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(71) Applicant: **SADEF N.V.**
8830 Hooglede-Gits (BE)

(72) Inventor: **Depauw, Marc**
8610 Kortemark (BE)

(74) Representative: **Bird, William Edward et al**
Bird Goën & Co.
Klein Dalenstraat 42A
3020 Winksele (BE)

(54) Construction beams for use in portal frame constructions

(57) A construction beam for use in frame constructions is defined by a first elongated member and a second elongated member, each of the elongated members having a longitudinal span in a longitudinal direction, a base wall having
o a first side and a second side,
o a width along said longitudinal direction, the width being measured perpendicular to the longitudinal direction of said elongated member,
o and a first outer end and a second outer end in longitudinal direction,

Each of the elongated members has a first and a second flange bounding the base wall in longitudinal direction and protruding on one of the first or second side of the base wall.

The longitudinal span H1 of the first elongated member is equal or larger than the longitudinal span H2 of the second elongated member. The members are positioned back-to-back with their base walls fixed with each other along a contacting zone, extending from the first outer end of the second elongated member to the second outer end of the second elongated member and comprising at least part of the first and second outer end of the second elongated member, For at least one position A along the longitudinal direction of the second elongated member, the contact width Wab of the contact zone is less than the minimum of the width Wa1 of the first elongated member at the position A and the width Wa2 of the second elongated member at the position A.

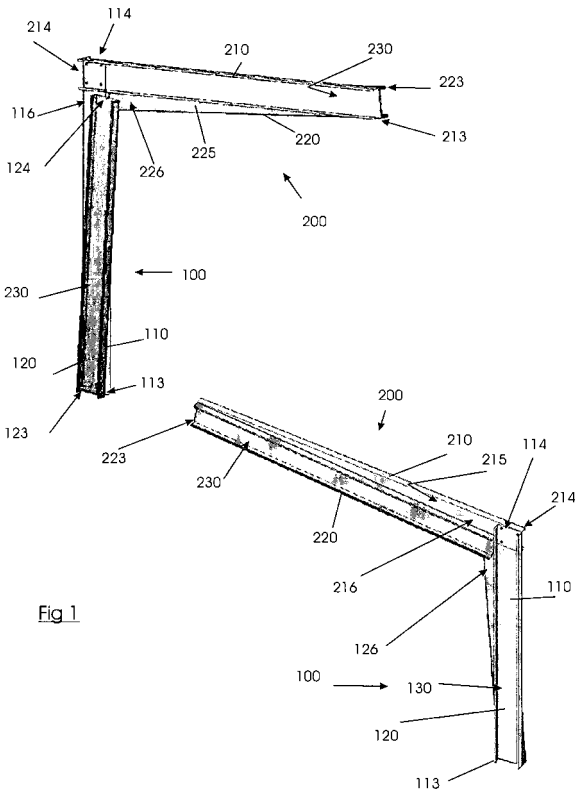


Fig 1

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Description

Technical field of the invention

[0001] The present invention relates to construction beams, more particular to construction beams for providing portal frames, such as stanchions, rafters and alike.

Background of the invention

[0002] The use of metal construction beams to provided portal frames for buildings, e.g. industrial mills, houses, halls, and many more, are well known. Very often construction beams with I-profiles are used to provide the stanchions or rafters of such portal frames.

[0003] As an example, in W09/54566 a portal frame is disclosed which comprises stanchions and rafters being provided by two channel shaped elongated members, which members are positioned back-to-back with their base walls in contact with each other. The two members thereby form an I-beam. The rafters and stanchions are connected to each other using haunch members.

[0004] The provision of such haunch members, and its use to couple the stanchions and rafters, has as a disadvantage that a large number of elements are to be connected to each other, which requires a significant amount of construction time.

[0005] As along the span of the stanchion, different angular moments are to be resisted around axes being perpendicular to the plane defined by the stanchion and the rafter coupled to this stanchion, the stanchion is to be dimensioned to resist the largest angular moment all along its length. This has as a consequence that the stanchions are usually over-dimensioned at the places which will not be subjected to the largest applicable angular moment. Hence, usually too much material is used to provide the portal frame construction.

Summary of the invention

[0006] It is a first object of the present invention to provide alternative construction beam for use in frame constructions such as portal frame constructions. According to some embodiments of the present invention, a construction beam as subject of the present invention may be provided with an increased moment of inertia, i.e. which is larger than comparable I-beam constructions having the same weight per length unit. According to some embodiments of the present invention, a construction beam has a varying moment of inertia along its longitudinal direction. According to some embodiments of the present invention, two construction beams as subject of the present invention can be coupled to each other at one end of the beam more easily as presently known, and substantially without the use of additional beams to provide the coupling. According to some embodiments of the present invention, a construction beam may be prestressed and/or provided and/or may be provided with a curvature in longitudinal direction while been provided with increased moment of inertia. According to some embodiments of the present invention, a construction beam may be provided having a low weight but still have a sufficient bending resistance. According to some embodiments of the present invention, a construction beam may be provided out of two coupled elongated members, such as C-profiles, C+-profiles, Σ-profiles or Σ+ profiles, Z-profiles or Z+ profiles, which has a bending resistance of about 2 times the bending resistance of a construction beam comprising identical elongated profiles being coupled back-to-back, having the profiles aligned in longitudinal direction and having entirely overlapping base walls. It is further an advantage of some embodiments of the present invention that construction beams with a base wall height of up to 800mm can be provided, using cold rolled profiles, having a base wall width of only up to 450mm

[0007] It is a second object of the present invention to provide a portal frame, which can be constructed without the use of a significant number of coupling parts or elements. According to some embodiments of the present invention, a portal frame comprising stanchions, rafters or both stanchions and rafters being construction beams according to the first object of the present invention. According to some embodiments of the present invention, the rafters of the portal frame may be prestressed and/or may be provided with a curvature in longitudinal direction while been provided with increased moment of inertia.

[0008] According to some embodiments of the present invention, a portal frame construction may be provided using less heavy, leaner construction beams without a loss in rigidity of the portal frame construction.

[0009] Some or all above-mentioned objective are accomplished by a construction beam for use in frame constructions such as portal frame constructions according to the present invention.

[0010] According to a first aspect of the present invention, a construction beam for use in frame constructions is defined by a first elongated member and a second elongated member, each of the elongated members having

- a longitudinal span in a longitudinal direction,
- a base wall having
    - o a first side and a second side,
    - o a width along said longitudinal direction, the width being measured perpendicular to the longitudinal direction of said elongated member,
    - o and a first outer end and a second outer end in longitudinal direction,
- a first and a second flange bounding the base wall in longitudinal direction and protruding on one of the first or second side of the base wall.

[0011] The longitudinal span H1 of the first elongated

member is equal or larger than the longitudinal span H2 of the second elongated member. The members are positioned back-to-back with their base walls fixed with each other along a contacting zone, the contacting zone extending from the first outer end of the second elongated member to the second outer end of the second elongated member. The contacting zone comprises at least part of the first outer end of the second elongated member, and at least part of the second outer end of the second elongated member. For at least one position A along the longitudinal direction of the second elongated member, the contact width Wab of the contact zone is less than the minimum of the width Wa1 of the first elongated member at the position A and the width Wa2 of the second elongated member at the position A. The contact width Wab is measured perpendicular to the longitudinal direction of the second elongated member.

[0012] According to some embodiments of the present invention, for each position X along the longitudinal direction of the second elongated member, the contact width Wab of the contact zone may be less than the minimum of the width Wa1 of the first elongated member at the position X and the width Wa2 of the second elongated member at the position X. The contact width Wab is measured perpendicular to the longitudinal direction of the second elongated member.

[0013] According to some embodiments of the present invention, the first outer end of the first elongated member may be substantially aligned with the first outer end of the second elongated member.

[0014] According to some embodiments of the present invention, the width Wa1 may be constant along the contact zone. According to some embodiments of the present invention, the width Wa2 may be constant along the contact zone. Optionally, both the width Wa1 and the width Wa2 may be constant along the contact zone. According to some embodiments of the present invention, the minimum of Wab along the contract zone may be equal to or less than one third of the minimum of Wa1 and Wa2.

[0015] According to some embodiments of the present invention, the base wall of the first elongated member may contact the base wall of the second elongated member along the first outer end of the second elongated members over a contact length W1 which may be smaller than or equal to the minimum of Wa1 and Wa2. According to some embodiments of the present invention, the base wall of the first elongated member may contact the base wall of the second elongated member along the second outer end of the second elongated members over a contact length W2 which may be smaller than or equal to the minimum of Wa1 and Wa2. Optionally, W1 may be equal to the minimum of Wa1 and Wa2. W1 may be larger than W2, or W1 may be equal to W2.

[0016] According to some embodiments of the present invention, Wab may change continuously from the first outer end to the second outer end of the second elongated member. Wab may decrease continuously from the first outer end to the second outer end of the second elongated member

[0017] According to some embodiments of the present invention, the longitudinal direction of the first elongated member and the longitudinal direction of the second elongated member may make an angle α being larger than 0.

[0018] According to some embodiments of the present invention, for at least one of the first elongated member and the second elongated member, the flanges may protrude to the same side of the base wall, thereby providing a channel shape to the at least one of the first elongated member and the second elongated member. Optionally for the first elongated member, the flanges may protrude to the same side of the base wall, thereby providing a channel shape to the first elongated member, and for the second elongated member, the flanges may protrude to the same side of the base wall, thereby providing a channel shape to the second elongated member. According to some embodiments of the present invention, at least one of the first elongated member or the second elongated member having a C-shaped, C+-shaped or sigma-shaped cross section.

[0019] According to some embodiments of the present invention, for at least one of the first elongated member and the second elongated member, the first flange may protrude to the first side of the base wall, the second flange protruding to the second side of base wall, thereby providing a Z-shaped cross section to the at least one of the first elongated member and the second elongated member. According to some embodiments of the present invention, for the first elongated member, the first flange may protrude to the first side of the base wall and the second flange protruding to the second side of base wall, thereby providing a Z-shaped cross section to the first elongated member, and for the second elongated member, the first flange may protrude to the first side of the base wall and the second flange protruding to the second side of base wall, thereby providing a Z-shaped cross section to the second elongated member.

[0020] According to some embodiments of the present invention, the first elongated member and the second elongated member may have identical cross sections.

[0021] According to some embodiments of the present invention, the first and second flanges being substantially perpendicular to the base wall, the first flange may have a protruding height being different from the protruding height of the second flange.

[0022] According to some embodiments of the present invention, at least one of the first elongated member or the second elongated member may be provided with additional profiled reinforcing members fixed to the base wall.

[0023] According to some embodiments of the present invention, the maximum of Wa1 and Wa2 may be in the range of 200mm to 450mm, for example.

[0024] According to some embodiments of the present invention, the elongated members are galvanised steel members. According to some embodiments of the

present invention, the elongated members are cold rolled members.

[0025] According to some embodiments of the present invention, the first elongated member and the second elongated member may be fixed to each other by welding, by bolts and nuts or by short firing using short firing pins.

[0026] According to a second aspect of the present invention, a frame, such as a portal frame is provided. According to some embodiments of the present invention, a frame comprises at least a first elongate beam, being a construction beam according to the first aspect of the present invention. Optionally, the frame further may comprise at least a second elongate beam, which second elongate beam may be a construction beam according to the first aspect of the present invention.

[0027] According to some embodiments of the present invention, a frame may comprise at least a first elongate beam, the first elongate beam being a construction beam according to the first aspect of the present invention, and at least a second elongate beam joined to the first elongate beam, the second elongate beam being a construction beam according to the first aspect of the present invention.

[0028] According to some embodiments of the present invention, the first elongate beam may comprise a first elongated member having a first free base wall section and a second elongated member having a second free base wall section. The second elongate beams may comprise a first elongated member having a first free base wall section and a second elongated member having a second free base wall section. The first free base wall sections of the second elongate beam the first elongate beam may be fixed to each other along first coupling section. The second free base wall sections of the second elongate beam and the first elongate beam may be fixed to each other along second coupling. According to some embodiments of the present invention, the frame may be a portal frame, the first elongate beam being a stanchion, the second elongate beam being a rafter.

