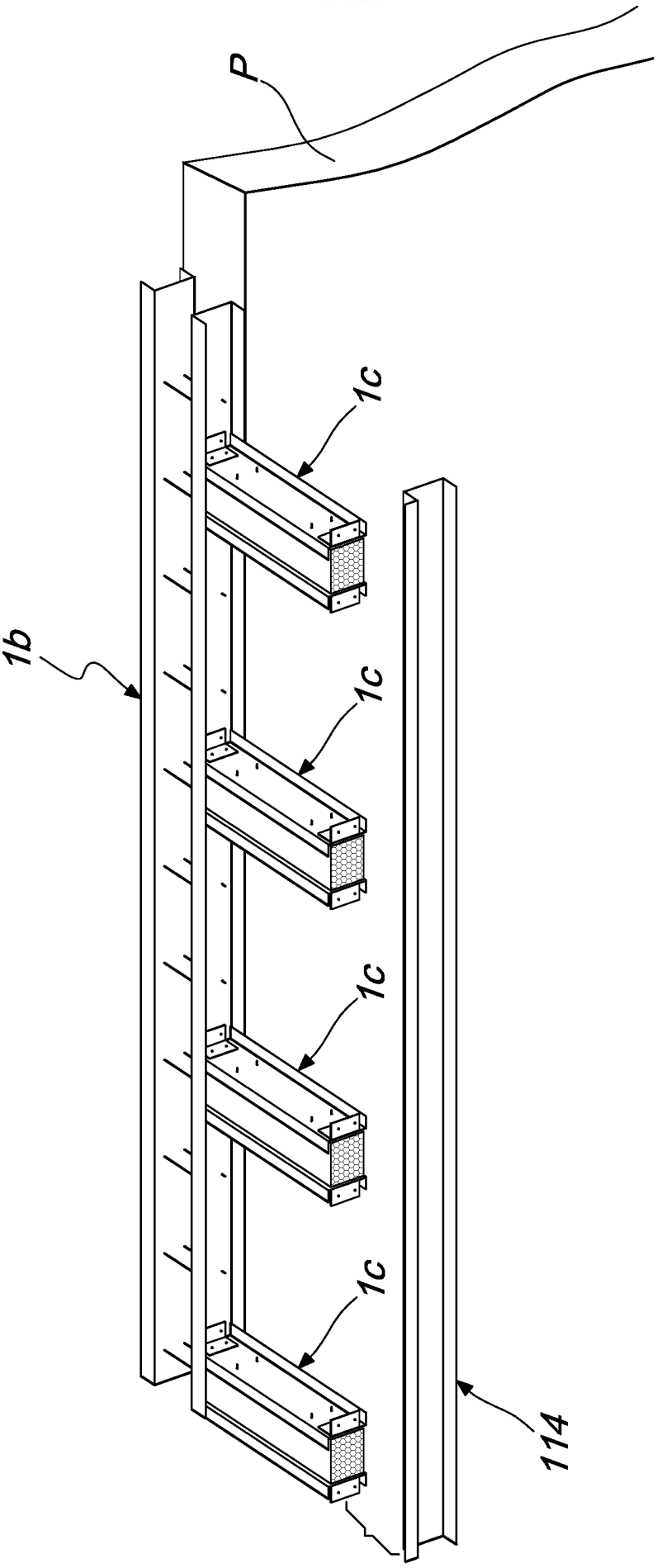
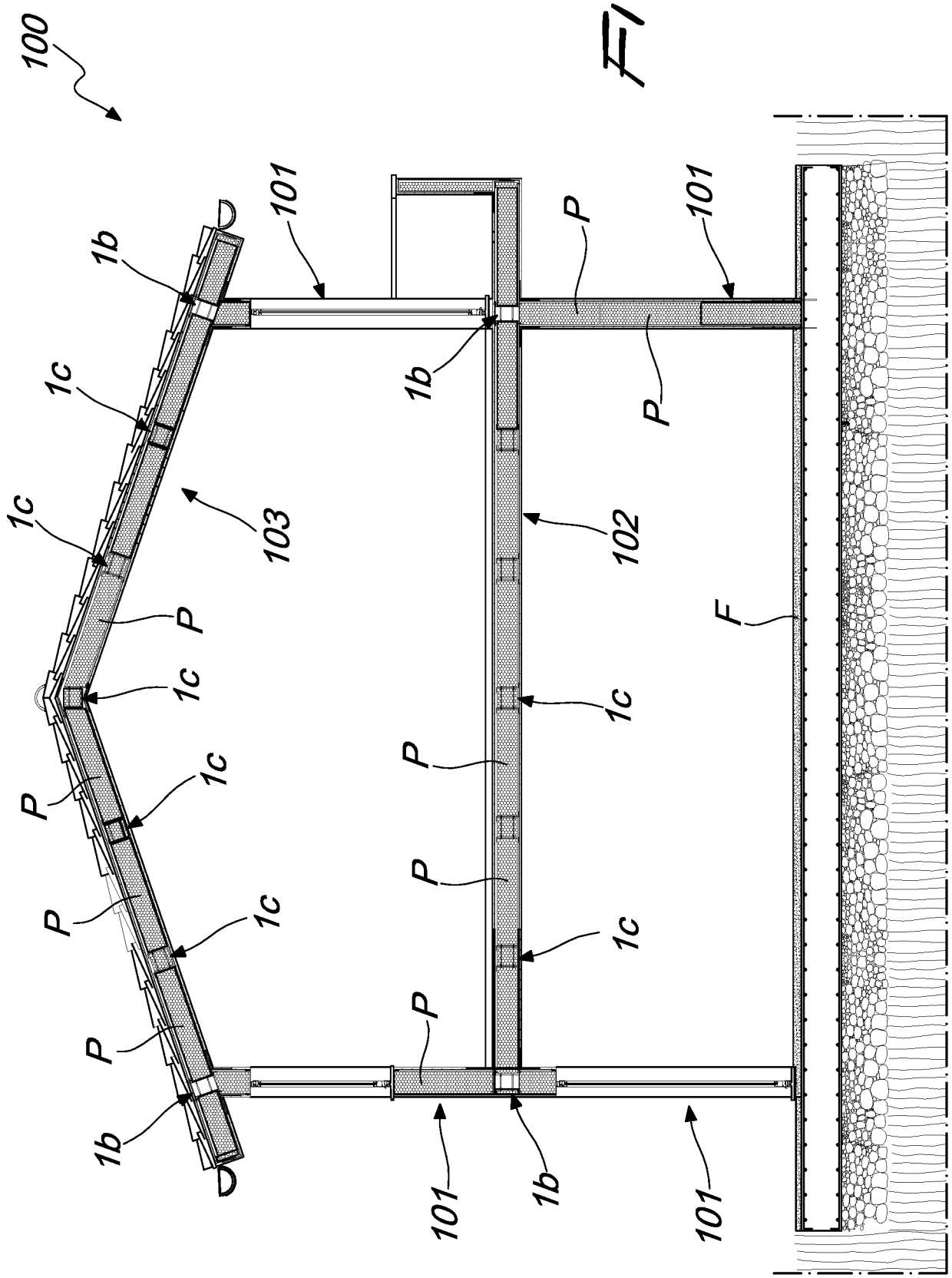


