

Description

Technical field

[0001] The present invention relates to a frame for a prefabricated element for the construction of buildings, which is used in the field of civil engineering, construction engineering and architecture.

Background art

[0002] Construction prefabrication has long been known, i.e., the construction process of buildings by means of elements made in outsourced factories, and subsequently assembled on-site with strongly codified procedures.

[0003] Thanks to the industrial anticipation of part of the manufacturing processes, construction prefabrication allows to obtain greater construction speed and less uncertainty in completion times with respect to the traditional techniques of on-site construction.

[0004] In particular, in the state of the art, highly prefabricated systems for the construction of building façades are known. In detail, such highly prefabricated systems envisage the use of a plurality of modules, made in outsourced factories, ready to be installed on-site. In some cases, the modules require the installation of splicing systems between one module and the other on-site, if they are not already part of the module itself. This type of system for prefabricating building façades includes, for example, "cellular", "prefabricated concrete panels", or "wooden frame wall" systems.

[0005] Furthermore, in the state of the art, not entirely prefabricated systems are known which, as can be seen from their name, have a substantially lower level of prefabrication with respect to the highly prefabricated systems previously described. In fact, the systems which are not entirely prefabricated require significant component assembly and finishing operations. This type includes, for example: upright and cross-beam systems, dry-stratified systems, and all the more traditional so-called wet-beam systems, such as walls in half-full brick blocks with finished external insulation and spliced with mortars.

[0006] However, the known type of prefabricated façade systems very often have strong limitations in terms of maximum module dimensions, as large modules are not able to ensure the structural stiffness necessary for the construction of a building. In particular, large modules are particularly sensitive to the action of forces outside the plane of the wall, such as wind.

[0007] Prefabricated systems for the construction of building façades are known, such as prefabricated concrete panels, designed to ensure adequate rigidity even if made of large modules; however, they are extremely heavy due to the high density of the materials used.

Summary of the invention

[0008] The object of the present invention is to provide a frame for a prefabricated element for the construction of buildings which allows the construction of prefabricated elements which are simultaneously light and stiff outside the façade plane. In other words, an object of the present invention is to provide a frame which allows to make prefabricated elements for the construction of buildings having high ratios between stiffness and weight.

[0009] Furthermore, an object of the present invention is to provide a frame for a prefabricated element which allows the integration of a thermal layer, inside the prefabricated element itself, without generating losses in terms of stiffness and load capacity.

[0010] This and other objects are achieved by a frame for a prefabricated element for the construction of buildings, according to any one of the appended claims.

[0011] Specifically, the frame for prefabricated elements of the present invention comprises a plurality of support structures, each arranged on a respective level in a thickness direction.

[0012] Furthermore, the frame comprises a plurality of connecting members adapted to connect different support structures to each other along the thickness direction.

[0013] The support structures are tensioned by means of a plurality of cables having two ends secured to distinct connecting members.

[0014] Advantageously, the frame object of the present invention, by means of the plurality of tensioning cables is able to increase the stiffness of a prefabricated element inside which it is inserted, without generating a significant weight increase. In greater detail, when pre-tensioned, the plurality of cables brings the different components of the frame together, making it work as a tensile structure. Therefore, by varying the pre-tensioning value of the cables it is possible to vary the stiffness of the frame, and therefore that of the prefabricated element which comprises it.

[0015] Advantageously, the high stiffness obtained by pre-tensioning the cables allows to avoid the introduction of additional stiffening material inside the prefabricated element, which would result in a considerable increase in weight.

[0016] Furthermore, advantageously, between the at least two levels spaced apart in the thickness direction, in which the respective support structures lie, one or more thermally insulating panels configured to increase the thermal insulation capabilities of the prefabricated element can be positioned.

[0017] Further features and advantages of the invention will be recognized by those skilled in the art from the following detailed description of exemplary embodiments of the invention.

Brief Description of the Figures

[0018] For a better understanding of the following detailed description, some embodiments of the invention are illustrated in the accompanying drawings, in which:

- figure 1 shows a front view of a prefabricated element for the construction of buildings;
- figure 2 shows a front view of a frame, for the prefabricated element of figure 1, according to the present invention;
- figure 3 shows a perspective of a detail of figure 2;
- figure 4 shows an exploded view of figure 3;
- figure 5 shows a partially sectional perspective view of the prefabricated element for the construction of buildings of figure 1.

DETAILED DESCRIPTION

[0019] Even if not explicitly highlighted, the individual features described with reference to the specific embodiments shall be understood as accessory and/or interchangeable with other features, described with reference to other embodiments.

[0020] With reference to the accompanying drawings, the present invention relates to a frame 11 for a prefabricated element 1 for the construction of buildings, in particular for the construction of façades of prefabricated buildings.

[0021] In the context of the present invention, prefabricated buildings are understood as all those constructions made by assembling a plurality of prefabricated elements 1, i.e., produced in outsourced factories and subsequently installed on-site.

[0022] Furthermore, it should be specified that the term prefabricated element 1 refers to a prefabricated module adapted to be placed next to and fixed to other modules similar thereto, to define the façade of a prefabricated building.

[0023] The prefabricated element 1 comprises a frame 11 and a plurality of panels, mounted on the frame 11, which will be further described below.

[0024] With reference to figure 1, the prefabricated element 1 object of the present invention extends along a first direction V-V between an upper edge S and a lower edge I, and along a second direction O-O, orthogonal to the first direction V-V, between a pair of side edges L. The upper edge S and the lower edge I are connected to the side edges L to define an outer perimeter C_{ext} of the prefabricated element.