[0029] Optionally, the frame further may comprise a third and a fourth elongate beam being construction beams according to the first aspect of the present invention. The elongate beam comprises a first elongated member having a first free base wall section and a second elongated member having a second free base wall section. The fourth elongate beam comprises a first elongated member having a first free base wall section and a second elongated member having a second free base wall section. The first free base wall sections of the third elongate beam and the fourth elongate beam may be fixed to each other along a third coupling section. The second free base wall sections of the third elongate beam and the fourth elongate beam may be fixed to each other along fourth coupling. The outer end of the second elongate beam remote from the first coupling section and the outer end of the third elongate beam remote from the third coupling section may be coupled to each other, e.g. by fixing the base walls to each other.

[0030] According to some embodiments of the present invention, the frame may be a portal frame and the first and fourth elongate beams being stanchions, the second and third elongate beam being rafters.

[0031] According to some embodiments of the present invention, the frame may further comprise additional reinforcing elements at the first coupling section and/or at the second coupling section and optionally at the third and/or fourth coupling section.

[0032] According to some embodiments of the present invention, the frame further may comprise at least a third elongate beam. The third elongate beam comprises a first elongated member having a longitudinal span in a longitudinal direction, a cross section being channel shaped in said longitudinal direction, a base wall having a width along said longitudinal direction, which width is measured perpendicular to said longitudinal direction of said third elongated member. The third elongated member may have a first and a second outer end, at least one of the first and second outer end of the first elongate member of the third elongate beam being coupled to the second outer end of the first elongated member of said first elongate beam. Optionally the other of the first and second outer end of the first elongate member of the third elongate beam may be coupled to the second outer end of the first elongated member of the second elongate beam. According to some embodiments of the present invention, the third elongate beam may be a construction beam according to the first aspect of the present invention.

[0033] According to some embodiments of the present invention, the frame may be a portal frame and the first and second elongate beams being stanchions, the third elongate beam being a rafter.

[0034] Particular and preferred aspects of the invention are set out in the accompanying independent and dependent claims. Features from the dependent claims may be combined with features of the independent claims and with features of other dependent claims as appropriate and not merely as explicitly set out in the claims.

[0035] Although there has been constant improvement, change and evolution of devices in this field, the present concepts are believed to represent substantial new and novel improvements, including departures from prior practices, resulting in the provision of more efficient, stable and reliable devices of this nature.

[0036] The teachings of the present invention permit the design of improved and simplified methods to construct portal frames and portal frames comprising less and less complex coupling elements to couple stanchions to rafters.

[0037] The above and other characteristics, features and advantages of the present invention will become apparent from the following detailed description, taken in conjunction with the accompanying drawings, which illustrate, by way of example, the principles of the invention. This description is given for the sake of example only, without limiting the scope of the invention. The ref-

erence figures quoted below refer to the attached drawings.

Brief description of the drawings

[0038]

Fig. 1 is perspective view of two construction beams as subject of the present invention, which are coupled to each other providing a stanchion-rafter part of a portal frame as subject of the present invention.
Fig. 2 is a schematically view of a construction beam of Fig. 1.
Fig. 3 , Fig. 4 ,Fig. 5, Fig. 6a and Fig. 6b are alternative schematically views of construction beams as subject of the present invention.
Fig. 7 shows schematically cross sections of elongated members used to provide a construction beam as subject of the present invention.
Fig. 8 is a cross section of an alternative construction beam as subject of the present invention.
Fig. 9, Fig. 10 and Fig. 11 are schematically views of portal frames as subject of the present invention.
Fig. 13 is a detailed view of a zone where two construction beams as subject of the present invention are coupled to form a part of a portal frame. Fig. 12 shows schematically how different elements of the construction zone of 13 are mounted.
Fig. 14 shows details of reinforcing elements.

[0039] In the different figures, the same reference signs refer to the same or analogous elements.

Description of illustrative embodiments

[0040] The present invention will be described with respect to particular embodiments and with reference to certain drawings but the invention is not limited thereto but only by the claims. The drawings described are only schematic and are non-limiting. In the drawings, the size of some of the elements may be exaggerated and not drawn on scale for illustrative purposes. The dimensions and the relative dimensions do not correspond to actual reductions to practice of the invention.

[0041] Furthermore, the terms first, second, third and the like in the description and in the claims, are used for distinguishing between similar elements and not necessarily for describing a sequential or chronological order. It is to be understood that the terms so used are interchangeable under appropriate circumstances and that the embodiments of the invention described herein are capable of operation in other sequences than described or illustrated herein.

[0042] Moreover, the terms top, bottom, over, under and the like in the description and the claims are used for descriptive purposes and not necessarily for describing relative positions. It is to be understood that the terms so used are interchangeable under appropriate circumstances and that the embodiments of the invention described herein are capable of operation in other orientations than described or illustrated herein.

[0043] It is to be noticed that the term "comprising", used in the claims, should not be interpreted as being restricted to the means listed thereafter; it does not exclude other elements or steps. It is thus to be interpreted as specifying the presence of the stated features, integers, steps or components as referred to, but does not preclude the presence or addition of one or more other features, integers, steps or components, or groups thereof. Thus, the scope of the expression "a device comprising means A and B" should not be limited to devices consisting only of components A and B. It means that with respect to the present invention, the only relevant components of the device are A and B.

[0044] Similarly, it is to be noticed that the term "coupled", also used in the claims, should not be interpreted as being restricted to direct connections only. Thus, the scope of the expression "a device A coupled to a device B" should not be limited to devices or systems wherein an output of device A is directly connected to an input of device B. It means that there exists a path between an output of A and an input of B which may be a path including other devices or means.

[0045] The following terms are provided solely to aid in the understanding of the invention. These definitions should not be construed to have a scope less than understood by a person of ordinary skill in the art.

[0046] The term 'cross section' is to be understood as the shape or profile of the beam, when cut in a direction substantially perpendicular to its longitudinal direction.

[0047] The term 'longitudinal direction' is to be understood as the direction extending between the two outer ends of a member.

[0048] The term "span" is to be understood as the length between the two outer ends of a construction beam measured at half the width of the base wall.

[0049] The term "contact zone" along which the base walls of the elongated members make contact is to be understood as the zone where the base wall of one of the members covers the base wall of the other. In this zone, the base walls will be fixed to each other.

[0050] The term "base walls being fixed to each other" is to be understood as two base walls, which abuts and are interlinked with each other in such a way, that they behave as one single part. The fixing may be a mechanical or chemical connection along the whole or a part of the contact zone, or the fixing may be established by riveting, bolting, gluing, welding, shot firing using shot fire pins, or any other local means to connect the two base walls with each other, so the members together behave as one integral element.

[0051] "The contact width Wab of the contact zone being less than the minimum of the width Wa1 of the first elongated member at said position A and the width Wa2 of the second elongated member at the position" is understood by the skilled person as the difference between

Wab and the minimum of (Wa1, Wa2) being more than the tolerances normally used in the technology of construction beam manufacturing.

[0052] The invention will now be described by a detailed description of several embodiments of the invention. It is clear that other embodiments of the invention can be configured according to the knowledge of persons skilled in the art without departing from the true spirit or technical teaching of the invention, the invention being limited only by the terms of the appended claims.

[0053] Fig. 1 shows schematically construction beams according to a first aspect of the present invention. Fig. 1 shows schematically two construction beams 100 and 200 which are coupled to each other, a first view from a first side, the second vies from the opposite side. This combination of construction beams 100 and 200 provide a part of a frame such as a part of a portal frame, where one elongate beam, being the construction beam 100, is used as stanchion, and the other elongate beam, being the construction beam 200, is used as rafter. The present invention is not limited to portal frames but can be used in any framed structure, particularly a load bearing structure.

[0054] Fig. 2 shows schematically a view of one of the construction beams construction beams.

[0055] The first construction beam 100 is defined by a first elongated member 110 and a second elongated member 120. Each of the elongated members have

- a longitudinal span H1 and H2 in a longitudinal direction of the elongated element, the longitudinal direction been referred to by reference 111 and 121 respectively.
- a part of a base wall 115, 125 having a width, Wa1 and Wa2, along the longitudinal direction, the width being measured perpendicular to the longitudinal direction of the elongated member. The flat central web is at least a part of the base wall. In particular in this embodiment, the width of the base walls of each of the elongated elements is constant. In this particular embodiment, the width of the base walls of both the elongated elements is identical, being, for example in the range of 200 to 450mm
- a cross-section that is channel shaped in its longitudinal direction and has a flat central web, and two flanges 117 and 118, and 128 and 128, bounding the respective base wall 115 and 125 in longitudinal direction and protruding on one of the first side 112 or 122, or second side 119 or 129 of the base wall. In the particular case of the embodiment shown both elongated members have a C+-profile, as shown in the cross section according to the plane AA' in Fig. 2..
- a first outer end, referred to by 113 and 123 respectively, and a second outer end referred to by 114 and 124 respectively along the longitudinal direction of the elongated member.

The longitudinal span H1 of the first elongated member is longer than the span H2 of the second elongated member. As an example H1 is about 5000 mm, whereas H2 is in the range of 4500 to 4900 mm. The members 110, 120 are positioned back-to-back with their base walls 115 and 125 fixed with each other along a contacting zone 130, which contacting zone extends from the first outer end 123 of the second elongated member 120 to the second outer end 124 of the second elongated member 120. The contacting zone comprises at least part of the first outer end 124 of the second elongated member 120, i.e. in this case the whole outer end 124. The contacting zone comprises at least part 131 of the second outer end 124 of the second elongated member 120. The first outer end 113 of the first elongated member 110 is provided substantially aligned with the first outer end 123 of the second elongated member 120.

[0056] As shown in Fig. 2, the longitudinal direction 111 of the first elongated member 110 is inclined versus the longitudinal direction 121 of the second elongated member 120 over an angle α. Along substantially the whole length of the longitudinal direction of the second elongated member 120, i.e. for each position X along the longitudinal direction 121 of the second elongated member 120, the contact width Wab of the contact zone is less than the minimum of the widths of the two elongated members.

[0057] If both widths of the elongated members are equal, Wab is less than this constant width. In this particular case, the maximum width Wab is measured at the first outer end of the second elongated member. In this particular position along the longitudinal direction of the second elongated member, the width Wab, hereafter named W1, is equal to the width Wa2 of the second elongated member 120.

[0058] The contact zone which has a width Wab changes continuously, more particular decreases continuously, from the first outer end 123 to the second outer end 124 of the second elongated member, i.e. decreasing from W1 to a width which may be almost zero at the second outer end 124. It has been found that the increase of the moment of inertia is significant when the minimum of the contact width Wab along thhe longitudinal direction of the second elongated member is less than about one third of the minimum of the widths of the elongated members. The contact width Wab may decrease to almost zero, but a remaining width to allow coupling of the two base walls by bolting, welding or shot firing using shot fire pins is preferred. A width of more than 30mm, e.g. not less than 60mm is preferred

[0059] This changing width Wab of the contact zone is in this embodiment due to the inclination of the longitudinal directions of both elongated members. It provides to each of the base walls of the elongated members a contact zone extending from the first outer end of the second elongated member to the second outer end of the second elongated member, as well as a free base wall section 116 and 126 along the base walls.

[0060] The moment of inertia of this construction

beam, according to an axis perpendicular to the base walls as subject of the present invention varies along the longitudinal direction of the first elongated member. In this particular case, using two elongated members having the same C shaped cross section with constant base wall width 450mm, two flanges of 120mm and a plate thickness of 5mm, at the first outer end 123 of the second elongated member 120, the moment of inertia is 2*Ix or 21000cm^4, where Ix is the moment of inertia of the elongated member according to this axis is perpendicular to the base wall. Because of the inclination of the longitudinal directions of both elongated members, and due to the fixing of the base walls at the contacting zone, the total width of the construction beam becomes larger than the maximum of the widths of the first elongated member and the second elongated member. This has as a result that the moment of inertia increases from 2*Ix at the first outer end of the first and second elongated member, to about 4.12*Ix or 43200 cm^4 at the second outer end of the second elongated member. A construction beam, having the same weight per meter of 62 kg/m, and comprising identical elongated profiles being coupled back-to-back, having the profiles parallel in longitudinal direction and having entirely overlapping base walls, have a moment of inertia of 2*Ix or 21000cm^4 at all positions in longitudinal direction.

[0061] A similar construction beams as subject of the present invention with inclined longitudinal directions, made from C+-shaped elongated members having a base wall width of 350mm, provide an increase of moment of inertia up to 3.76 Ix, there in this case Ix is the moment of inertia of one such C+-profile.