Fig. 11

Fig. 12



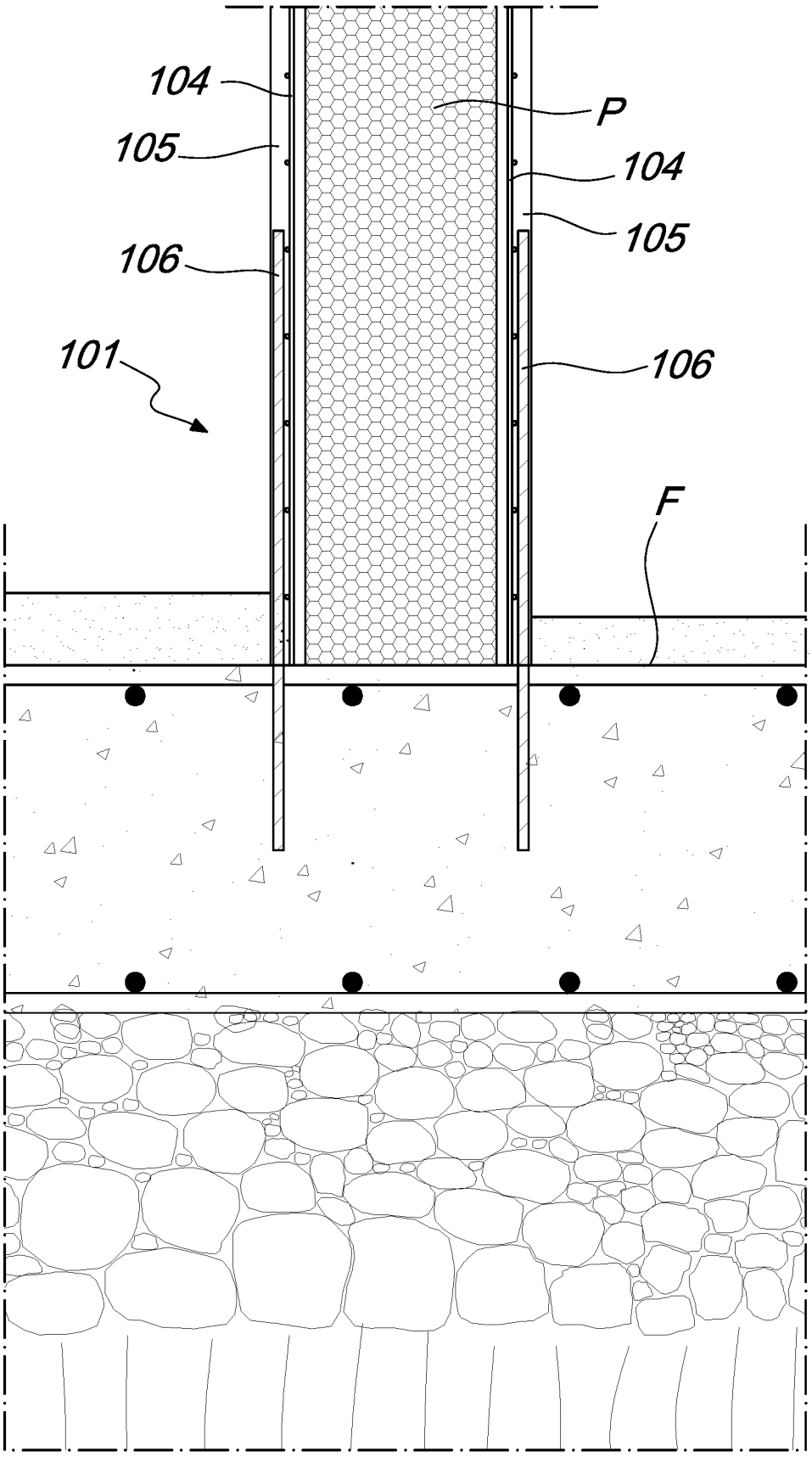


Fig. 13

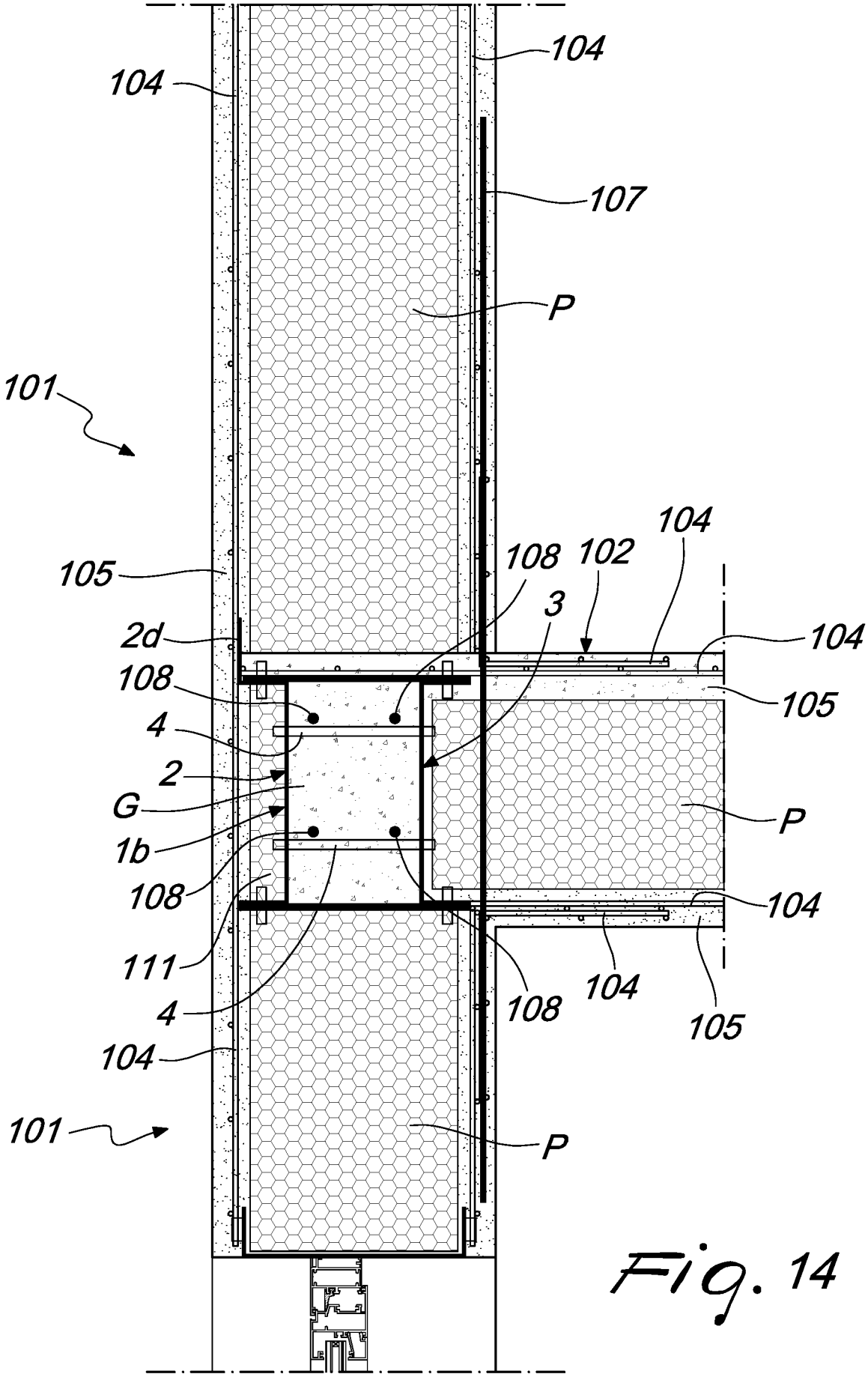

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Fig. 14