[0025] Preferably, but not necessarily, the upper edge S and the lower edge I extend parallel to the second direction O-O, and the side edges L extend parallel to the first direction V-V. In other words, preferably the outer perimeter C_{ext} is quadrangular in shape, even more preferably it is rectangular in shape. It should be specified that in alternative embodiments, the outer perimeter can have any other geometric shape.

[0026] The frame 11 and the panels of the prefabricated element 1 identify two walls 2 arranged parallel to each other. In particular, the two walls 2 are arranged on respective levels of at least two parallel levels and spaced apart from each other in a thickness direction X-X.

[0027] Each wall 2 extends along the first direction V-V between the upper edge S and the lower edge I, and along the second direction O-O between the pair of side edges L. Furthermore, each wall 2 has a plurality of angular regions 20 arranged at the meeting points of the upper edge S and the lower edge I with the side edges L.

[0028] Preferably, each wall 2 has a surface finishing layer or panel 200 which acts as a support for affixing the final finish visible to an external user. Such a surface finishing layer or panel 200 extends from the upper edge S to the lower edge I along the first direction V-V, and from one side edge L to the other along the second direction O-O. For example, such a finishing layer or panel 200 can support a layer of plaster, a panel of wood or synthetic material, or an additional frame supporting the finishing for making a ventilated façade.

[0029] Preferably, each wall 2 is flat and extends parallel to a main façade extension plane in which the prefabricated element 1 lies.

[0030] In detail, as shown in figures 2 and 3, the frame 11 comprises a plurality of support structures 12, namely at least one support structure 12 for each wall 2, included in the wall 2. The support structures 12 are configured to support respective panels of the prefabricated element 1. The support structures 12 are configured to support at least one respective surface finishing layer or panel 200. In even further detail, each support structure 12 consists of a plurality of main beams 120 connected together.

[0031] Preferably, as shown in figure 2 and detailed in figure 3, the support structures 12 comprise at least peripheral support structures 12a, composed of peripheral main beams 120a. Such peripheral main beams 120a are arranged along the outer perimeter C_{ext} of the prefabricated element 1 defining the upper edge S, the lower edge I, and the pair of side edges L.

[0032] Furthermore, in the embodiment of figure 1, each wall 2 has an opening 6 for positioning a fixture, such as a door or a window. Such an opening 6 is delimited by a peripheral opening portion C_{int} which defines the contour thereof. The wall 2 has a plurality of angular opening regions 60 arranged along the peripheral opening portion C_{int} .

[0033] Even more preferably, the support structures 12 comprise opening support structures 12b composed of main opening beams 120b. Such main opening beams 120b are arranged along the peripheral opening portion C_{int} , i.e., they surround the opening 6 defining the contour thereof.

[0034] As shown in figure 3, each support structure 12 is arranged on one respective level on which the walls 2 are arranged. The support structures 12 are configured to support at least one panel of the prefabricated element 1 for each level, namely at least one panel for each wall 2.

[0035] In the embodiment shown in the accompanying drawings, the support structures 12 comprise at least one pair of homologous support structures 12, i.e., two support structures arranged on distinct levels and facing each other in the thickness direction X-X. In particular, the peripheral support structures 12a of the two walls 2 are homologous to each other. Furthermore, for each opening 6, two opening support structures 12b are provided homologous to each other, in the distinct walls 2.

[0036] As shown in figure 3, the walls 2 are spaced apart from each other along the thickness direction X-X by a gap 3. In other words, the gap 3 is delimited on opposite sides, along the thickness direction X-X, by the two walls 2.

[0037] It should be specified that in the embodiment shown in figures 3 and 4 the gap 3 is arranged between the pair of homologous support structures 12 arranged on two distinct levels in the thickness direction X-X. In other words, the gap 3 is at least partially enclosed between two homologous support structures 12 arranged on two distinct levels. Therefore, with reference to figure 3, by crossing the prefabricated element 1 in the thickness direction X-X, a support structure 12, the cavity 3 and a support structure 12 homologous to that arranged on the other side of the cavity 3 meet in succession.

[0038] The prefabricated element 1 comprises a plurality of connecting members 4 configured to connect and fix the walls 2 together along the thickness direction X-X. The connecting members 4 form a part of the frame 11 which connects the two walls 2.

[0039] In detail, each connecting member 4 extends through the gap 3 between the two walls 2 along the thickness direction X-X. At least part of the connecting members 4 are arranged along the outer perimeter C_{ext} , and preferably, in the case in which the wall 2 has an opening 6, at least another part thereof is arranged along the peripheral opening portion C_{int} of the opening 6. The connecting members 4 arranged along the outer perimeter C_{ext} are referred to as angular connecting members 4a, while the connecting members 4 arranged along the peripheral opening portion C_{int} are referred to as opening connecting members 4b.

[0040] With reference to figures 3 and 4, each connecting member 4 has a first portion 41 connected to a support structure 12, and a second portion 42 connected to another support structure 12, distinct and homologous to the one to which the first portion 41 is connected. More in detail, the first portion 41 and the second portion 42 are respectively connected to two main peripheral or opening beams 120a, 120b belonging to different homologous support structures 12.

[0041] Preferably, the main peripheral and/or opening beams 120a, 120b each comprise a connecting wall 121 and a support wall 122, oriented transversely to the respective connecting wall 121. For example, the main peripheral and/or opening beams 120a, 120b have an L-profile obtained by hot-rolling steel bars.