[0062] This is especially advantageous when the construction beam is used as a stanchion of a portal frame. It is known that acting bending moments are larger at the top of the stanchion, as compared to the bending moment in the lower part of the stanchion. By gradually varying, i.e. increasing the moment of inertia along the stanchion from the bottom to the top of the stanchion, the moment of inertia at a given height in longitudinal direction of the stanchion follows well the actual bending moment in the stanchion so the deformation and stresses in the stanchion can be reduced.

[0063] The construction beam as subject of the present invention has an additional advantage that rafters, optionally being also similar or identical construction beams as subject of the present invention, can easily be coupled to the stanchion by using the free base wall sections of the two elongated members along the second outer ends of the first and second elongated member.

[0064] As is shown in Fig. 1, two substantially similar construction beams are coupled to each other. The second construction beam has two elongated members 210 and 220, which each have a first outer end 213, respectively 223 and a second outer end 214, respectively 224. According to the first aspect of the present invention, the webs or base walls 215, respectively 225 of the channel shaped elongated members 210 and 220 are fixed to each other along a contact zone 230. The free base wall section 116 of the first elongated member 110 of the first construction beam 100 is fixed to the free base wall section 216 of the first elongated member 210 of the second construction beam 200. The free base wall section 126 of the second elongated member 120 of the first construction beam 100 is fixed to the free base wall section 226 of the second elongated member 210 of the second construction beam 200.

[0065] This allows a very easy construction of a portal frame. Although the coupling of the first construction beam and the second construction beam as set out above may be sufficient to provide a moment-rigid joint, also referred to as moment-continuous joint, the coupling of free base wall sections 116 and 216, and 126 and 226 may be provided with reinforcing elements as will be explained hereafter.

[0066] The channel shaped elongated member have a C-profiled cross section 701. Alternatively this may be C+ profiles 702, sigma profiles 703 or sigma + profiles 704, as schematically shown in Fig. 7. Alternatively the profiles of the channel shapes may be sigma-shaped 705 having more than one recess or intermediate stiffener 706. As an other example, Z- profile 708 and Z+ profile 709 is shown. For each example, the base wall 715 is shown, having

- a first side 711 and a second side 712,
- having a width, the width being measured perpendicular to said longitudinal direction of the elongated member. The width preferably ranges between 200mm and 450mm.

[0067] The cross sections also show a first flange 717 and a second flange 718 bounding the base wall 715 in longitudinal direction and protruding on one of the first or second side 711 or 712 of the base wall 715.

[0068] In order to obtain a channel shaped cross section, the flanges both protrude on the same side of the base wall. Z-shaped profiles are obtained when the first flange protrude on one side of the base wall, whereas the other flange protrude on the other side of the base wall.

[0069] The protruding height F1 and F2 of the flanges 717 and 718 of the profile may vary, and may be equal or may be different. When the sides of a profile of an elongated member have different heights, the sides from an elongated member not projecting from the base wall of the other elongated member to which the elongated member is fixed, are less high. As an example a C-profile 707 is shown in Fig. 7, which has to different protruding heights. The protruding heights may preferably vary, for example, in a range from 40mm to 120mm.

[0070] The elongated member may be provided from steel, stainless steel but preferably are provided from galvanised normal steel, or from steel qualities such as S250GD, S350GD or S390GD.

[0071] The thickness of the wall is preferably in the

range, for example, of 2mm to 5mm.

[0072] The fixing of the webs or base walls along the contact zone may be done in many different ways, such as by bolts and nuts, welding riveting, nailing but is preferably done by shot firing using shot fire pins, especially when galvanised steel is used to provide the elongated members. The elongated member may be cold rolled elongated member.

[0073] According to alternative embodiments of the construction beam 801, as shown in Fig. 8, the cross section according to AA' shows two channel shaped elongated members 810, 820, with base walls 815, 825 fixed to each other, further comprising additional reinforcing profiles 851, 852 fixed to the base wall of the elongated members. Such additional profiles may be provided to increase the strength of the elongated members and the construction beam, as well as for aesthetic reasons. The fixing of the additional profiles to the base walls may be provided using the same techniques as used to fix the base walls to each other. According to still another embodiment of the construction beam 802 as subject of the present invention and as shown in Fig. 8, two Z-shaped elongated members 830 and 840 having a base wall 835 respectively 845, and two flanges 831 and 832, respectively 841 and 842 are coupled to each other along a contact zone.

[0074] Alternative embodiments of construction beams are schematically shown in Fig. 3, Fig. 4, Fig. 5 and Fig. 6.

[0075] Fig. 3 shows schematically a view of one of the construction beams construction beams.

[0076] The construction beam 300 is defined by a first elongated member 310 and a second elongated member 320. Each of the elongated members have

- a longitudinal span H1 and H2 in a longitudinal direction of the elongated element, the longitudinal direction been referred to by reference 311 and 321 respectively.
- a part of a base wall 315, 325 having a width, Wa1 and Wa2, along the longitudinal direction, which width is measured perpendicular to the longitudinal direction of the elongated member. The central web is at least a part of the base wall. In particular in this embodiment, the width of the base walls of each of the elongated elements is constant. In this particular embodiment, the width of the base walls of both the elongated elements is identical, being, for example, in the range of 200 to 450mm. The base wall or web has one intermediate stiffener, providing the elongated member with a Σ-shaped cross sectional profile as shown in the cross section according to AA' in Fig. 3.
- a cross-section that is channel shaped in this longitudinal direction and has a central web, and two flanges 317 and 318, and 328 and 328, bounding the respective base wall 315 and 325 in longitudinal direction and protruding on one of the first side 312 or 322, or second side 319 or 329 of the base wall.
- a first outer end, referred to by 313 and 323 respectively, and a second outer end referred to by 314 and 324 respectively along the longitudinal direction of the elongated member.

The longitudinal span H1 of the first elongated member is longer than the span H2 of the second elongated member. The members 310, 320 are positioned back-to-back with their base walls 315 and 325 fixed with each other along a contacting zone 330, which contacting zone extends from the first outer end 323 of the second elongated member 320 to the second outer end 324 of the second elongated member 320. The contacting zone comprises at least part of the first outer end 324 of the second elongated member 320, i.e. in this case the whole outer end 324. The contacting zone comprises at least part 331 of the second outer end 324 of the second elongated member 320. The first outer end 313 of the first elongated member 310 is remote from the first outer end 323 of the second elongated member 320.

[0077] Similar as shown in the embodiment according to Fig. 2, the longitudinal direction 311 of the first elongated member 310 is inclined versus the longitudinal direction 321 of the second elongated member 320 over an angle α. The changing width Wab of the contact zone is in this embodiment due to the inclination of the longitudinal directions of both elongated members. It provides to each of the base walls of the elongated members a contact zone extending from the first outer end of the second elongated member to the second outer end of the second elongated member, as well as a free base wall section 316 and 326 along the base walls.

[0078] The section 340 of the first elongated member 310, extending beyond the second elongated member 320 can e.g. be used as a part of the stanchion, in case the construction beam is used as stanchion of a portal frame construction. A part or the whole section 340 may e.g. be embedded in concrete which concrete is part of the foundation of the portal frame building

[0079] Another embodiment of a construction beam 400 as subject of the present invention is schematically shown in Fig. 4. Fig. 4 shows a construction beam 400 comprising a first elongated member 410 having a longitudinal direction 411 and a second elongated member 420 having a longitudinal direction 421, which is inclined to the longitudinal direction 411 of the first elongated member 410. Both elongated members 410 and 420 have a first outer end 413, respectively 423, and a second outer end 414, respectively 424. The first outer ends 413 and 423 are substantially aligned. The span H1 of the first elongated member is larger than the span H2 of the second elongated member. The web or base wall 415 of the first elongated member 410 is fixed to the web or base wall 425 of the second elongated member along the contact zone 430. The base wall 415 of the first elongated member has a free base wall section 416. The base wall 425 of the second elongated member has a

free base wall section 426. For the positions X along the part of the longitudinal direction of the second elongated member, as indicated with reference number 450, the contact zone has a contact width Wab which is smaller than the minimum of the width Wa1 and Wa2 of the first and second elongated member, which widths Wa1 and Wa2 are constant along the longitudinal direction of the first elongated member respectively the second elongated member. The span H1 may range, for example, from 3 to 8m, the span H2 may range from 2.9 to 7.6m, for example. The width Wa1 may e.g. range from 250mm to 450mm, for example, whereas the width Wa2 may range from 200mm to 400mm, for example. The contact width Wab continuously decreases from Wa2 to approximately zero at the second outer end of the second elongated member.

[0080] Along the part of the longitudinal direction of the second elongated member, as indicated with reference number 450, the construction beam has an improved, i.e. increased moment of inertia.

[0081] Another embodiment of a construction beam 500 as subject of the present invention is schematically shown in Fig. 5. Fig. 5 shows a construction beam 500 comprising a first elongated member 510 having a longitudinal direction 511 and a second elongated member 520 having a longitudinal direction 521, which is inclined to the longitudinal direction 511 of the first elongated member 510. The span H1 of the first elongated member is larger than the span H2 of the second elongated member. The web or base wall 515 of the first elongated member 510 is fixed to the web or base wall 525 of the second elongated member along the contact zone 530. The first outer end 513 of the first elongated member 510 is substantially aligned with the first outer end 523 of the second elongated member 520. The second outer end 514 of the first elongated member 510 is inclined versus the second outer end 524 of the second elongated member 520. The base wall 515 of the first elongated member has a free base wall section 516. The base wall 525 of the second elongated member has a free base wall section 526. All along the contact zone 530, i.e. for each position X along the longitudinal direction of the second elongated member, the contact zone has a contact width Wab which is smaller than the minimum of the width Wa1 and Wa2 of the first and second elongated member, which widths Wa1 and Wa2 are constant along the longitudinal direction of the first elongated member respectively the second elongated member. The span H1 may range, for example, from 3m to 8 m, the span H2 may range, for example, from 2.7m to 7.6m. The width Wa1 and the width Wa2 may range, for example, from 200mm to 450mm. The constant contact width Wab continuously decreases from W1 to approximately zero at the second outer end of the second elongated member, which W1 is less than Wa1.

[0082] Along the contact zone 530 the construction beam has an improved moment of inertia.

[0083] Another embodiment of a construction beam 600 as subject of the present invention is schematically shown in Fig. 6a. Fig. 6a shows a construction beam 600 comprising a first elongated member 610 having a longitudinal direction 611 and a second elongated member 620 having a longitudinal direction 621. The elongated members is provided in a curved shape. The span H1 of the first elongated member is about equal to the span H2 of the second elongated member. The web or base wall 615 of the first elongated member 610 is fixed to the web or base wall 625 of the second elongated member along the contact zone 630. The base wall 615 of the first elongated member has a free base wall section 616, a first outer end 613 and a second outer end 614. The base wall 625 of the second elongated member has a free base wall section 626. For each position X along the part of the longitudinal direction of the second elongated member, as indicated with reference number 650, the contact zone has a contact width Wab which is smaller than the minimum of the width Wa1 and Wa2 of the first and second elongated member, which widths Wa1 and Wa2 are constant along the longitudinal direction of the first elongated member respectively the second elongated member. The span H1 and span H2 may being the rang of 3m to 15m. The width Wa1 and the width Wa2 are equal and may be in the range, for example, of 200mm to 450mm. The contact width Wab continuously changes from W1 to W2, and has a minimum at substantially half the span of the first elongated member, wherein W1 is the contact width along the first outer end 623 of the second elongated member, and W2 is the contact width along the second outer end 624 of the second elongated member.

[0084] Along the part of the longitudinal direction of the second elongated member, as indicated with reference number 650, the construction beam has an improved moment of inertia. The curved elongated member can be provided by plastically deforming not curved elongated members, or the elongated members can be fixed to each other while being under tension. The latter provides a prestressed construction beam.

[0085] The construction beam can be used as main beams in e.g. roof constructions.

[0086] An alternative construction beam 1600 as subject of the present invention is schematically shown in Fig. 6b. Fig. 6b shows a construction beam 1600 comprising a first elongated member 1610 having a longitudinal direction 1611 and a second elongated member 1620 having a longitudinal direction 1621. The elongated second member is provided in a curved shape. The span H1 of the first elongated member is longer than the span H2 of the second elongated member. The web or base wall 1615 of the first elongated member 1610 is fixed to the web or base wall 1625 of the second elongated member along the contact zone 1630. The base wall 1615 of the first elongated member has a free base wall section 1616. The base wall 1625 of the second elongated member has a free base wall section 1626. The free base wall section 1626 are provided at the outer ends 1623 and

1624 of the second elongated member 1620. the free base wall section 1616 is provided at the outer ends 1613 and 1614 of the first elongated member 1610. For at least the positions X in section 1651 and 1652 along the part of the longitudinal direction of the second elongated member, the contact zone has a contact width Wab which is smaller than the minimum of the width Wa1 and Wa2 of the first and second elongated member, which widths Wa1 and Wa2 are constant along the longitudinal direction of the first elongated member respectively the second elongated member. The span H1 and span H2 may be in the rang of 3m to 15m. The width Wa1 and the width Wa2 may be in the range, for example, of 200mm to 450mm.