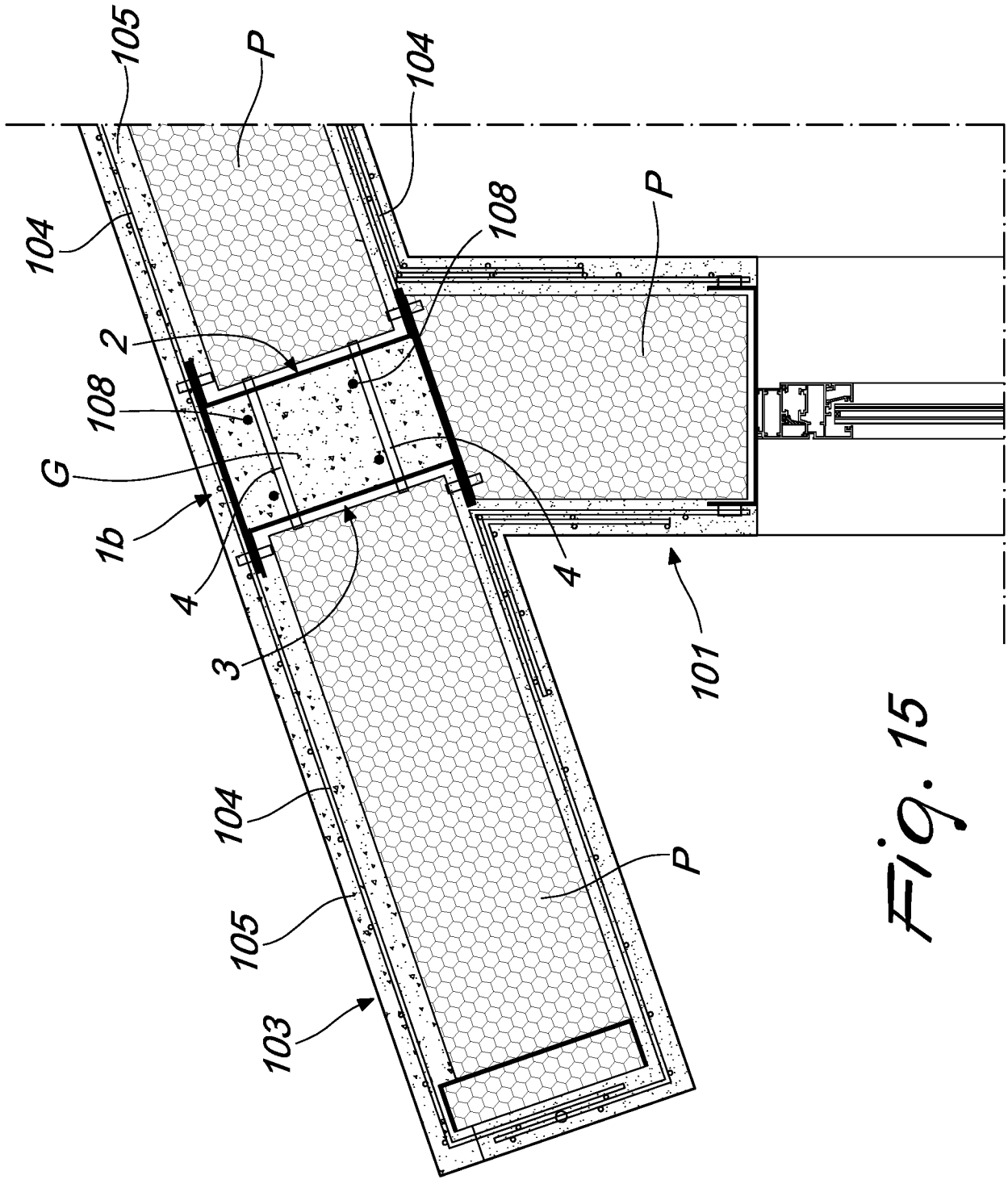


Fig. 15

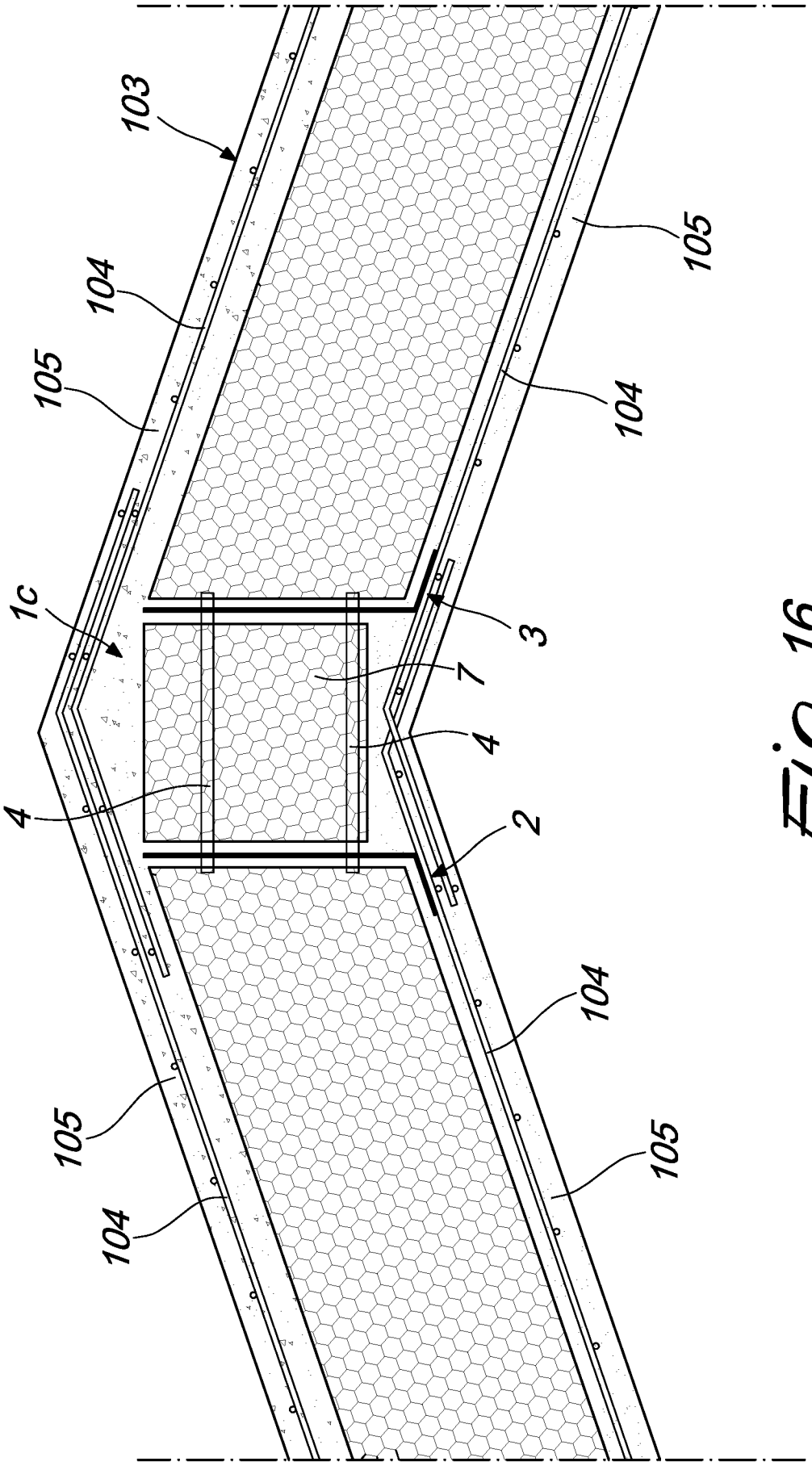
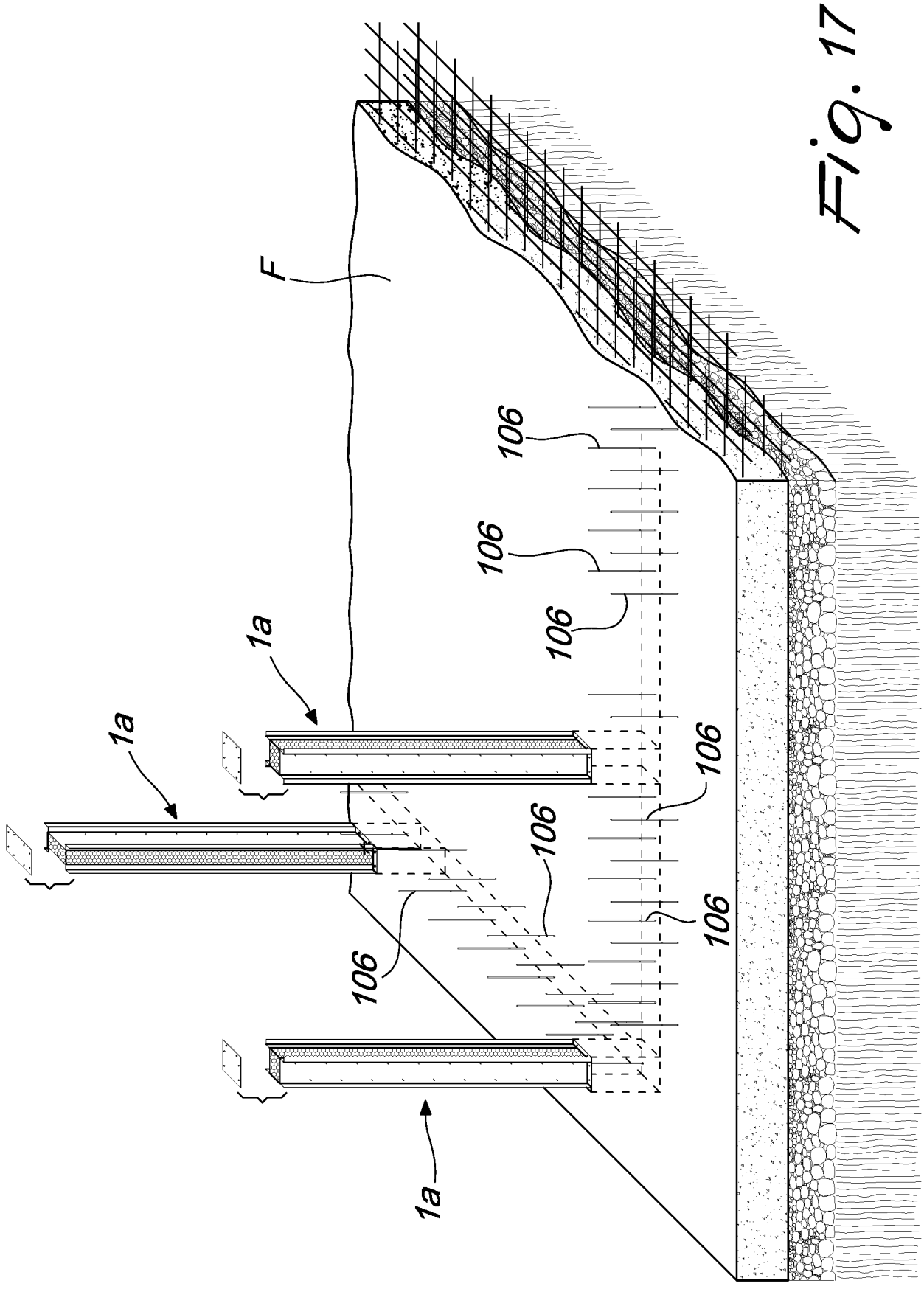