[0042] As shown in figure 3, the connecting walls 121

of homologous support structures 12 partially delimit the gap 3 along the thickness direction X-X. Even more preferably, the connecting members 4 are connected to the connecting walls 121 of the main peripheral or opening beams 120a, 120b belonging to distinct support structures 12.

[0043] In the embodiment shown in figures 3 and 4, the connecting members 4 comprise a plurality of bolts configured to be inserted into special holes obtained in the connecting walls 121 of main beams 120 belonging to distinct homologous support structures 12. When inserted into the respective holes of the connecting walls 121 and suitably tightened, the bolts are configured to fix along the thickness direction X-X the distinct homologous support structures 12 and therefore the two walls 2 associated therewith.

[0044] Preferably, the connecting members 4 comprise plates 40, 80, connected to the bolts. The plates 40, 80 are arranged in the cavity 3 between the pair of homologous support structures 12. Even more preferably, first plates 40 are arranged at the angular regions 20 of the walls 2, and second plates 80 are arranged at the opening angular regions 60. The plates 40, 80 are interposed between the pair of homologous support structures 12 so as to result in direct or indirect contact with each of these on opposite sides. It should be noted that the plates 40, 80 distance the homologous support structures 12 along the thickness direction X-X, allowing to make the gap 3 between the two walls 2.

[0045] The plates 40, 80 are preferably oriented perpendicularly to the thickness direction X-X. In detail, each plate 40, 80 has at least one through hole adapted to accommodate a respective bolt, and can be aligned with the holes of the connecting walls 121 belonging to main beams 120 of distinct homologous support structures 12. In detail, when inserted in the respective holes of the connecting walls 121 and in the respective hole of a plate 40, 80, each bolt is configured to tighten the plate to which it is connected between the homologous support structures 12 along the thickness direction X-X. Preferably, each plate 40, 80 comprises a pair of holes, each crossed by a respective bolt.

[0046] With even more detail, each plate comprises annular protrusions 45 extending along the thickness direction X-X and abutting respective through holes. Preferably, such annular protrusions 45 are present on both sides of the plate, and each one is in direct or indirect contact with a respective homologous support structure 12. Such annular protrusions are configured to further distance the homologous support structures 12, to increase the extension of the cavity 3 in the longitudinal direction X-X.

[0047] Preferably, as shown in figure 3 and 4, the connecting members 4 comprise thermally insulating elements 43, i.e., elements adapted to prevent or limit the transmission of heat between the homologous support structures 12. At least part of the thermally insulating elements 43 is arranged in the cavity 3 between the ho-

homologous support structures 12 to prevent the direct contact thereof, and therefore the transmission of heat from one support structure 12 to the other one homologous thereto.

[0048] Even more preferably, at least part of the thermally insulating elements 43 is interposed between the plates 40, 80 and the homologous support structures 12. It is thereby possible to limit the transmission of heat between the support structures 12 passing through the plates 40, 80. In the embodiment shown in figure 4, the thermally insulating elements 43 comprise washers, made of material with low thermal conductivity, arranged on both sides of at least one plate 40, 80, each at a respective annular protuberance. In other words, at least some of the thermally insulating elements 43 are compressed between a plate 40, 80 and the support wall 122 of a main beam 120. It should be specified that in the context of the present invention, thermal conductivity is to be understood as low when below 0.2 W/mK.

[0049] In an alternative embodiment, not shown, part of the thermally insulating elements 43 are represented by the plates 40, 80 themselves.

[0050] To further hinder the flow of heat from one support structure 12 to the other through the connecting members 4, the latter comprise further thermally insulating elements 44 arranged outside the cavity 3, between a respective connecting member 4 and a respective support wall 122 of a main beam 120. In greater detail, such further thermally insulating elements 44 can be interposed between a head portion of the bolt and/or a nut portion of the bolt, and the relative support wall 122 of the main beam 12.

[0051] The prefabricated element 1 further comprises a plurality of tensioning cables 5 configured to make the frame 11 work as a tensile structure, thereby increasing the off-plane stiffness of the prefabricated element 1. Therefore, the cables 5 are a part of the frame 11 and are configured to tension it to stiffen the prefabricated element 1. It should be noted that the rigidity of the prefabricated element 1 increases with the increase in the pre-tensioning value of the cables 5. In other words, the stiffness of the prefabricated element 1 and the pre-tensioning value of the cables 5 are proportional. In use, each cable 5 is tensioned until reaching the design tension, determined, for example, based on the impositions on the maximum displacements of the prefabricated element outside the plane. Furthermore, the support structures 12 provide the necessary contrast to the tension induced by the cables 5.

[0052] Each cable 5 is arranged in the cavity 3 and has two ends 50 respectively secured to two distinct connecting members 4. Preferably, as shown in figure 3, at least some cables 5 are secured, for at least one of the ends 50 thereof, to respective angular connecting members 4a, by means of respective first plates 40. Furthermore, preferably, at least some tensioning cables 5 are secured, for at least one of the ends 50 thereof, to respective opening connecting members 4b, by means of respective

second plates 80.

[0053] In the embodiment of figure 2 and 3, the two ends 50 of each tensioning cable are respectively connected to a respective angular connecting member 4a, and to a respective opening connecting member 4b. It should be specified that in the embodiment of figures 2 and 3, each tensioning cable 5 is indirectly connected, from opposite sides, respectively to the peripheral support structures 12a and to the opening support structures 12b, by means of a respective angular connecting member 4a and a respective opening connecting member 4b. The cables 5, when pre-tensioned, induce a state of compressive stress in the main peripheral beams 120a of the support structures 12a, and a state of tensile stress in the main opening beams 120b, generating the so-called "self-tensioning" state.