[0087] Along the sections of the longitudinal direction of the second elongated member, as indicated with reference number 1651 and 1652, the construction beam has an improved moment of inertia. The curved elongated member can be provided by plastically deforming not curved elongated members, or the elongated members can be fixed to each other while being under tension. The latter provides a prestressed construction beam.

[0088] The type and dimensions of the elongated members, the materials used to provide the construction beams, the methods to fix base walls to each other and all other features as explained for Figures 1 and 2, are applicable to the embodiments as schematically disclosed in the figures 3, 4, 5 and 6.

[0089] Turning to the second aspect of the present invention, as already mentioned in relation to Fig. 1 and Fig. 2, the construction beams may be used as elongate beams to provide a frame structure such as a portal frame.

[0090] A portal frame 900 as subject of the present invention is schematically shown in Fig. 9. Two identical stanchions 91 and 92 are shown, which are elongate beams, identical to the construction beams as shown in Fig. 2. The two stanchions, hereafter referred to as left stanchion 91 and right stanchion 92, are provided and coupled to ground 901 in an appropriate way as presently known in the art. Both stanchions comprise two elongated members 910 and 920, and 930 and 940, which are coupled base wall to base wall according to the first aspect of the present invention. The first elongated member 910 of the stanchion 91 has a free base wall section 916, the first elongated member 930 of the stanchion 92 has a free base wall section 936. The stanchions 91 and 92 are mounted on the ground 901 at the first outer ends 913, 923, 933 and 943 of the elongated members 910 respectively 920, 930 and 940. A part of the first elongated member 910 and 930 is used to couple the stanchion to the foundation of the building construction.

[0091] The portal frame 900 further comprises two identical rafters, 93 and 94, which are elongate beams i.e. construction beam similar to the contruction beams as shown in Fig. 2, except that at the first outer ends of the first elongated member and the second elongated member are not aligned but a free end is provided to the first outer end of the first elongated members. The two rafters, hereafter referred to as left rafter 93 and right rafter 94, are coupled to the left and right stanchion as will be explained hereafter.

[0092] The two rafters 93 and 94 are construction beams as shown in Fig. 2. Both rafters comprise two elongated members 950 and 960, and 970 and 980, which are coupled base wall to base wall according to the first aspect of the present invention. The first elongated member 950 of the rafter 93 has a free base wall section 956 at its base wall 955, the first elongated member 970 of the rafter 94 has a free base wall section 976 at its base wall 975. The second elongated member 960 of the rafter 93 has a free base wall section 966 at its base wall 965, the second elongated member 980 of the rafter 94 has a free base wall section 986 at its base wall 985.

[0093] The first elongated members 950 and 970 have first outer ends 953, 973 and second outer ends 954, 974. The second elongated members 960 and 980 have first outer ends 963, 983 and second outer ends 964, 984. The first outer ends 963 and 983 of the second elongated members 960 and 980 are located at about half the span length of the first elongated member 950, respectively 970.

[0094] The rafters are preferably galvanised cold rolled profiles.

[0095] The stanchions and rafters, being embodiments according to the first aspect of the present invention, have the advantage that at each of the free base wall sections 916, 936, along the second outer ends 914 and 934 of the first elongated members 910, 930 of the stanchions, the free base wall sections 956 and 976 of the second outer end 954 and 974 of the first elongated member 950 and 970 of the rafters can be fixed in coupling sections 991 respectively 992.

[0096] At each of the free base wall sections 926, 946, along the second outer ends 924 and 944 of the second elongated members 920, 940 of the stanchions, the free base wall sections 966, 986 of the second outer end 964 and 984 of the second elongated member 960 and 980 of the rafters can be fixed in coupling sections 994 respectively 995.

[0097] The two first outer ends 953 and 973 of the two first elongated members 950 and 970 of the rafters, which outer ends 953 and 973 are remote from the coupling sections 991 respectively 992, are coupled with their base wall to each other at coupling section 993.

[0098] An alternative portal frame 1000 as subject of the present invention is schematically shown in Fig. 10. Two identical stanchions as described in Fig. 9 are provided. Same references refer to the same features.

[0099] The portal frame 1000 further comprises one rafter, which is an elongate beam, being a construction beam 1001 as subject of the present invention according to the first aspect of the invention as described in Fig. 6b.

[0100] The stanchions being embodiments according to the first aspect of the present invention, have the ad-

vantage that at each of the free base wall sections 916, 936 of the first elongated members 910, 930 of the stanchions 91, 92, the first outer end 1113 and the second outer end 1114 of the first elongated member 1110 of the construction beam 1001 can be fixed. At the second outer end 914 of the first elongated member 910 of the stanchion 91, the first outer end 1113 of the first elongated member 1110 is fixed in coupling section 991, e.g. by bolting. At the second outer end 934 of the first elongated member 930 of the second stanchion 92, the second outer end 1114 of the first elongated member 1110 is fixed at coupling section 992, e.g. by bolting. At each of the free base wall sections 926, 946 of the second elongated members 920, 940 of the stanchions 91, 92, the first outer end 1123 and the second outer end 1124 of the second elongated member 1120 of the construction beam 1001 can be fixed. At the second outer end 924 of the second elongated member 920 of the stanchion 91, the first outer end 1123 of the second elongated member 1120 is fixed in coupling section 994, e.g. by bolting. At the second outer end 944 of the second elongated member 940 of the second stanchion 92, the second outer end 1124 of the second elongated member 1120 is fixed at coupling section 995, e.g. by bolting.

[0101] Still another portal frame 1100 as subject of the present invention is schematically shown in Fig. 11. Two identical stanchions as described in Fig. 9 are provided. In similar way as in the embodiment of Fig. 9, two substantially identical rafters 93 and 94 are coupled to the stanchions 91 and 92 is a similar way as shown in Fig. 9. The rafters 93 and 94 however comprises each two elongated members, which have a contact zone as subject of the present invention along substantially the whole span of the first elongated members. The first outer ends 963 and 983 of the second elongated members 960 and 980 are approximating the first outer ends 953 and 973 of the first elongated member 950, respectively 970. The two first outer ends 953 and 973 of the two first elongated members 950 and 970 of the rafters, which outer ends 953 and 973 are remote from the coupling sections 991 respectively 992, are coupled with their base wall to each other at coupling section 993.

[0102] It was found that the stanchions and rafters, being construction beams as subject of the present invention, have the advantage that the moment of inertia of the stanchion or rafter can be varied along the span of the stanchion or rafter, to meet the required moment of inertia which is found necessary according to the design of the portal frame. As an example, it is known that at the outer end of the stanchion, where the stanchion is coupled to a rafter, a large moment of inertia is required. The required moment of inertia decreases towards the side of the stanchion, which is coupled to the ground. As explained above, the moment of inertia of a construction beam, being used as a stanchion of a portal frame, varies along the span from the bottom to the upper part where the stanchion is coupled to the rafter according to the present invention.

[0103] As shown in Figs. 12 and 13 at the coupling to the elongated members of the stanchion and rafter as shown on Fig. 11, additional reinforcing elements 1201, 1202, 1203 and 1204 may be provided. Reinforcing element 1201 is to reinforce the outer end 1213 of the first elongated member 1210 of the rafter. Reinforcing element 1202 is to reinforce the outer end 1223 of the second elongated member 1220 of the rafter reinforcing element 1203 is to reinforce the outer end 1243 of the second elongated member 1240 of the stanchion reinforcing element 1231 is to reinforce the outer end 1233 of the first elongated member 1230 of the stanchion

[0104] The reinforcing elements 1201 and 1203, reinforcing the first elongated members, have a corner-like shaped profile, to meet both the base wall 1215 respectively 1235, and the flange 1217 respectively 1237, which flange is located at the outer side of the corner made by the rafter-stanchion combination. The reinforcing elements 1202 and 1204, reinforcing the second elongated members, are shaped corner-like, to meet both the base wall 1225 respectively 1245, and the flange 1227 respectively 1247, which flange is located at the inner side of the corner made by the rafter-stanchion combination. The reinforcing elements are thicker, preferably hot rolled, metal elements which are e.g. coupled to the second elongated members of both a stanchion and a rafter or coupled to the first elongated members of both a stanchion and a rafter. The reinforcing elements are designed to fit into the channel profile of the elongated members. The reinforcing elements can be coupled to the elongated members by bolting, but preferably shot fired pins are used. When making the rafter-stanchion construction coupling stanchion to rafter by means of bolts, preferably the bolts used to couple rafter and stanchion penetrate through the reinforcing elements. As shown in Fig. 14, a reinforcing element for a 1401 for a C-profile and a similar reinforcing element 1402 for a Σ-profile is shown.

[0105] Other arrangements for accomplishing the objectives of the present invention will be obvious for those skilled in the art.

[0106] It is to be understood that although preferred embodiments, specific constructions and configurations, as well as materials, have been discussed herein for devices according to the present invention, various changes or modifications in form and detail may be made without departing from the scope and spirit of this invention.

Claims

1. A construction beam for use in frame constructions, which construction beam is defined by a first elongated member and a second elongated member, each of said elongated members having

    - a longitudinal span in a longitudinal direction,
    - a base wall having

o a first side and a second side,
o a width along said longitudinal direction, said width being measured perpendicular to said longitudinal direction of said elongated member,
o and a first outer end and a second outer end in longitudinal direction,

• a first and a second flange bounding the base wall in longitudinal direction and protruding on one of the first or second side of the base wall;

said longitudinal span H1 of said first elongated member being equal or larger than said longitudinal span H2 of said second elongated member, said members are positioned back-to-back with their base walls fixed with each other along a contacting zone, said contacting zone extending from said first outer end of said second elongated member to said second outer end of said second elongated member, said contacting zone comprising at least part of said first outer end of said second elongated member, said contacting zone comprising at least part of said second outer end of said second elongated member, for at least one position A along the longitudinal direction of said second elongated member, the contact width Wab of said contact zone is less than the minimum of the width Wa1 of said first elongated member at said position A and the width Wa2 of said second elongated member at said position A, said contact width Wab being measured perpendicular to said longitudinal direction of said second elongated member.

2. A construction beam according to claim 1, wherein for each position X along the longitudinal direction of said second elongated member, the contact width Wab of said contact zone is less than the minimum of the width Wa1 of said first elongated member at said position X and the width Wa2 of said second elongated member at said position X, said contact width Wab being measured perpendicular to said longitudinal direction of said second elongated member.

3. A construction beam according to any one of the claims 1 to 2, wherein said first outer end of said first elongated member is substantially aligned with said first outer end of said second elongated member,

4. A construction beam according to any one of the claims 1 to 3, wherein the width Wa1 is constant along the contact zone and/or the width Wa2 is constant along the contact zone.

5. A construction beam according to claim 4, wherein the minimum of Wab along said contract zone is equal to or less than one third of the minimum of Wa1 and Wa2.

6. A construction beam according to claim 5, wherein said base wall of said first elongated member contacts said base wall of said second elongated member along said first outer end of said second elongated members over a contact length W1 which is smaller than or equal to the minimum of Wa1 and Wa2 or
said base wall of said first elongated member contacts said base wall of said second elongated member along said second outer end of said second elongated members over a contact length W2 which is smaller than or equal to the minimum of Wa1 and Wa2.

7. A construction beam according to claim 6, wherein W1 is equal to said minimum of Wa1 and Wa2 and/or W1 is larger than W2 or W1 is equal to W2.

8. A construction beam according to claim 7, wherein Wab decreases continuously from said first outer end to said second outer end of said second elongated member or Wab changes continuously from said first outer end to said second outer end of said second elongated member.

9. A construction beam according to any one of the claims 1 to 8, wherein the longitudinal direction of said first elongated member and the longitudinal direction of the second elongated member make an angle α (alpha) being larger than 0.

10. A construction beam according to any one of the claims 1 to 9, wherein for at least one of the first elongated member and the second elongated member, the flanges protrude to the same side of the base wall, thereby providing a channel shape to the at least one of the first elongated member and the second elongated member.