Fig. 16



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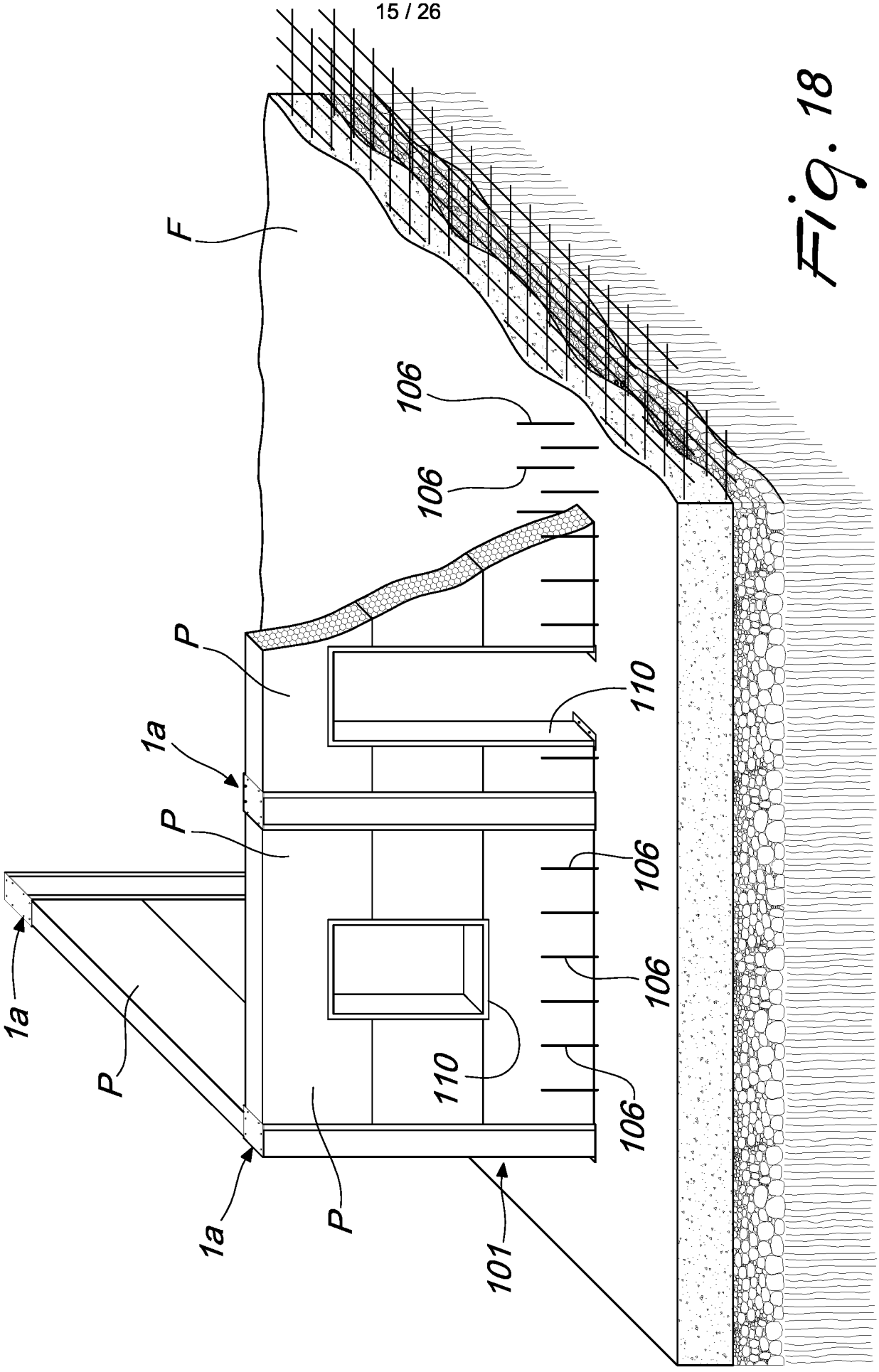

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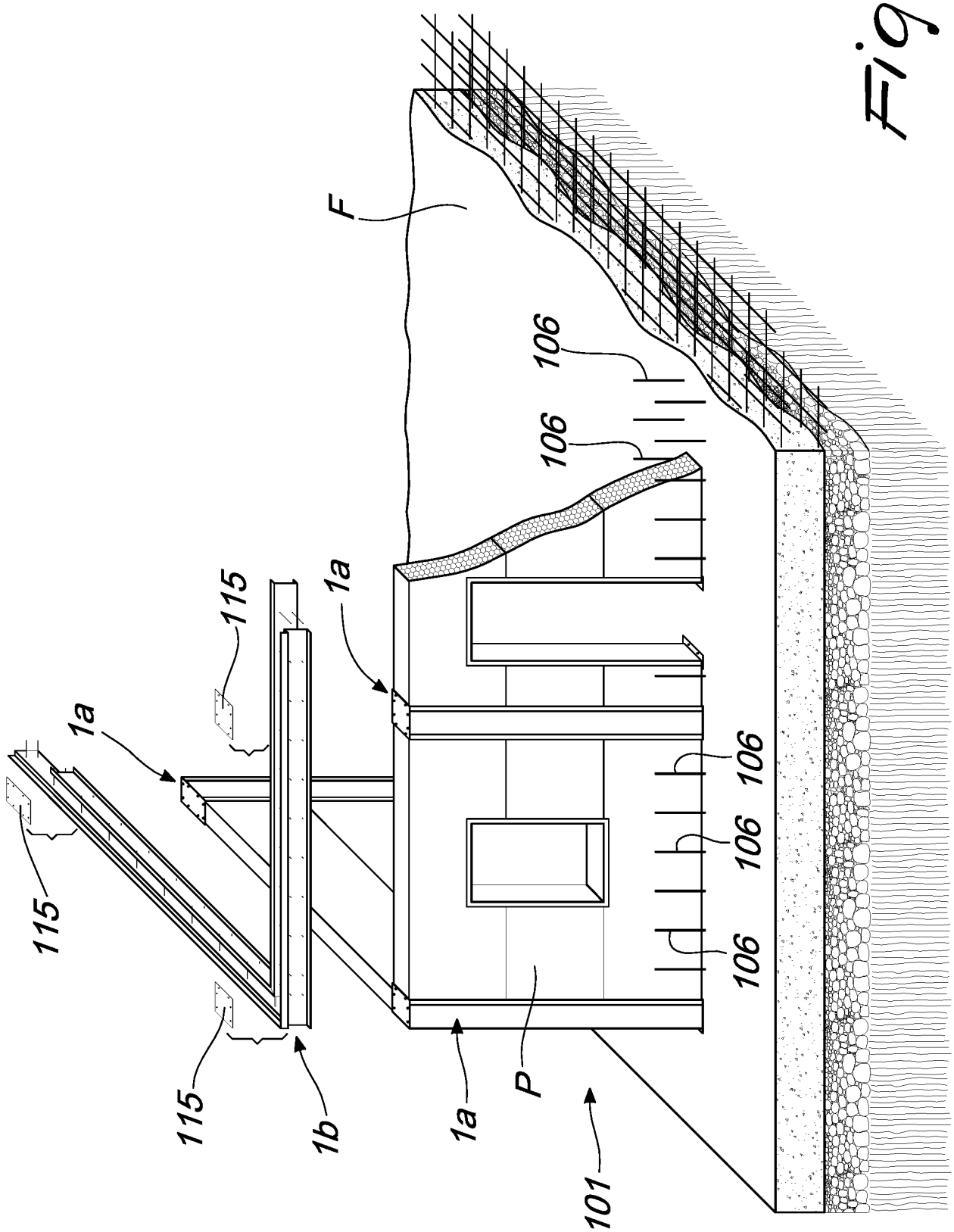