[0054] Furthermore, it should be specified that, as can be seen from figures 2 and 3, each cable is lying in a centre plane of the prefabricated element 1. Furthermore, each cable 5 is connected to the respective beam at the centre of gravity of the cross section of the beam. The positioning of the tensioning cables 5 indicated above ensures that the stress state induced by the pre-tensioning of the cables 5 is distributed equally on each homologous support structure 12, without inducing imbalances in the prefabricated element 1, and that each beam is mainly axially loaded.

[0055] Preferably, at least one support structure 12 comprises a plurality of stiffening elements 10 adapted to increase the rigidity of the prefabricated element 1 outside the plane. As shown in figure 5, each stiffening element 10 is connected on opposite sides to respective main beams 120 of the same support structure. In detail, each stiffening element 10 extends between the upper edge S and the lower edge I of the prefabricated element 1 along the first direction V-V, i.e., perpendicular to the main extension direction O'-O' of the main beams 120 to which it is connected. In further detail, at least part of the stiffening elements 10 is connected to the support walls 122 of the opposite main beams of the same support structure 12.

[0056] Even more preferably, two homologous support structures 12 each comprise respective stiffening elements 10. It should be specified that, as shown in figure 5, the stiffening means 10 of the homologous support structures 12 are arranged on opposite parts of the gap 3, and therefore on opposite parts of the plurality of tensioning cables 5. Therefore, the tensioning cables 5 are at least partially arranged between the stiffening elements 10 of distinct homologous support structures 12.

[0057] With reference to figure 5, the stiffening elements 10 of each support structure 12 comprise a plurality of secondary beams, i.e. uprights 10a arranged in succession, spaced apart from each other, along a main extension direction O'-O' of the main beams 120 to which they are connected. Therefore, the uprights 10a of the same support structure 12 face each other along the second direction O-O, and face respective uprights 10a of

the support structure 12 homologous thereto along the thickness direction X-X.

[0058] At least one cable 5 is provided with a plurality of load transfer elements 13 adapted to transfer a load oriented transversely to the two walls 2, for example caused by the wind, from the stiffening elements 10 to the respective cable(s) 5. In detail, each load transfer element 13 is arranged between a respective stiffening element 10 and at least one cable 5, and connected thereto. Still more in detail, each load transfer element 13 comprises a first ring portion 13a insertable on the respective cable 5, and a protrusion 13b insertable in a specific seat (not shown in the figures) of the stiffening element 10.

[0059] As shown in figure 4, preferably, each cable 5 is provided with a plurality of load transfer elements 13, arranged in succession along the extension of the cable, so that each is at a respective stiffening element 10 to which it is connected by means of the protrusion 13b.

[0060] Preferably, with reference to figure 4, at least one cable includes tensioning members 14 configured to approach or distance the ends 50 of the respective cable to tension it.

[0061] For example, in the embodiment of figure 4, the tensioning members 14 define an end 50 of at least one cable 5 and comprise a first body 14a, connected to a plate 40, 80, and a second body 14b connected to the cable 5. The first and second bodies 14a, 14b are mutually constrained preferably, but not necessarily, by means of a threaded connection, therefore, when they rotate they approach or distance with respect to each other, varying the tension value of the cable 5 and the distance between the ends 50.

[0062] In alternative embodiments, the cable 5 can comprise at least two cable segments connected on opposite parts by the tensioning member 14. The latter varying the length thereof allows to approach or distance the two cable segments, and therefore to adjust the tension of the respective cable 5.

[0063] Preferably, as shown in figure 5, the prefabricated element comprises a plurality of first insulating panels 9a configured to act as a thermal shield between the two walls 2. In other words, the first insulating panels 9a limit the transfer of heat from one wall 2 to the other. Such first insulating panels 9a can be made, for example, of mineral fibres (rock wool, glass fibre), natural fibres (wood wool, cork) or insulation sheets based on (polyurethane).

[0064] In detail, the first insulating panels 9a lie in the gap 3 between the two walls 2, and at least some first panels 9a are arranged on opposite sides of at least one cable 5. Even more preferably, the first insulating panels 9a extend into the gap 3 along the first direction V-V and the second direction O-O, filling the portions of the cavity obtained between the plurality of cables 5. In other words, at least some of the first insulating panels 9a have a first edge 90a arranged at a respective cable 5.

[0065] In the embodiment of figure 5, each cable 5 is

enclosed in the gap along the first and second directions V-V, O-O by first edges 90a of separate insulating panels 9a.

[0066] Furthermore, preferably each wall 2 comprises second insulating panels 9b configured to limit the transfer of heat through the wall 2 itself. Such second insulating panels 9b can be made, for example, of mineral fibres (rock wool, glass fibre), natural fibres (wood wool, cork), or traditional insulation plates (polyurethane).

[0067] As shown in figure 5, the second insulating panels 9b of each wall 2 are arranged on opposite sides of the plurality of cables 5 along the thickness direction X-X. Therefore, the second insulating panels 9b enclose, at least partially, the first insulating panels 9a along the thickness direction X-X.

[0068] In the embodiment of figure 5, at least some second insulating panels 9b are arranged between two respective stiffening elements 10 along the second direction O-O. In detail, at least some of the second insulating panels 9b have a pair of second edges 90b arranged along two distinct uprights 10a of the stiffening elements 10.