11. A construction beam according to any one of the claims 1 to 10, wherein for the first elongated member, the flanges protrude to the same side of the base wall, thereby providing a channel shape to the first elongated member, and for the second elongated member, the flanges protrude to the same side of the base wall, thereby providing a channel shape to the second elongated member.

12. A construction beam according to any one of the claims 1 to 11, wherein at least one of said first elongated member and said second elongated member has a C-shaped, C+-shaped or sigma-shaped cross section.

13. A construction beam according to any one of the claims 1 to 12, wherein for at least one of the first

elongated member and the second elongated member, the first flange protrudes to the first side of the base wall, the second flange protruding to the second side of base wall, thereby providing a Z-shaped cross section to the at least one of the first elongated member and the second elongated member, or for the first elongated member, the first flange protrudes to the first side of the base wall and the second flange protruding to the second side of base wall, thereby providing a Z-shaped cross section to the first elongated member, and for the second elongated member, the first flange protrudes to the first side of the base wall and the second flange protruding to the second side of base wall, thereby providing a Z-shaped cross section to the second elongated member.

14. A construction beam according to any one of the claims 1 to 13, the first and second flanges being substantially perpendicular to said base wall, the first flange having a protruding height being different from the protruding height of said second flange.

15. A construction beam according to any one of the claims 1 to 14, wherein said first elongated member and said second elongated member have identical cross sections.

16. A construction beam according to any one of the claims 1 to 15, wherein at least one of said first elongated member or said second elongated member is provided with additional profiled reinforcing members fixed to said base wall.

17. A construction beam according to any one of the claims 1 to 16, wherein said first elongated member and said second elongated member are fixed to each other by welding or by bolting or by short firing.

18. A construction beam according to any one of the claims 1 to 17, wherein said elongated members are galvanised steel members or cold rolled members.

19. A frame comprising at least a first elongate beam, wherein said first elongate beam being a construction beam according to any one of the claims 1 to 18.

20. A frame according to claim 19, wherein said frame further comprises at least a second elongate beam, said second elongate beam being a construction beam according to any one of the claims 1 to 18.

21. A frame according to claim 20, wherein the second elongate beam is joined to the first elongate beam.

22. A frame according to claim 21, wherein said first elongate beam comprises a first elongated member having a first free base wall section and a second elongated member having a second free base wall section, said second elongate beam comprising a first elongated member having a first free base wall section and a second elongated member having a second free base wall section, the first free base wall sections of said second elongate beam and said first elongate beam being fixed to each other along a first coupling section, the second free base wall sections of said second elongate beam and said first elongate beam being fixed to each other along second coupling.

23. A frame according to claim 22, the frame further comprises additional reinforcing elements at said first coupling section and/or at said second coupling section or also comprises at least a third elongate beam, said third elongate beam comprising a first elongated member having a longitudinal span in a longitudinal direction, a cross section being channel shaped in said longitudinal direction, a base wall having a width along said longitudinal direction, said width being measured perpendicular to said longitudinal direction of said third elongated member, said third elongated member having a first and a second outer end, at least one of the first and second outer end of the first elongate member of the third elongate beam being coupled to said second outer end of said first elongated member of said first elongate beam.

24. A frame according to claim 23, wherein the other of the first and second outer end of the first elongate member of the third elongate beam is coupled to said second outer end of said first elongated member of said second elongate beam.

25. A frame according to claim 23 or 24, wherein said third elongate beam is a construction beam according to any one of the claims 1 to 18.

26. A frame according to claim 23 or 24, wherein the frame further comprises a third and a fourth elongate beam being construction beams according to any one of the claims 1 to 18, said third elongate beam comprising a first elongated member having a first free base wall section and a second elongated member having a second free base wall section, said fourth elongate beam comprising a first elongated member having a first free base wall section and a second elongated member having a second free base wall section, the first free base wall sections of said third elongate beam and said fourth elongate beam being fixed to each other along a third coupling section, the second free base wall sections of said third elongate beam and said fourth elongate beam being fixed to each other along fourth coupling, the outer end of the second elongate beam remote from the first coupling section and the outer end of the third elongate beam remote from the third coupling

section being coupled to each other.

27. The frame according to any of the claims 19 to 26, the frame being a portal frame and the first elongate beam being a stanchion and the second elongate beam being a rafter.