Fig. 19

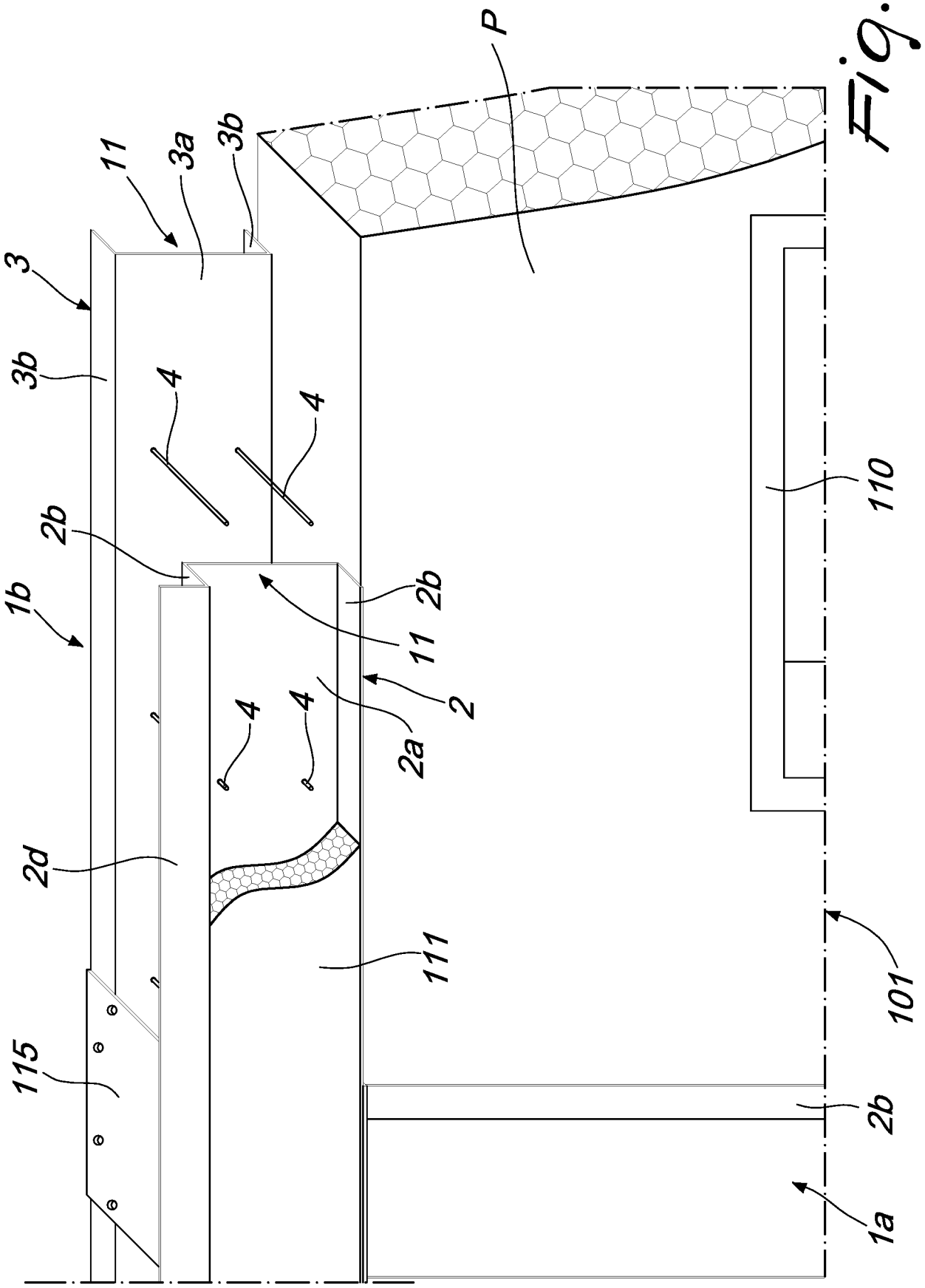

Fig. 20

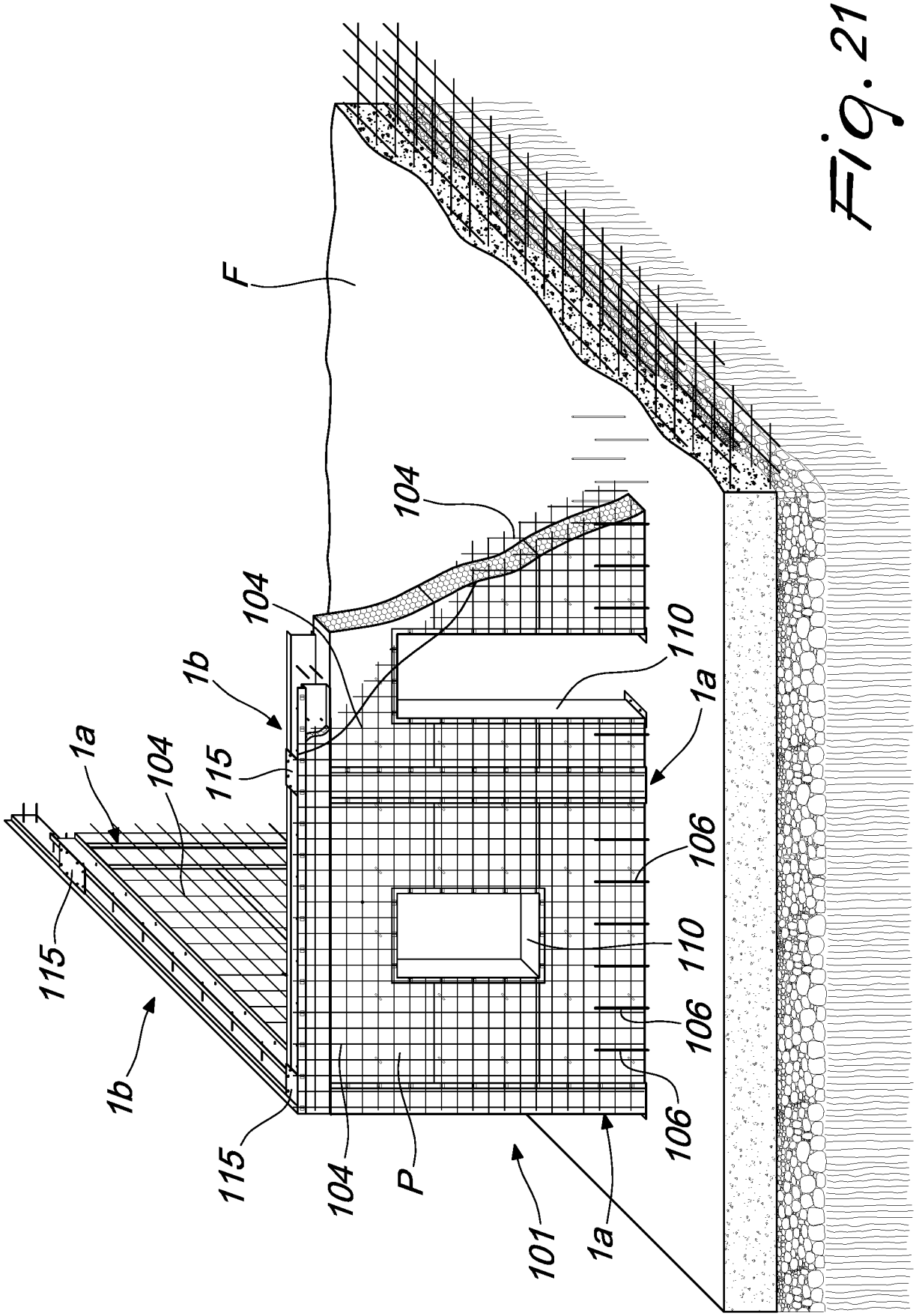
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Fig. 21

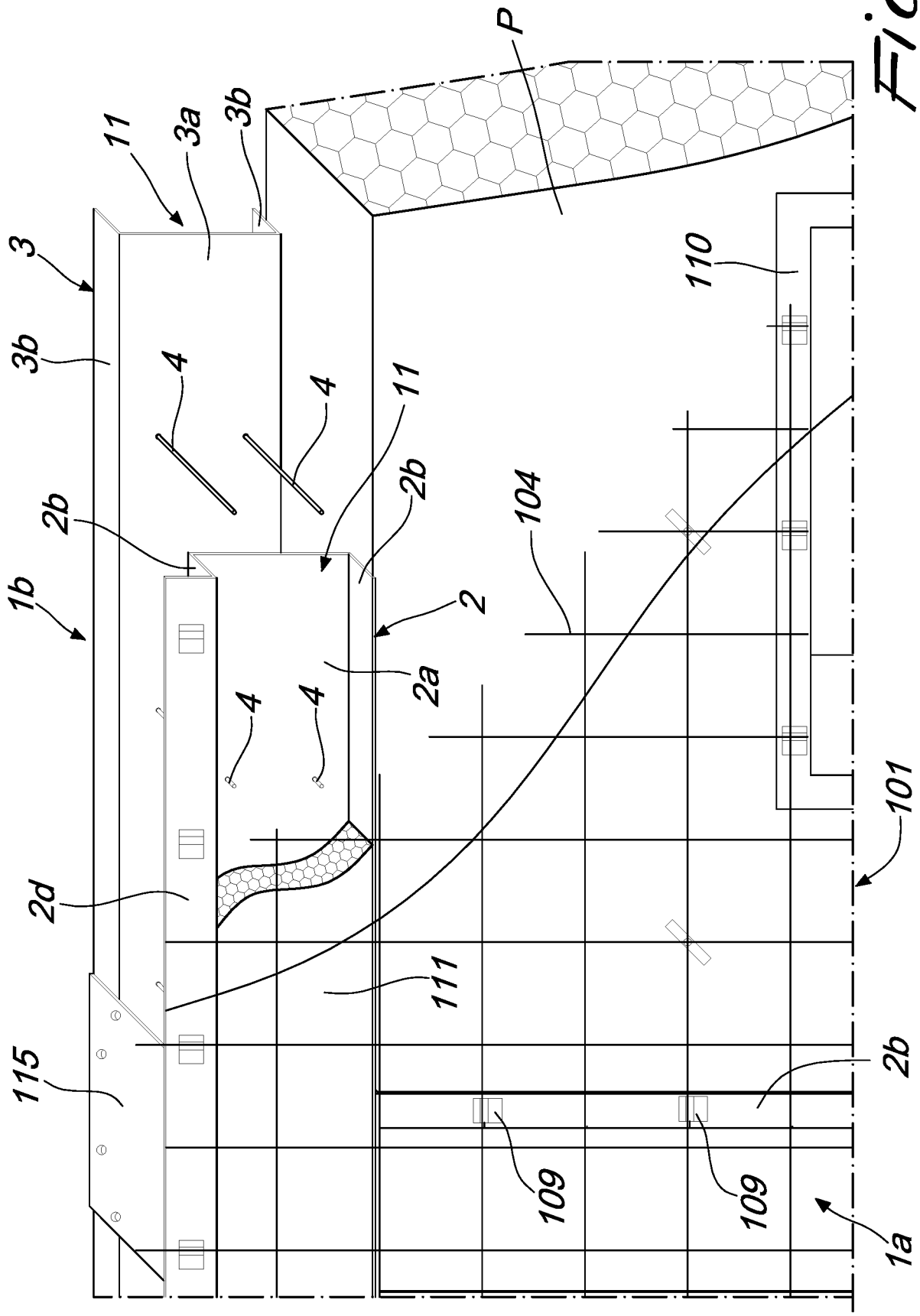
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Fig. 22