[0069] Preferably, at least some second insulating panels 9b extend between the upper edge S and the lower edge I along the first direction V-V. Even more preferably, at least some of the second insulating panels 9b of each wall 2 abut against the support wall 122 of at least one main beam 120 of a support structure 12, to be supported. In other words, at least some second insulating panels 9b have respective third edges 91b placed in contact with the support wall 122 of at least one main beam 120 of a support structure 12.

[0070] Obviously, those skilled in the art will be able to make numerous equivalent changes to the above-mentioned variants, without thereby departing from the scope of protection defined by the united claims.

Claims

1. Frame (11) for a prefabricated element (1) for a building, comprising:

- a plurality of support structures (12), each support structure (12) consisting of a plurality of main beams (120) connected together,

wherein each support structure (12) is arranged on a respective level of at least two levels which are parallel and spaced apart from each other in a thickness direction (X-X), at least one pair of homologous support structures (12) including two support structures arranged on distinct levels and facing each other in the thickness direction (X-X), wherein the support structures (12) are configured to support a panel of the prefabricated element for each level,

- a plurality of connecting members (4), each connecting member (4) connecting two homologous support structures (12) together, and
 - a plurality of tensioning cables (5), each cable (5) being arranged between two distinct levels and having two ends (50), the two ends (50) of each cable (5) being secured to two distinct connecting members (4).
2. Frame (11) according to claim 1, wherein the plurality of support structures (12) comprise peripheral support structures (12a), composed of peripheral main beams (120a), arranged along an outer perimeter of the prefabricated element.
3. Frame (11) according to claim 2, wherein:
- the plurality of support structures (12) comprises opening support structures (12b), composed of main opening beams (120b), surrounding at least one opening (6) of the prefabricated element (1), and
 - at least one tensioning cable (5) has the two ends (50) secured, respectively, to an angular connecting member (4a), connecting two homologous peripheral support structures (12a), and to an opening connecting member (4b), connecting two homologous opening support structures (12b).
4. Frame (11) according to any one of the preceding claims, wherein:
- at least one support structure (12) comprises a plurality of stiffening elements (10);
 - each stiffening element (10) being connected on opposite sides to respective main beams (120) of the same support structure (12).
5. Frame (11) according to claim 4, wherein:
- at least two homologous support structures (12) each comprise respective stiffening elements (10);
 - at least one tension cable (5) is at least partially arranged between the stiffening elements (10) of several homologous support structures (12).
6. Frame (11) according to claim 5, wherein the stiffening elements (10) of a support structure (12) comprise a plurality of uprights (10a) arranged in succession, spaced apart from each other along a main extension direction of the respective main beams (120) to which each upright is connected on opposite sides.
7. Frame (11) according to any one of claims 4 to 6,
- wherein at least one cable (5) is provided with load transfer elements (13), each of which is connected to a respective stiffening element (10) and to the at least one cable (5).
8. Frame (11) according to claim 7, wherein each load transfer element (13) comprises a first ring portion (13a) insertable on the respective tension cable (5), and a protrusion (13b) connectable to a stiffening element (10).
9. Frame (11) according to any one of the preceding claims, wherein at least one cable (5) provides tensioning members (14) configured to approach or distance the ends (50) of the respective cable (5) to tension it.
10. Frame (11) according to any one of the preceding claims, wherein the connecting members (4) comprise thermally insulating elements (41), at least part of the thermally insulating elements (41) being arranged between the two homologous support structures (12) to prevent the direct contact thereof.