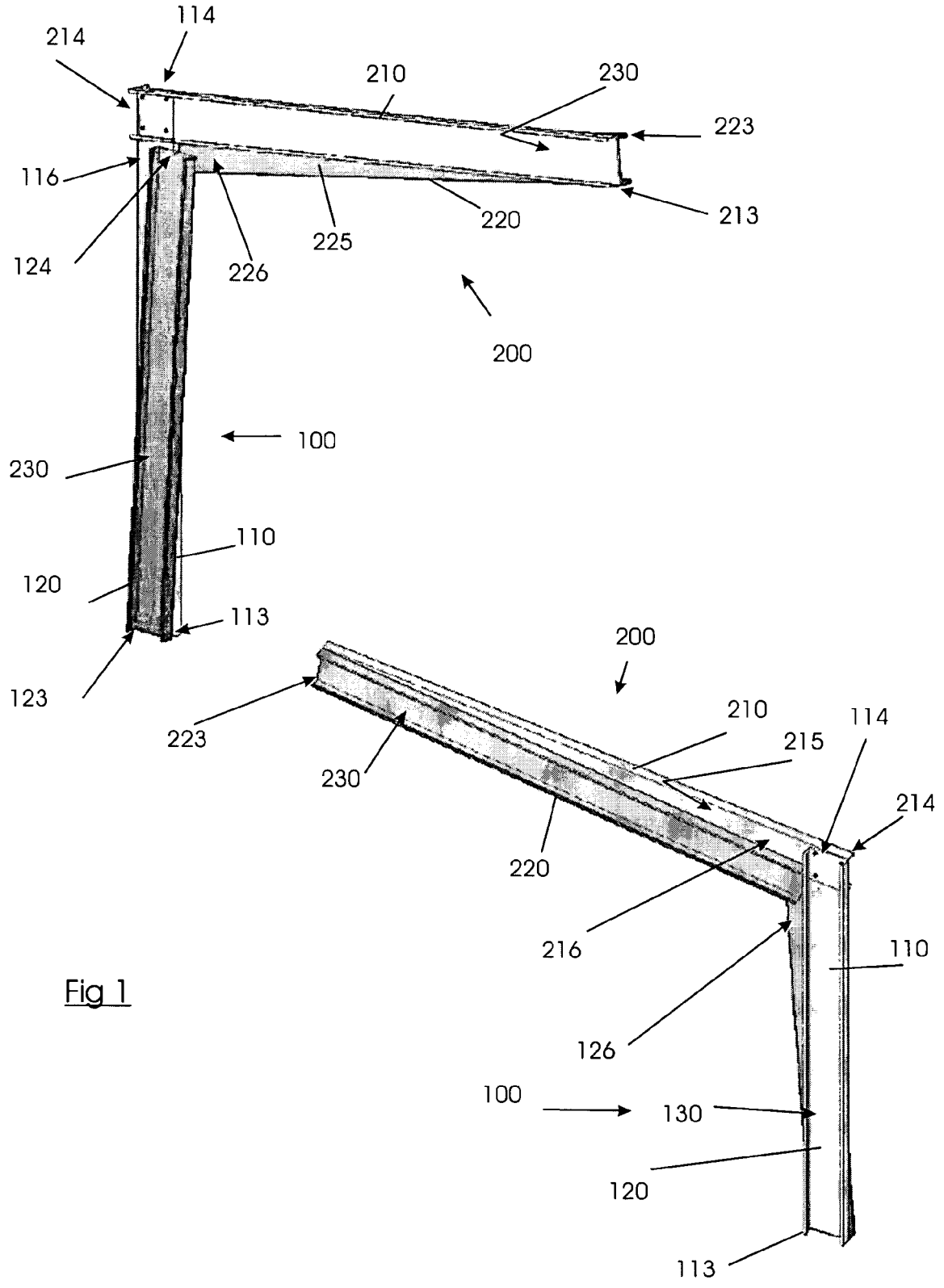

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Fig 1

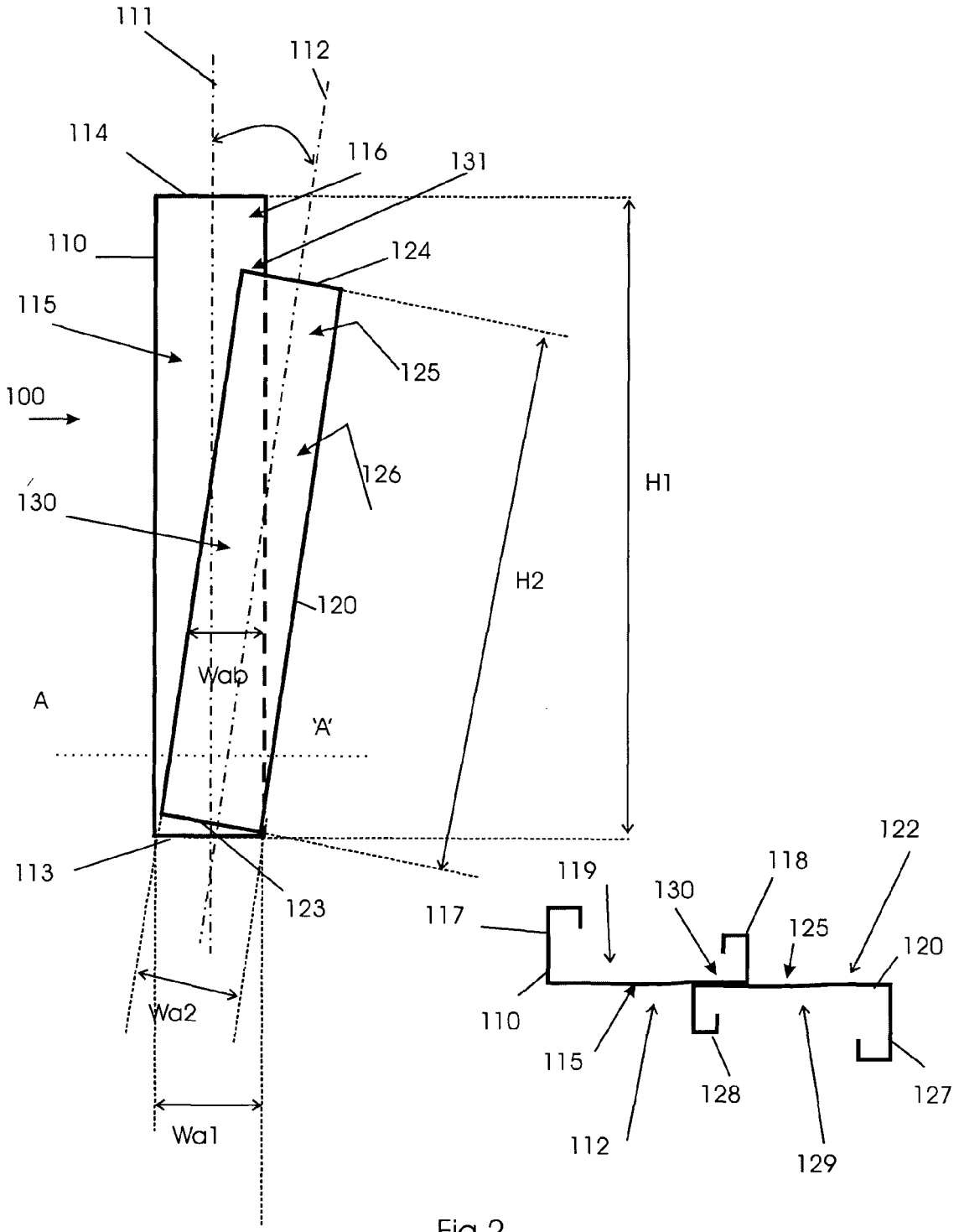

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Fig 2

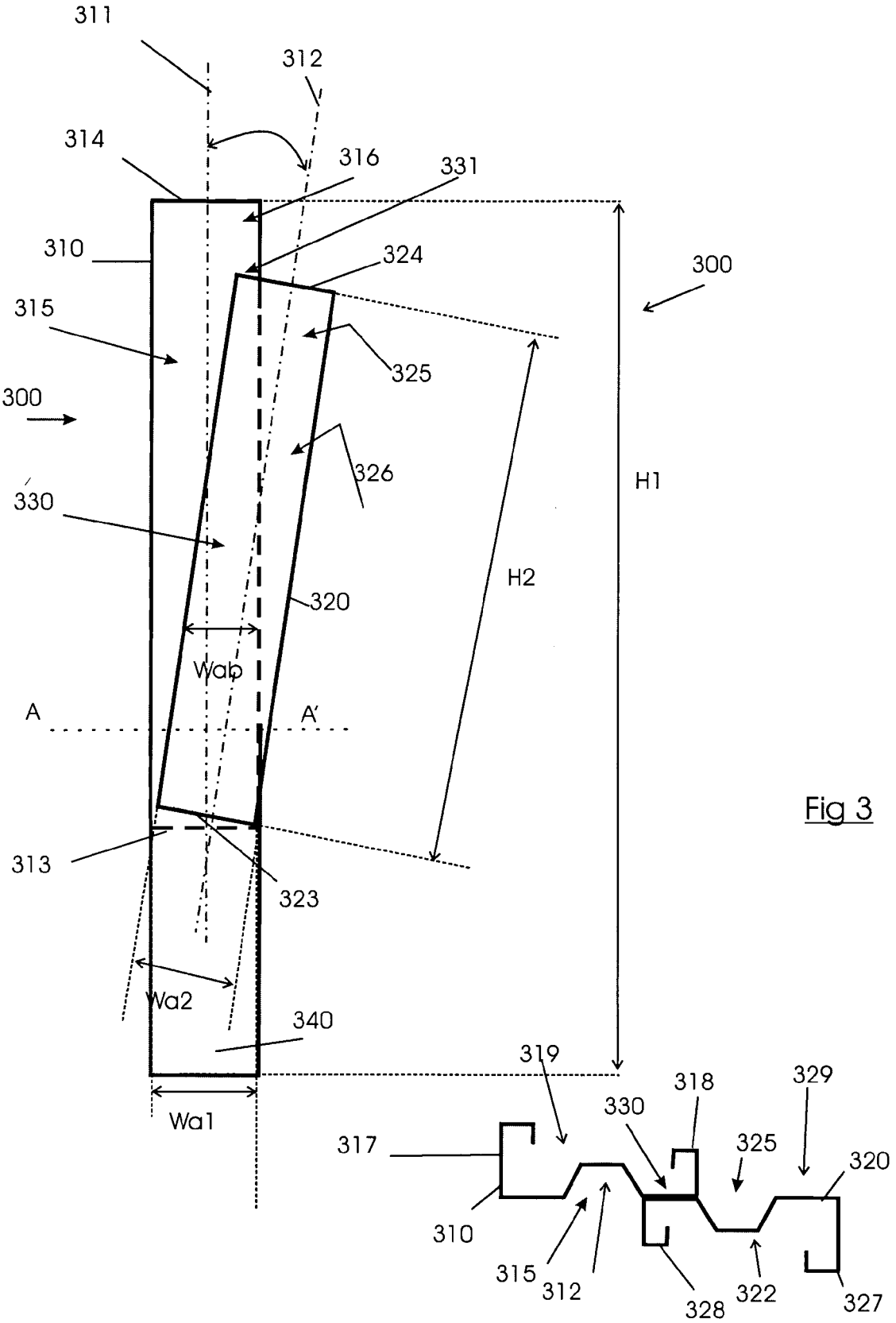

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Fig 3

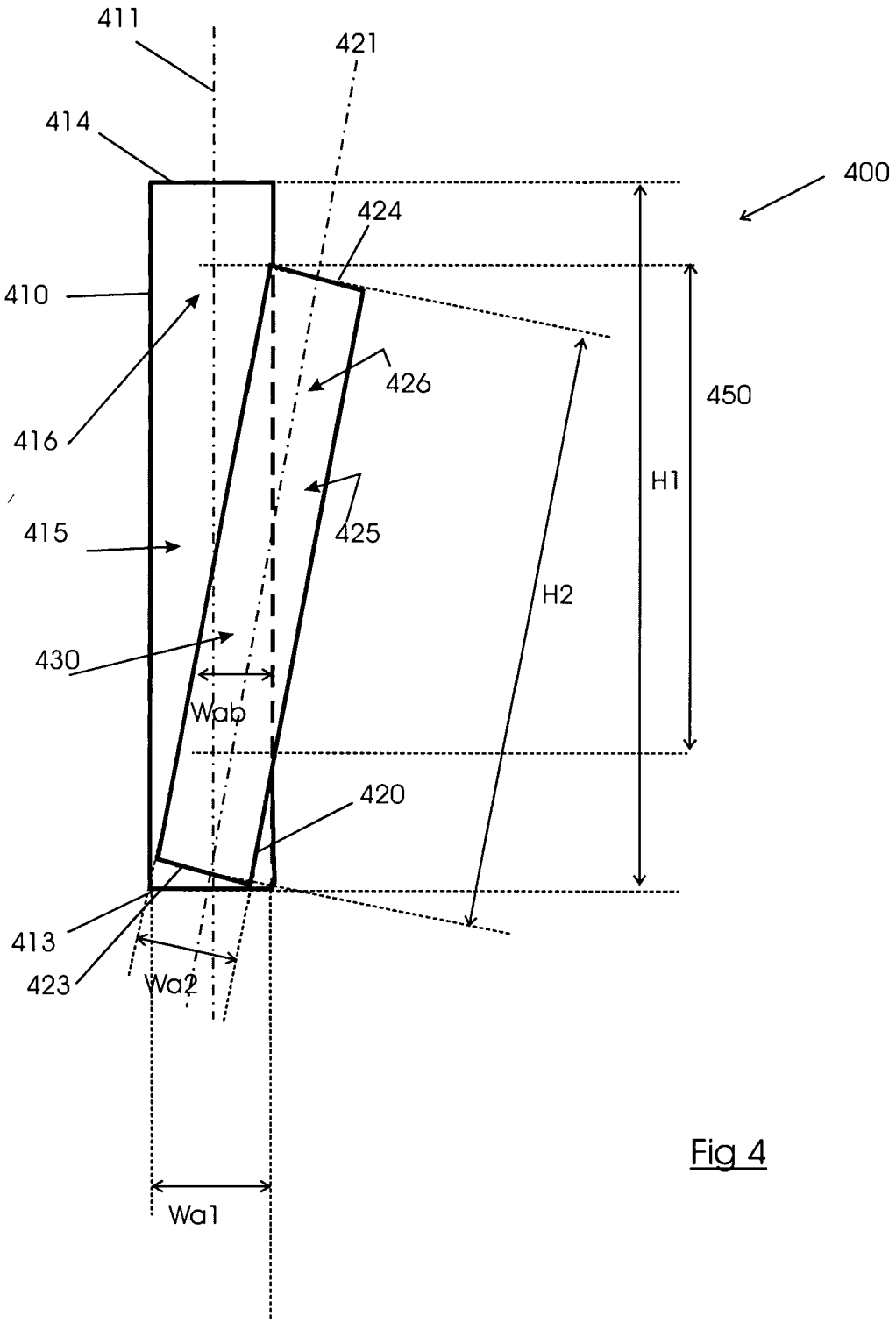

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400
424
410
426
450
416
H1
415
425
H2
430
Wab
420
413
423
Wa2
Wa1

Fig 4

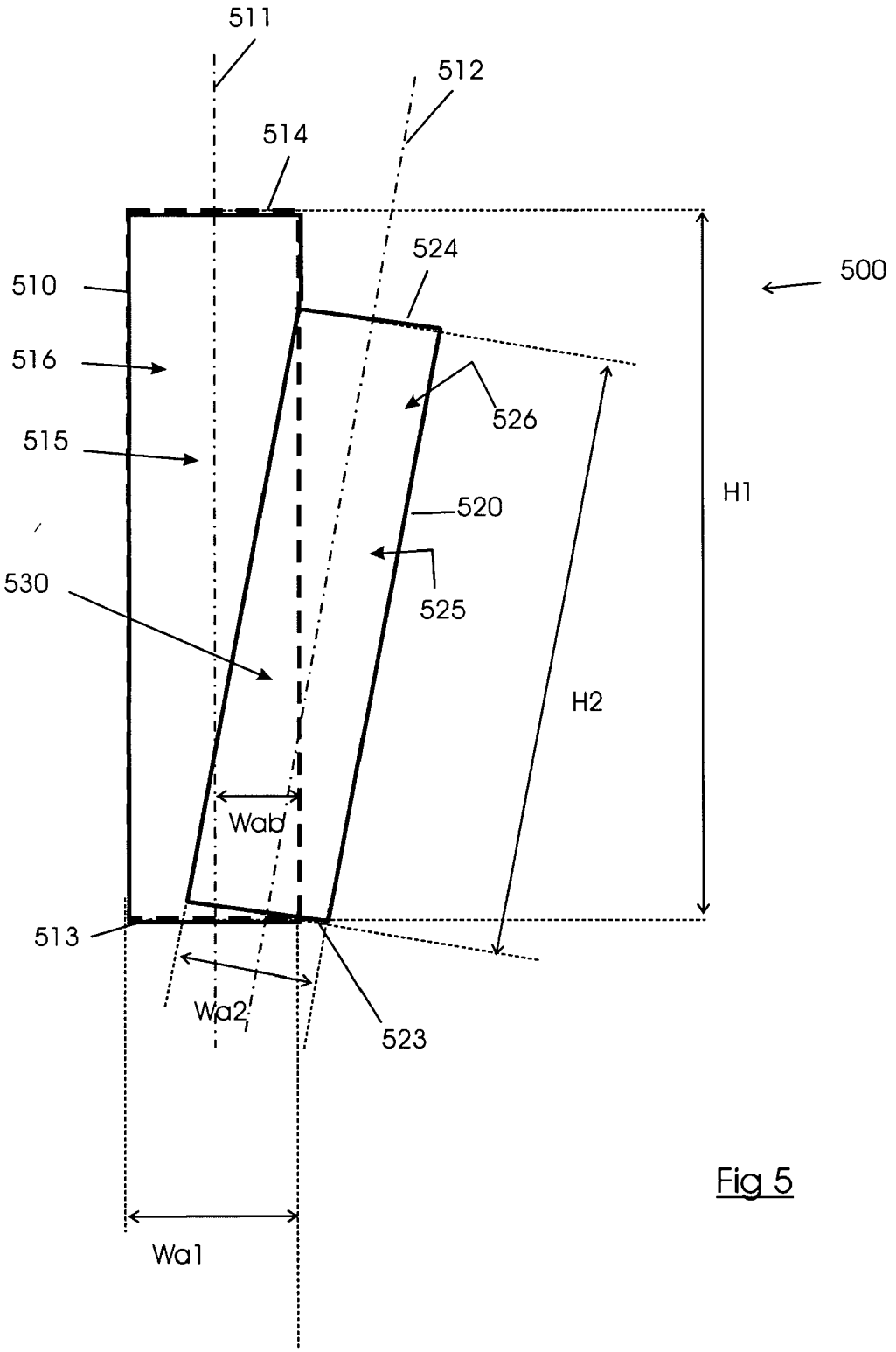

511
512
514
524
500
510
516
526
515
H1
520
530
525
H2
Wab
513
Wa2
523
Wa1

Fig 5

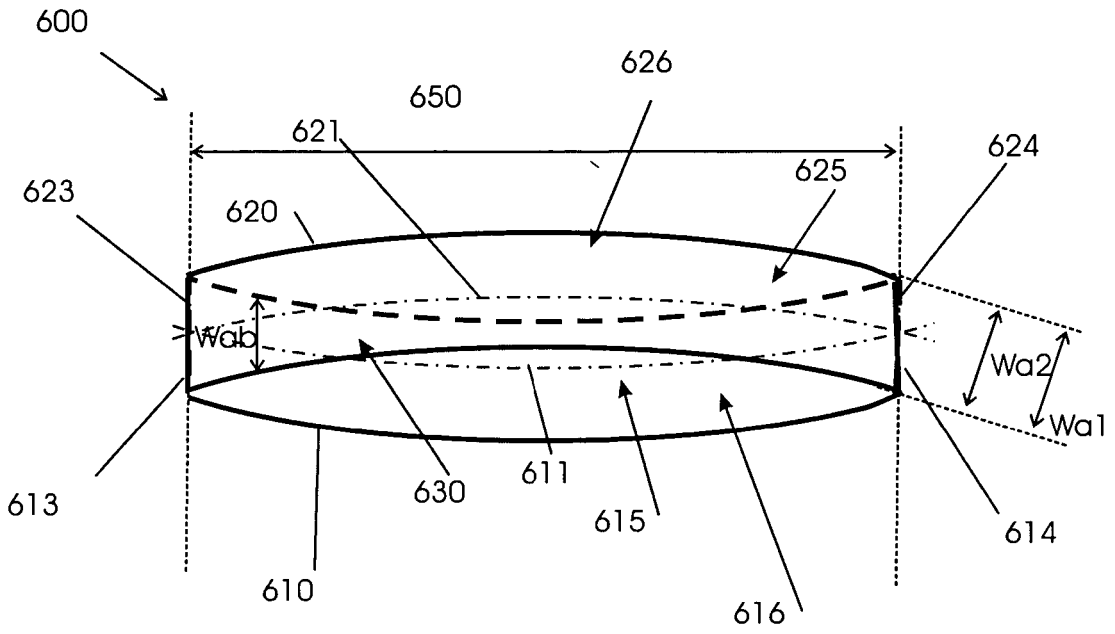

600
650
626
621
624
625
623
620
Wab
Wa2
Wa1
613
630
611
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614
610
616