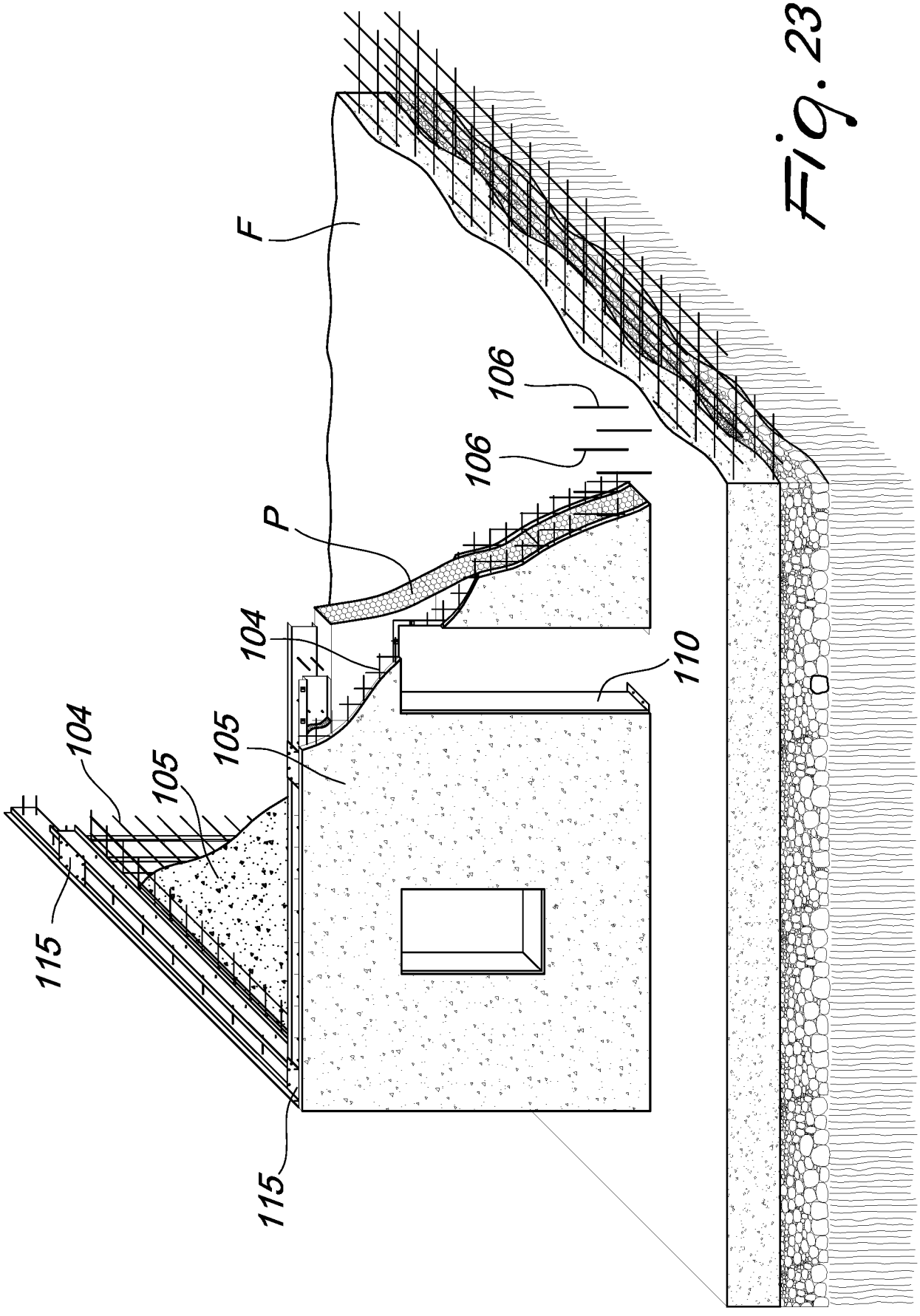

Fig. 23

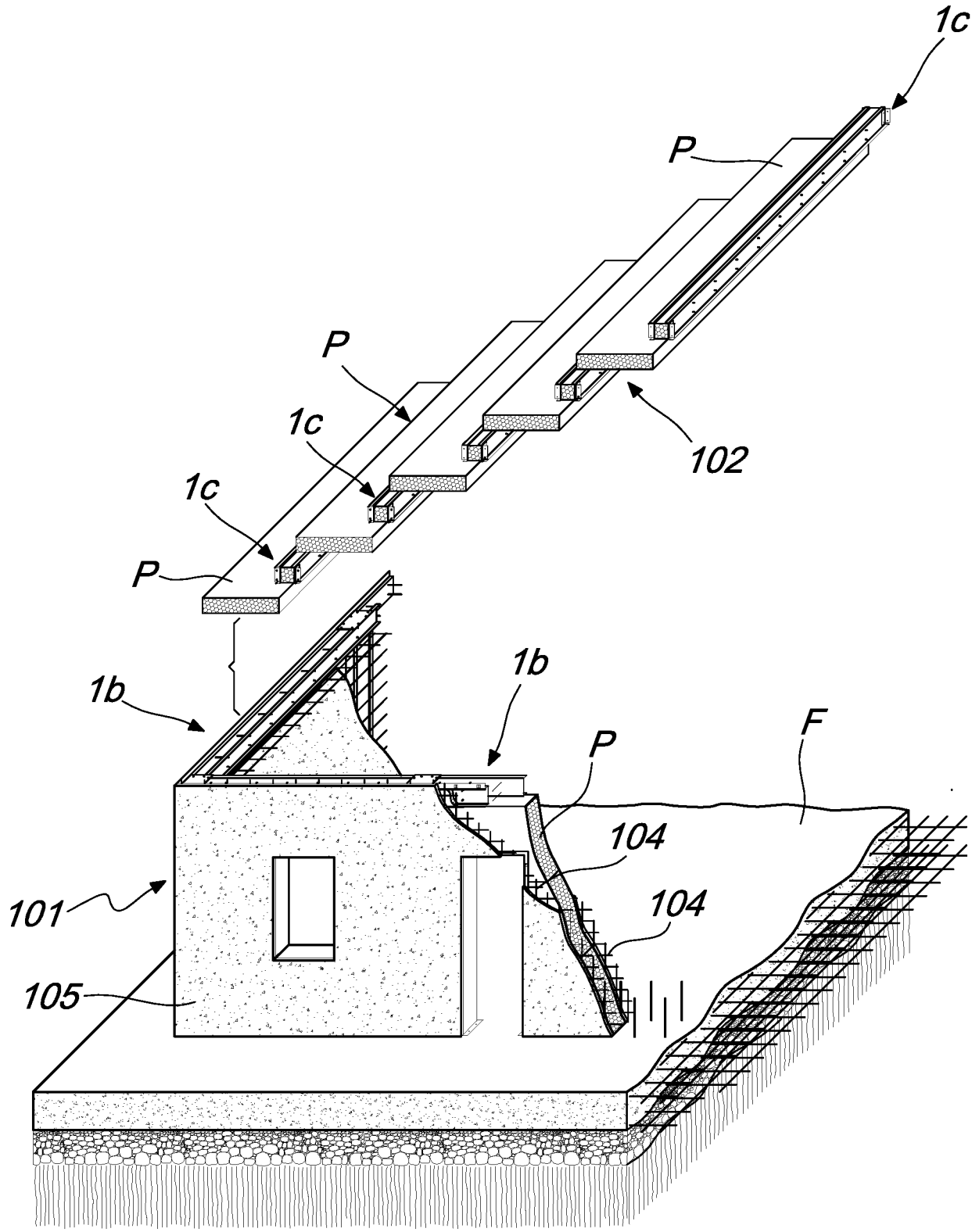

Fig. 24

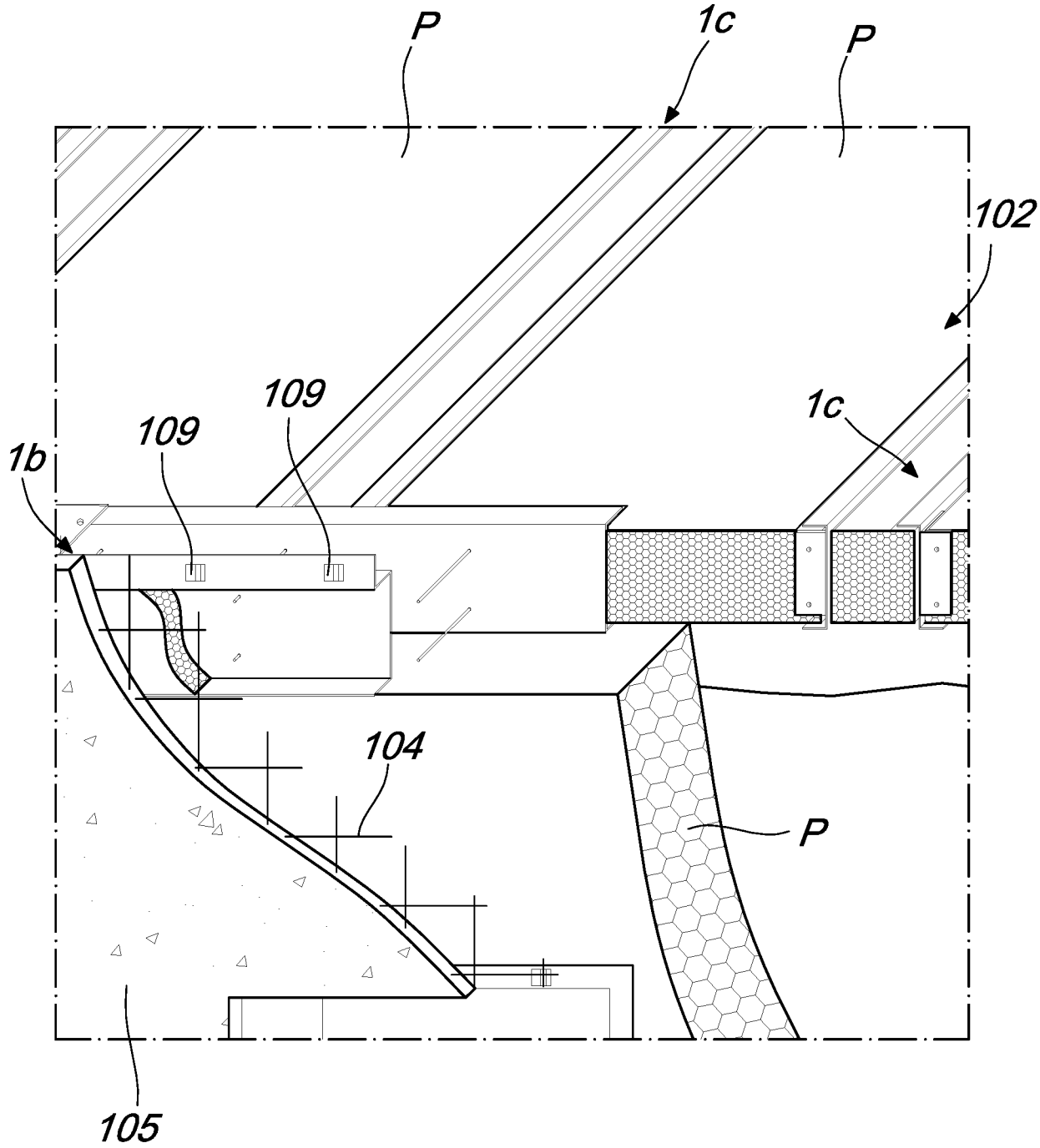

Fig. 25

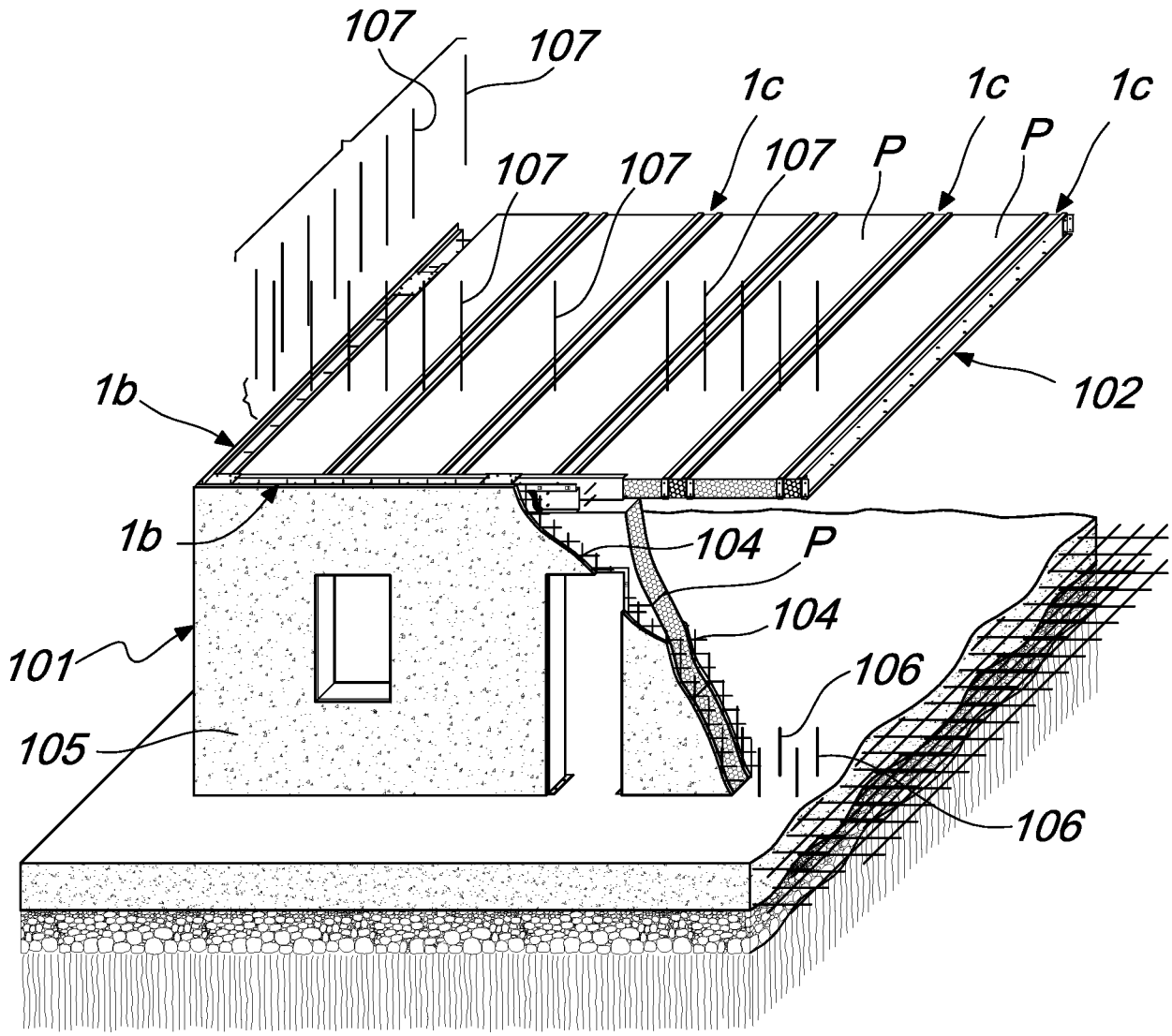

Fig. 26

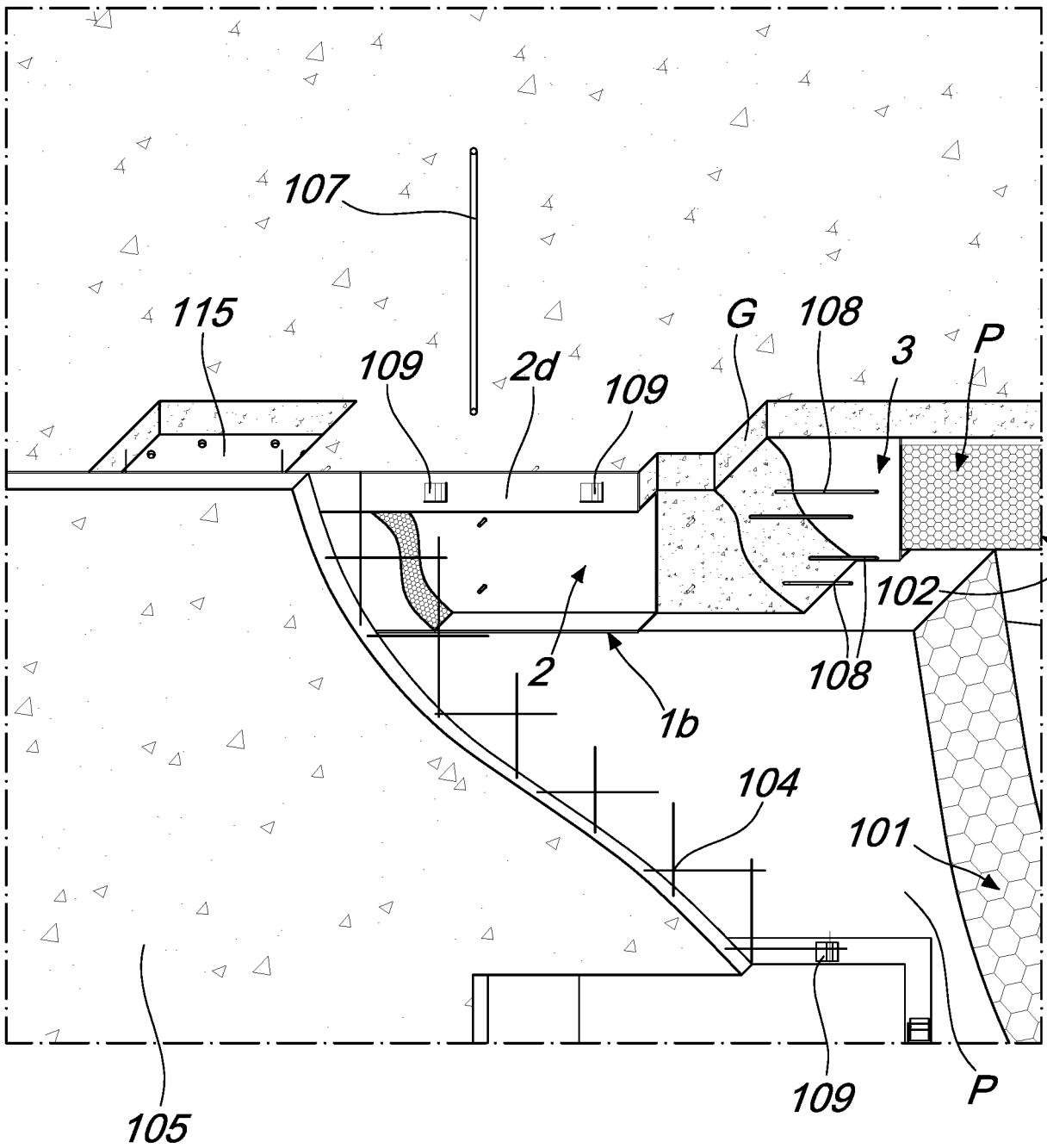

Fig. 27

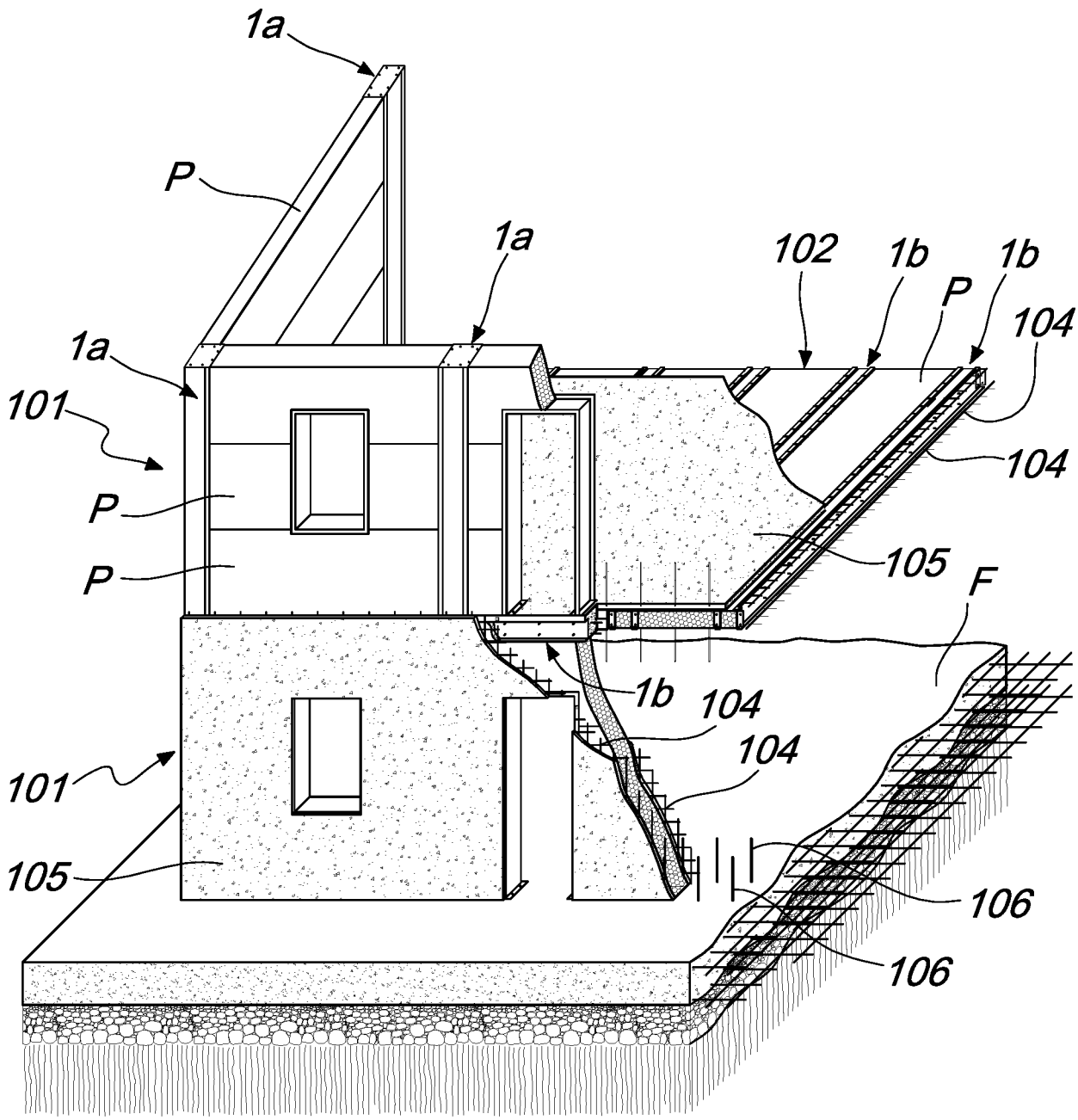
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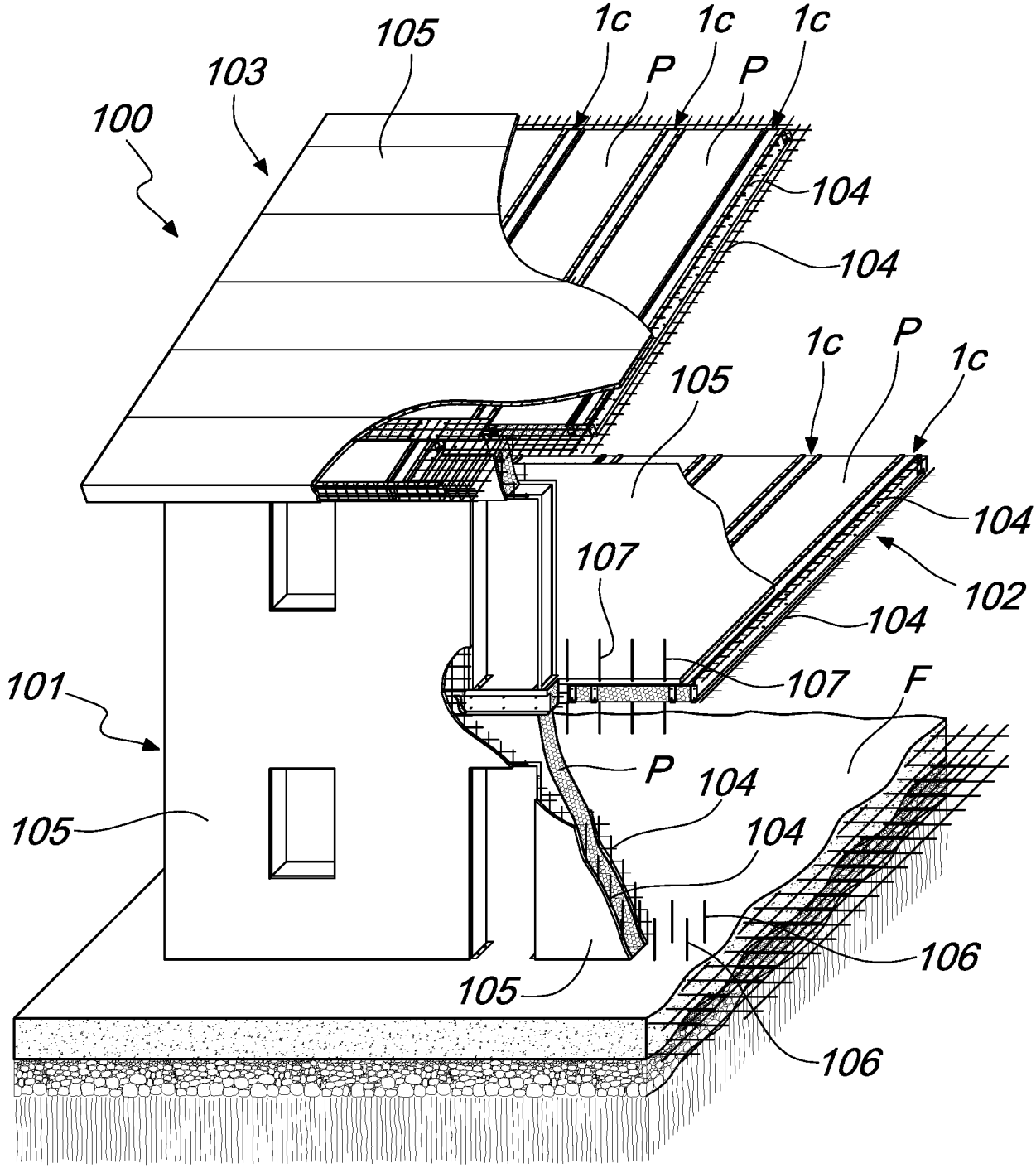
Fig. 28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106
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106

Fig. 29

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2015/065137

A. CLASSIFICATION OF SUBJECT MATTER
INV. E04C3/36 E04C3/29 E04C3/293 E04B1/30 E04B2/84
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E04C 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	US 6 519 911 B1 (SAWADA TAIICHI [AU]) 18 February 2003 (2003-02-18) figures 1,8,10,13	1,3-5
X	DE 10 2004 020381 A1 (POETTMANN UWE [DE]) 24 November 2005 (2005-11-24) figures 1-4	1,13-15
X	FR 1 593 550 A (MARY RAIMOND) 1 June 1970 (1970-06-01) figures 1,4	1-4,11
X	US 1 899 454 A (BEMIS ALBERT F) 28 February 1933 (1933-02-28)	1,3-12
Y	figures 1,6,8	16-20

-/--

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

[X] See patent family annex.

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"P" document published prior to the international filing date but later than the priority date claimed

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 August 2015	02/09/2015

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Delzor, François

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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2015/065137

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2012/016921 A1 (AUREA S R L [IT]; MOLFETTA ANGELO [IT]) 9 February 2012 (2012-02-09) figures 1-5,11 -----	16-20

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2015/065137

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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US 1899454 A	28-02-1933	NONE	
WO 2012016921 A1	09-02-2012	NONE	