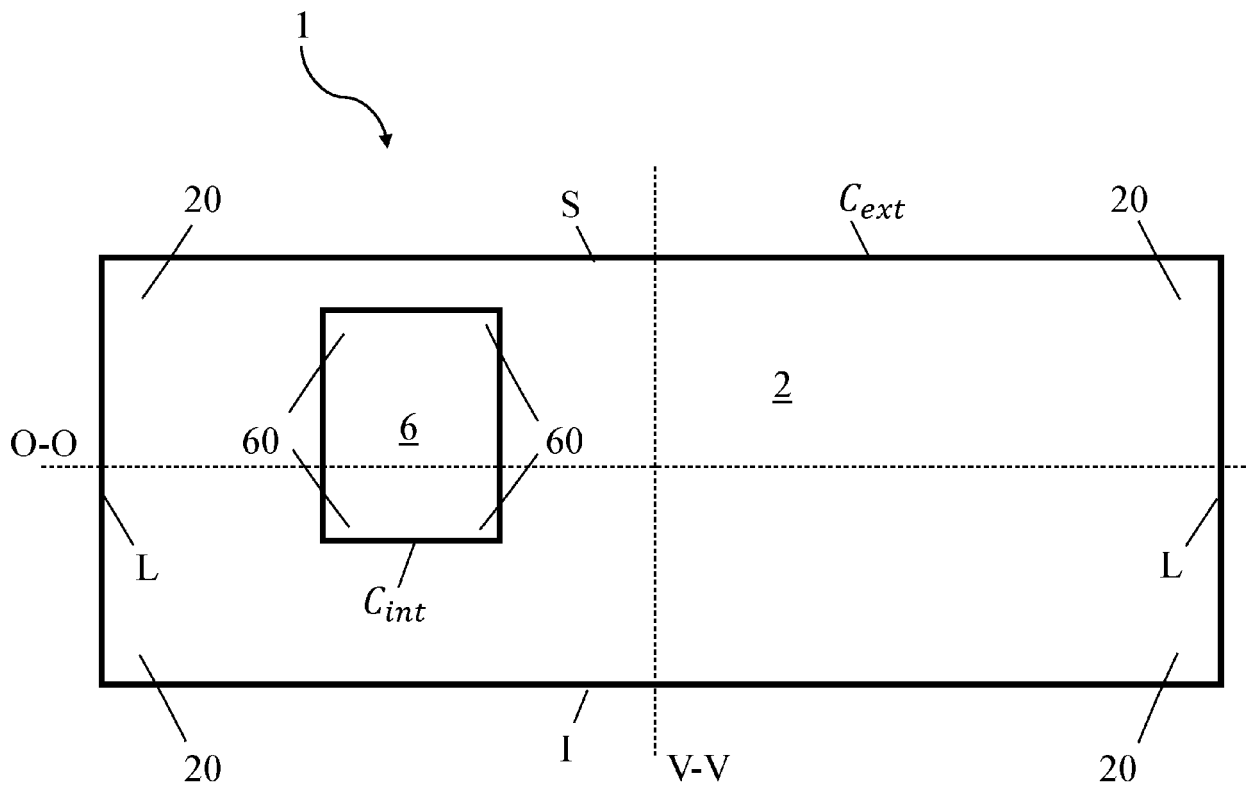


Fig. 1

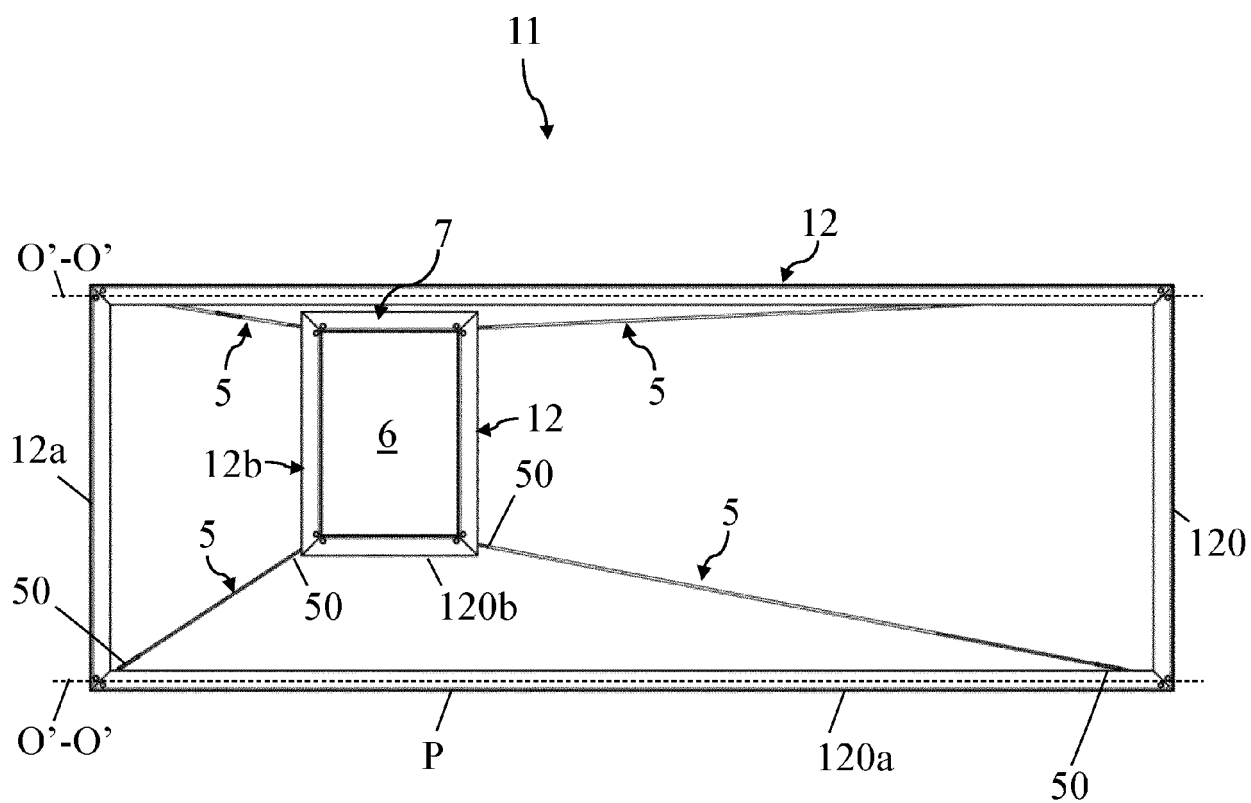


Fig. 2

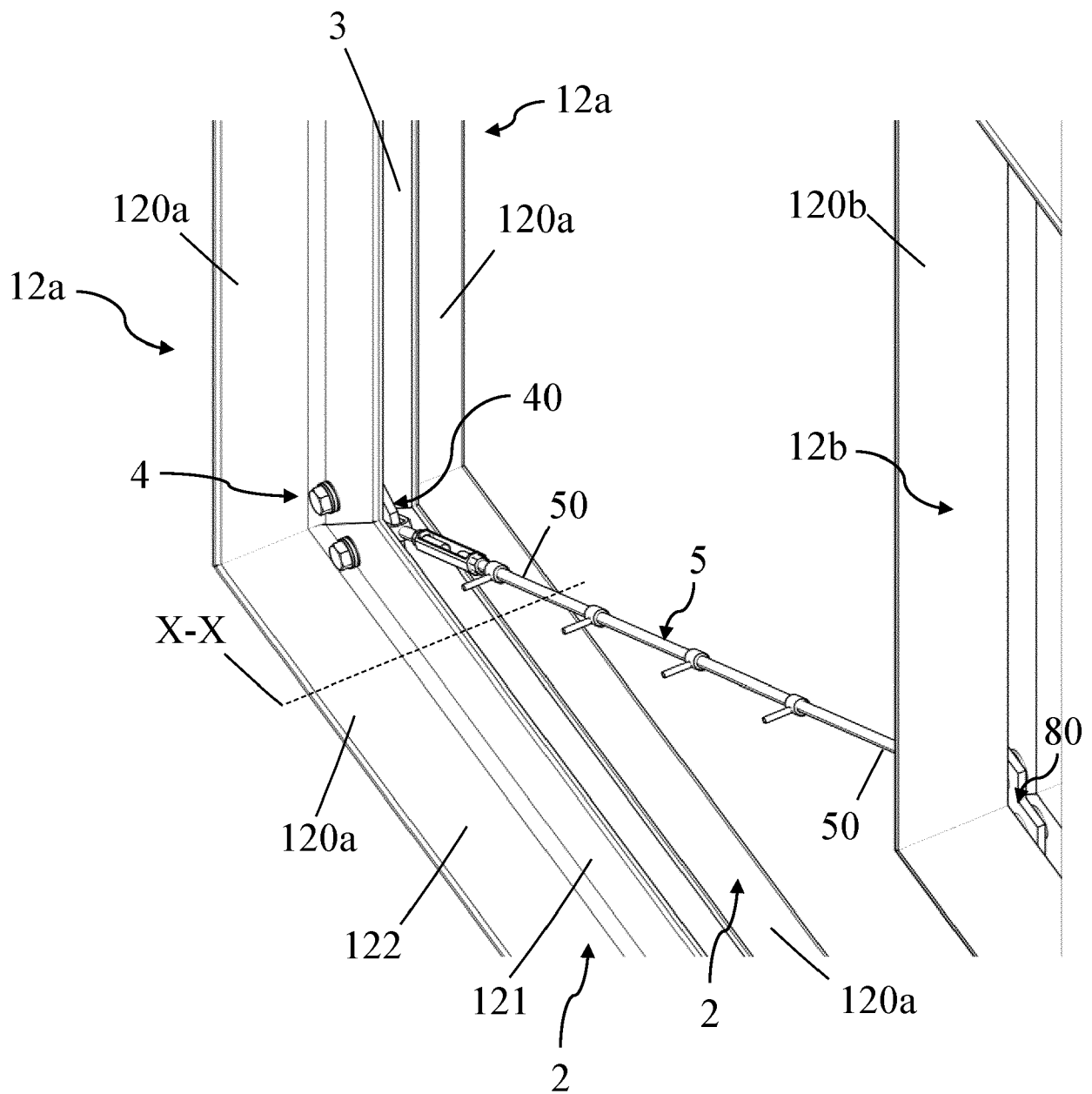


Fig. 3

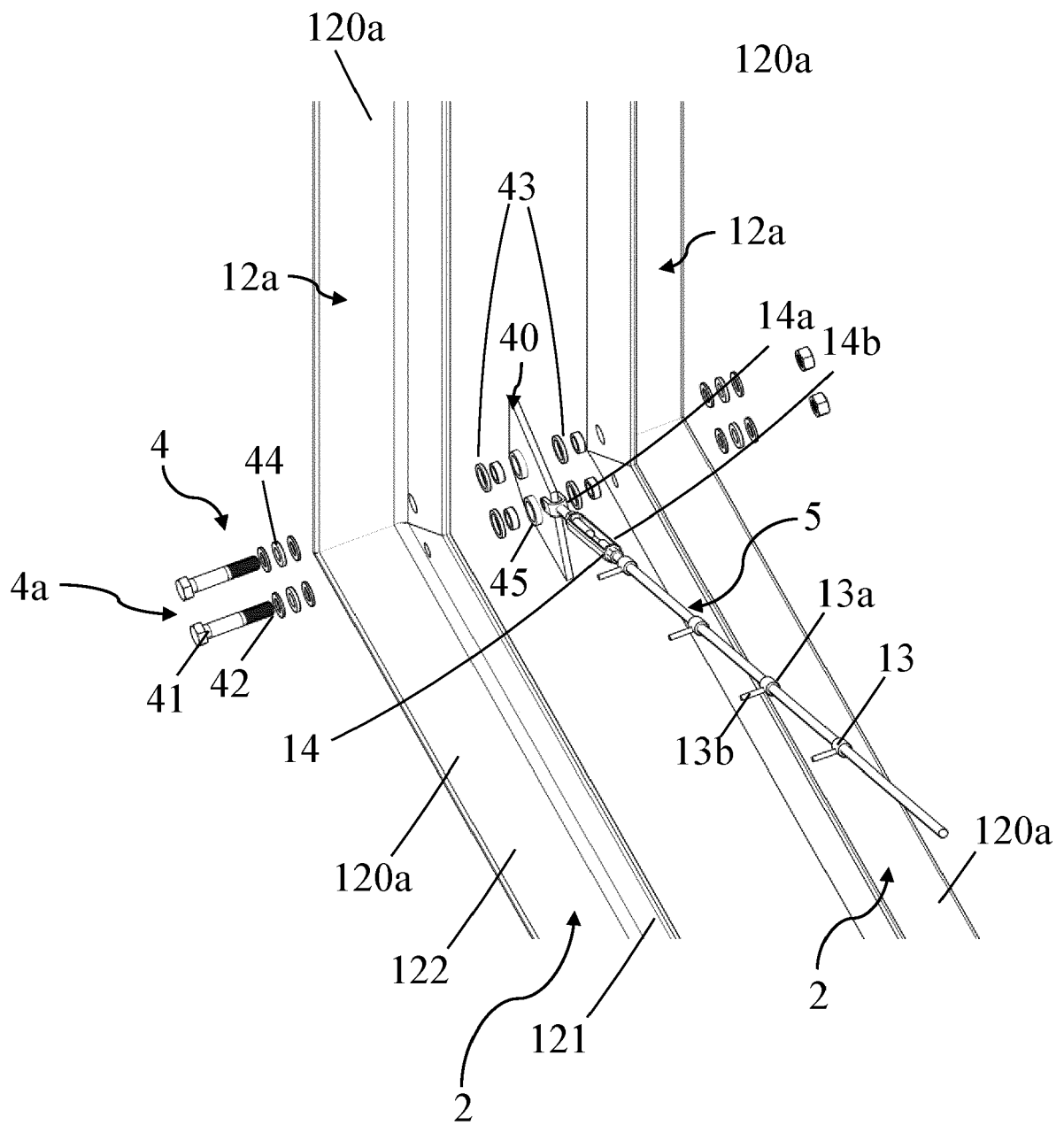


Fig. 4

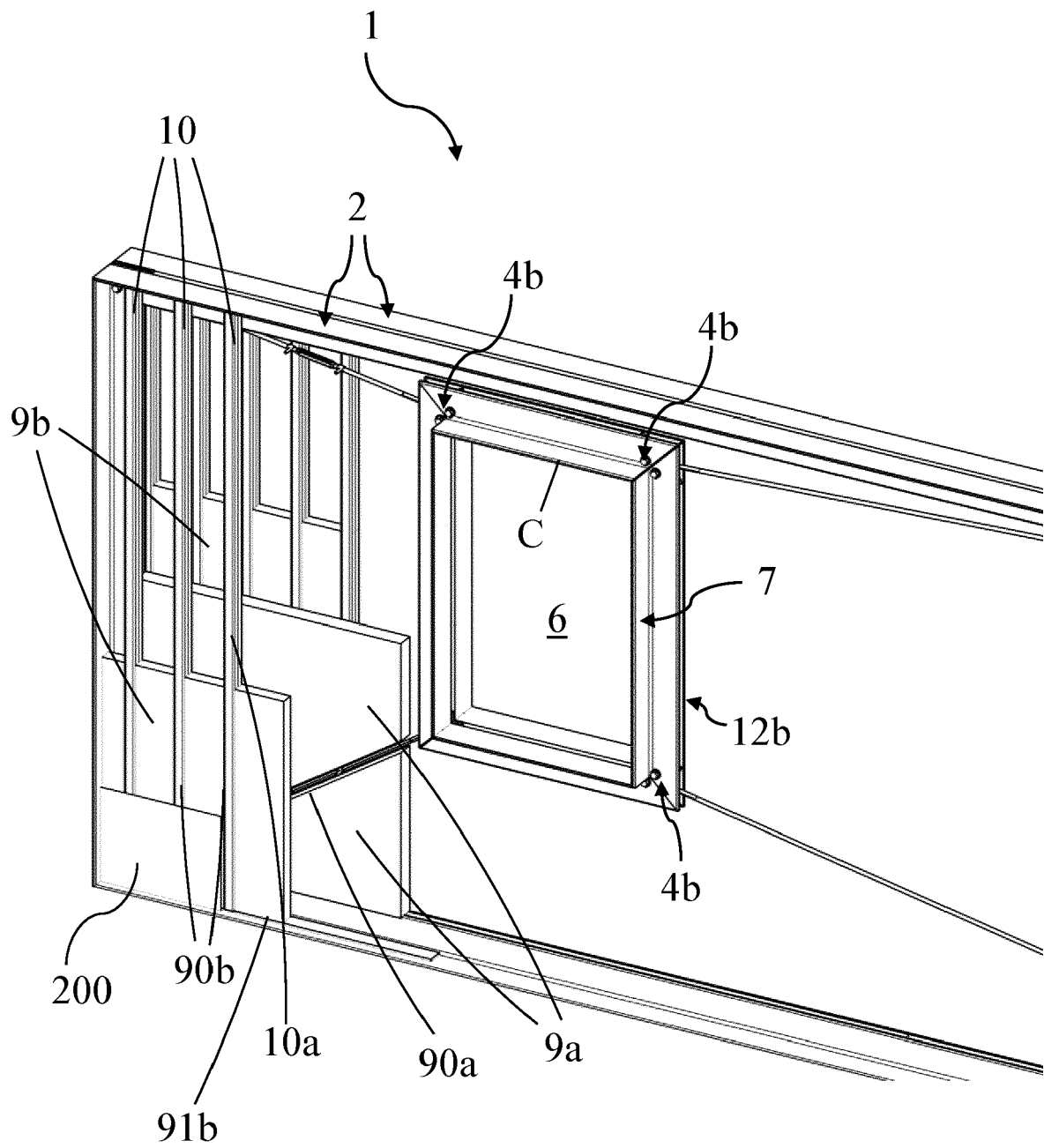


Fig. 5



EUROPEAN SEARCH REPORT

Application Number

EP 21 19 6230

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EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 6 941 718 B1 (DIGIROLAMO EDWARD R [US] ET AL) 13 September 2005 (2005-09-13) * column 2, line 50 - column 6, line 4 * * figures *	1-10	INV. E04C2/34 E04C1/00
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			TECHNICAL FIELDS SEARCHED (IPC)
			E04C
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 3 February 2022	Examiner Durrenberger, Xavier
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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03-02-2022

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