Fig 6a

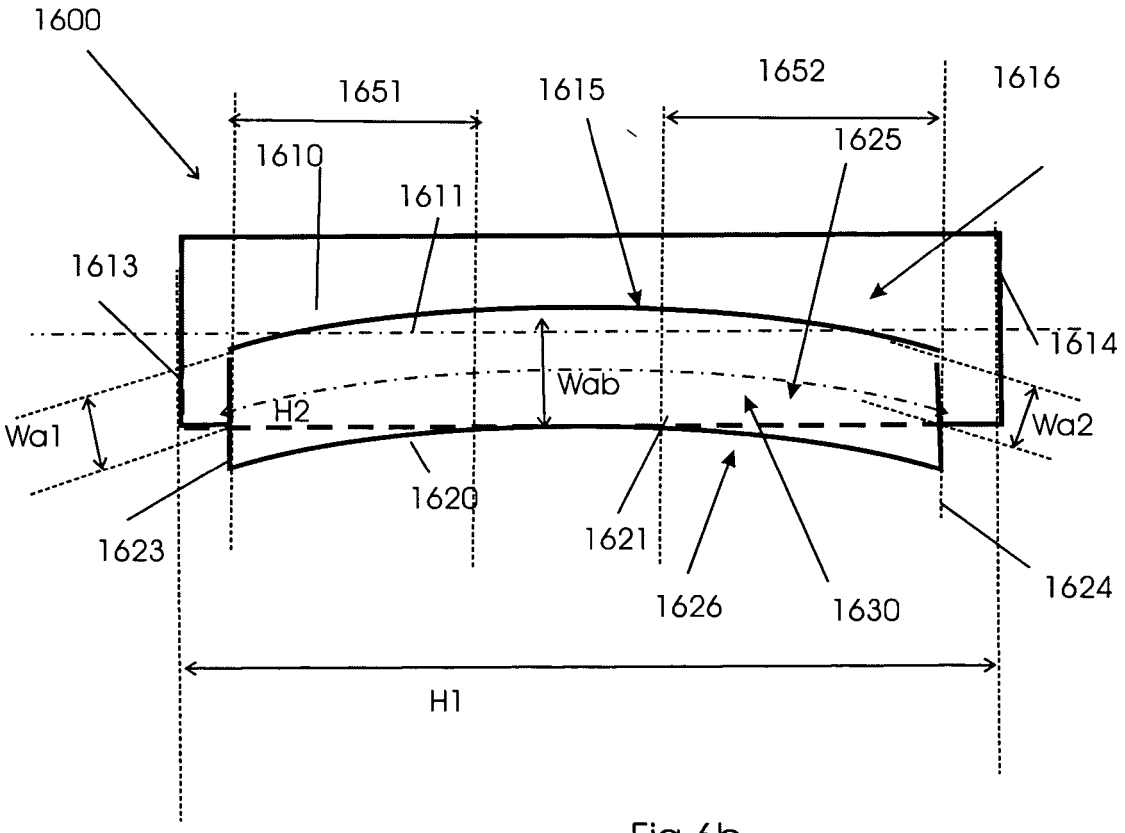

1600
1651
1615
1652
1616
1610
1625
1611
1613
1614
Wab
H2
Wa1
Wa2
1620
1623
1621
1624
1626
1630
H1

Fig 6b

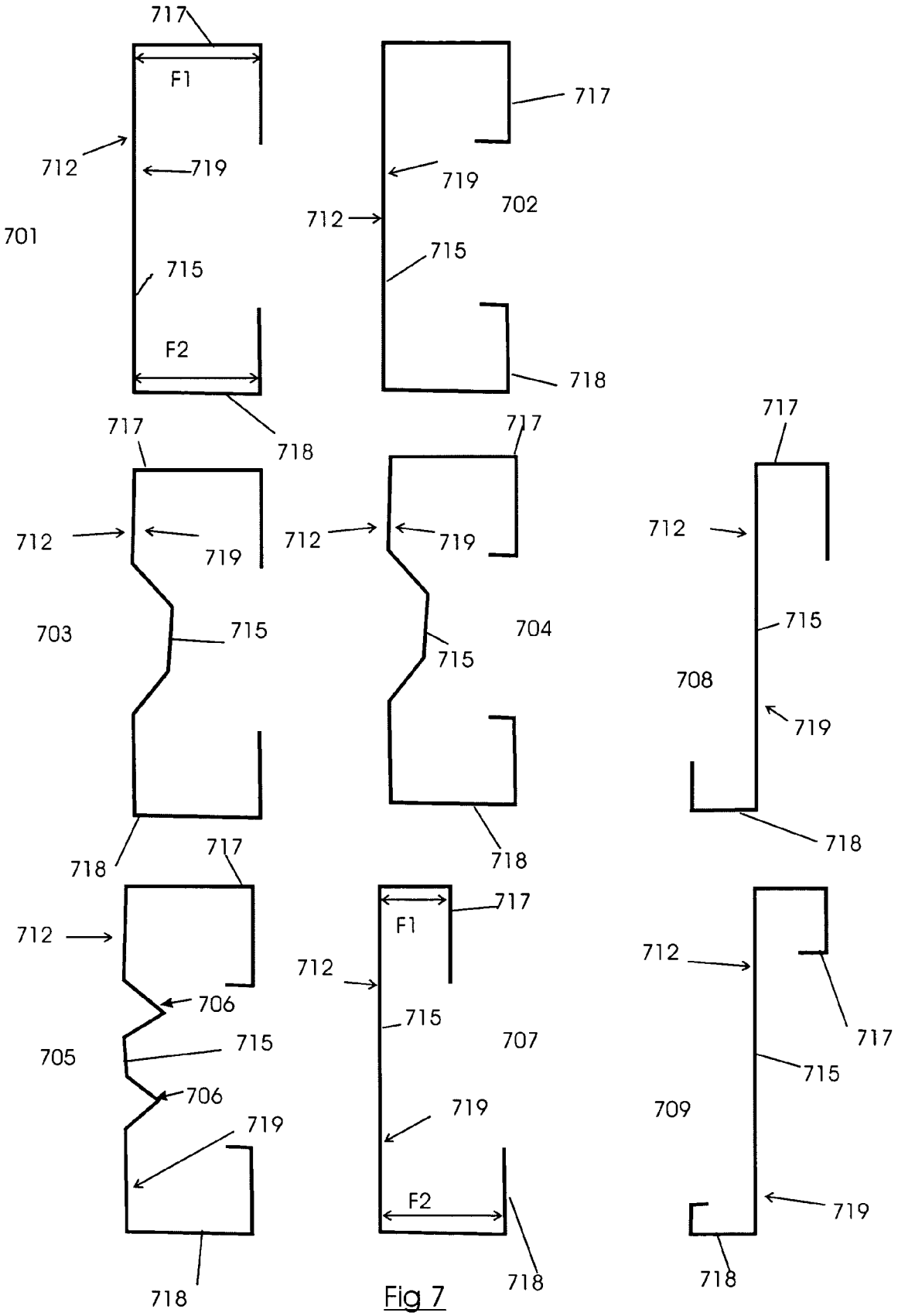

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F1
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719
701
715
F2
718
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719
712
702
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F1
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F2
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709
719
718

Fig 7

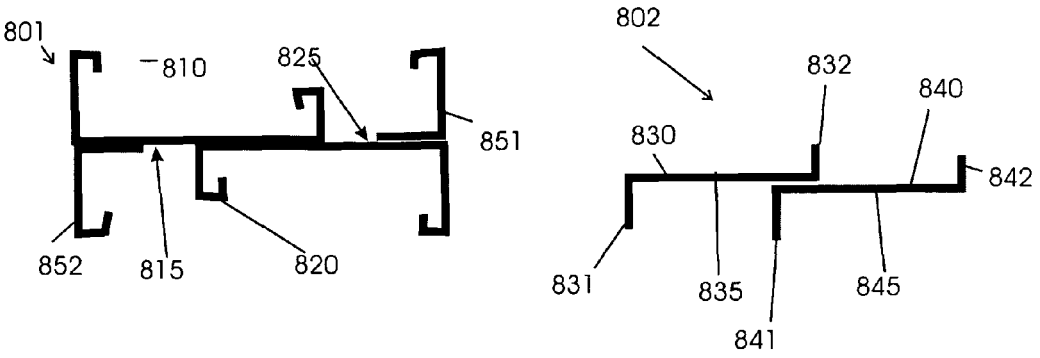

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Fig 8

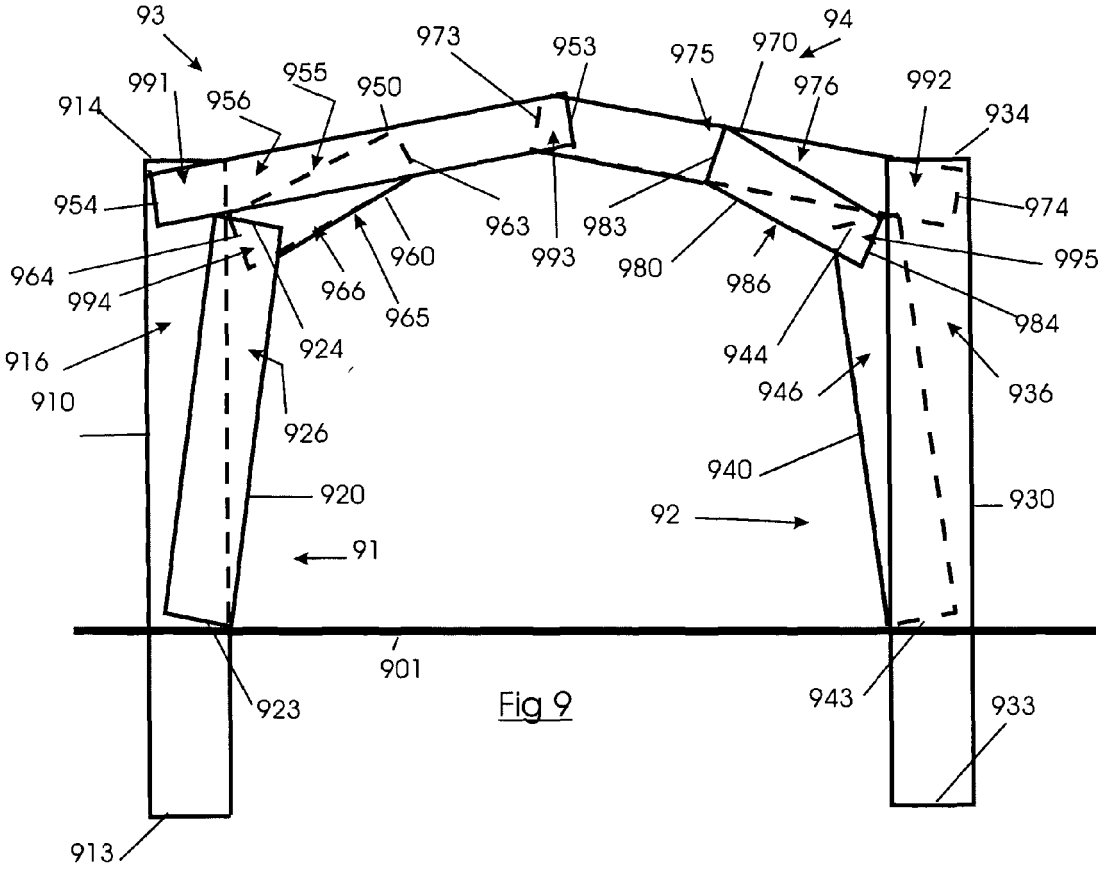

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Fig 9

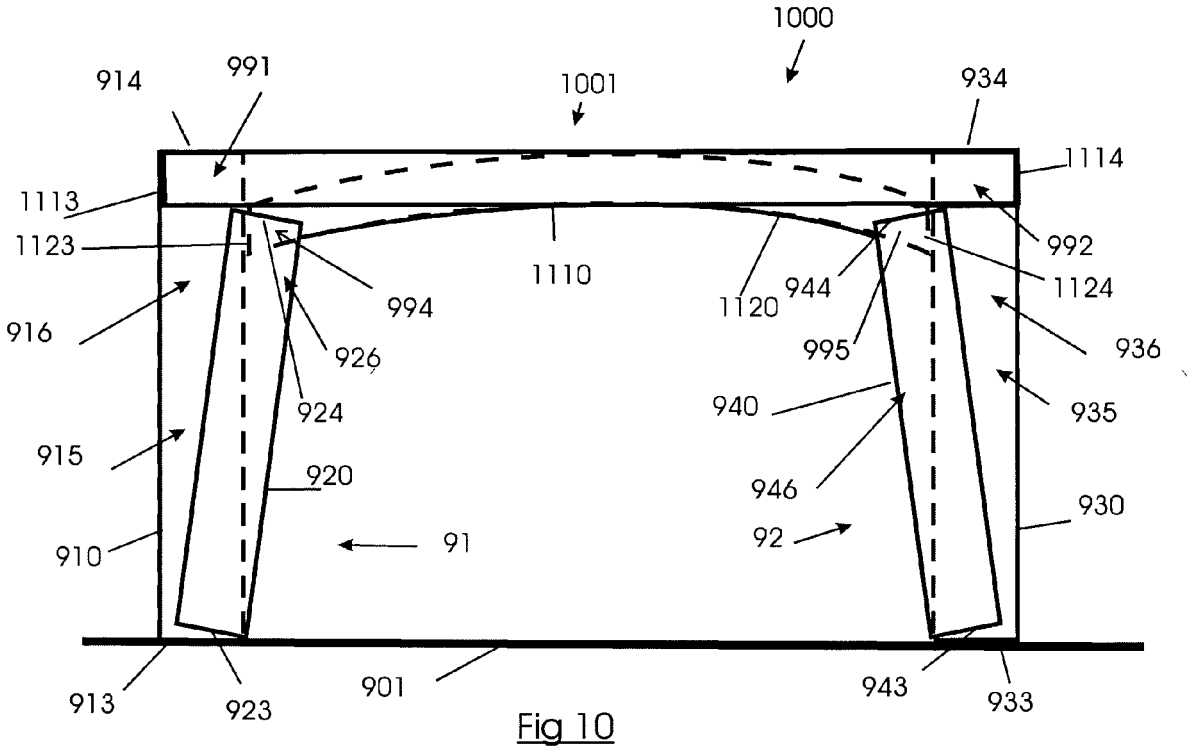

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Fig 10

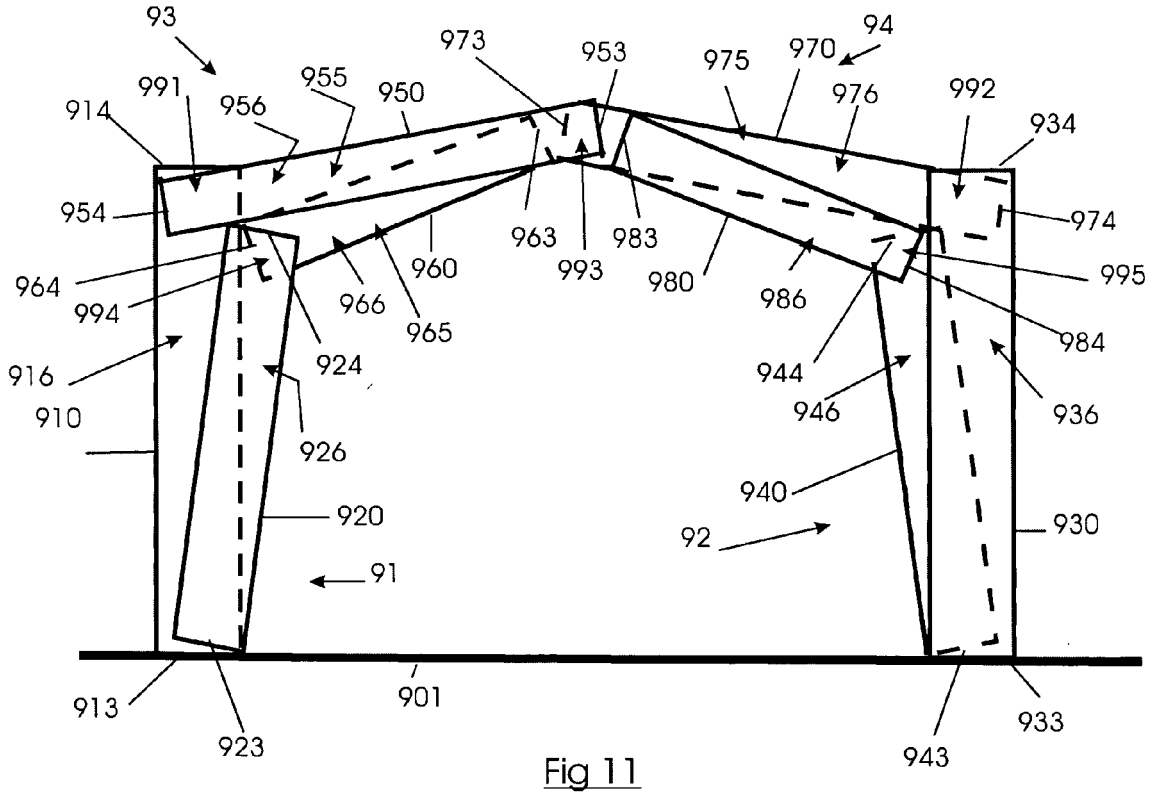

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Fig 11

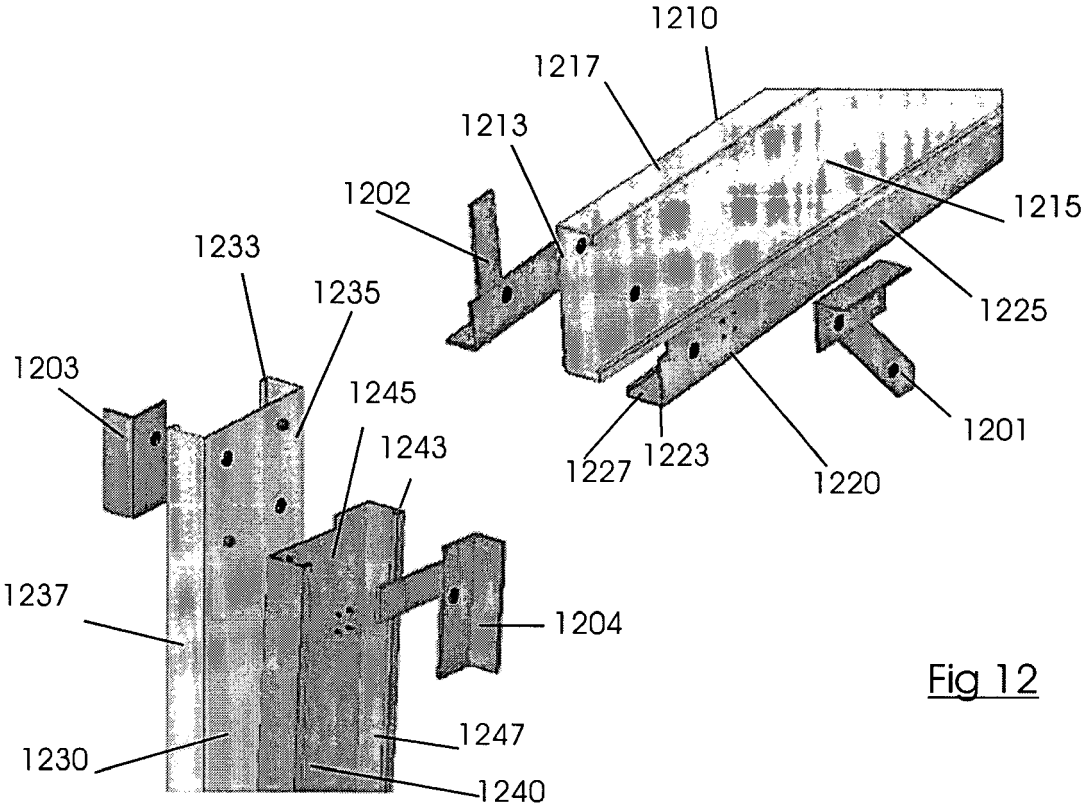

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Fig 12

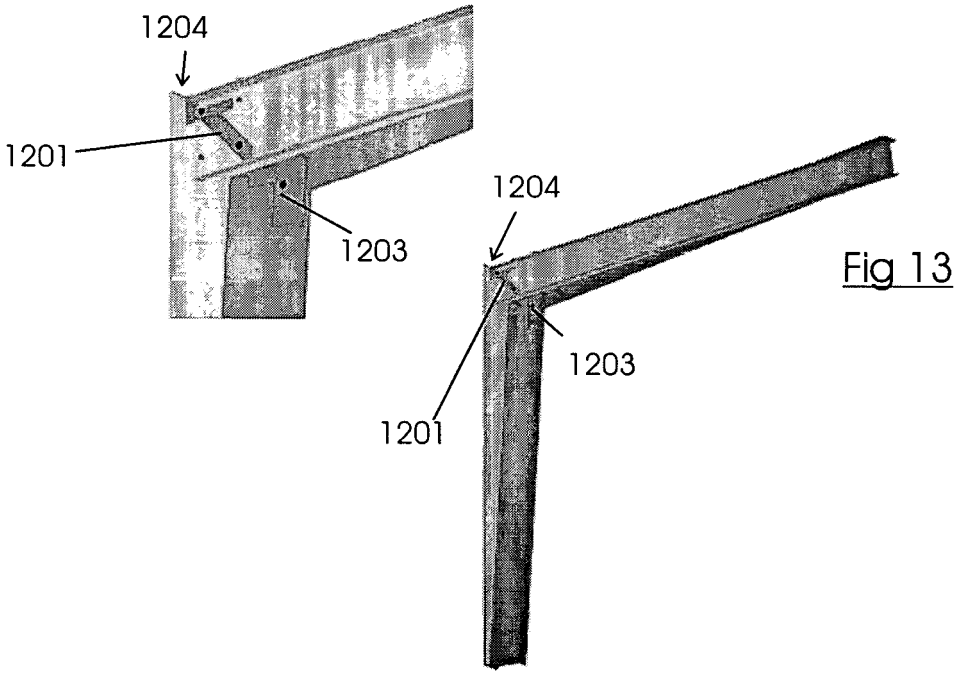

1204
1201
1203
1204
1203
1201

Fig 13

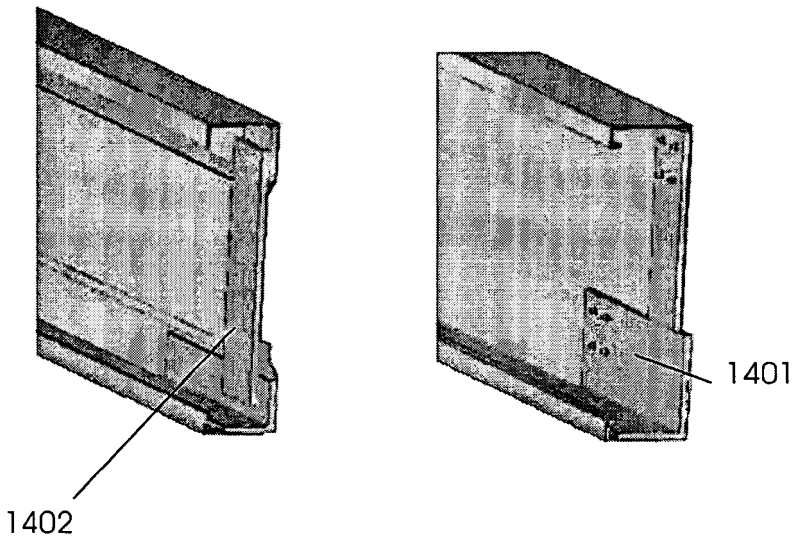


Fig 14

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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