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(54) **IMPROVED CONNECTION ELEMENT FOR TENT BEAMS**

(57) The current invention pertains to a structure and a method for building a tent framework. The structure comprises multiple beams (600) and a connection element (201). The connection element comprises a center (207) and a set of elongated arms (205). Each arm comprises an attachment means (203) for hingedly attaching a beam. An arm further comprises a length direction (u) and a projection plane in essence perpendicular to the length direction and passing through the center. The arm is positioned off-center, at a distance from the center. The arm furthermore comprises a portion on each side of the projection plane of the arm via which the arm is connected to the connection element.

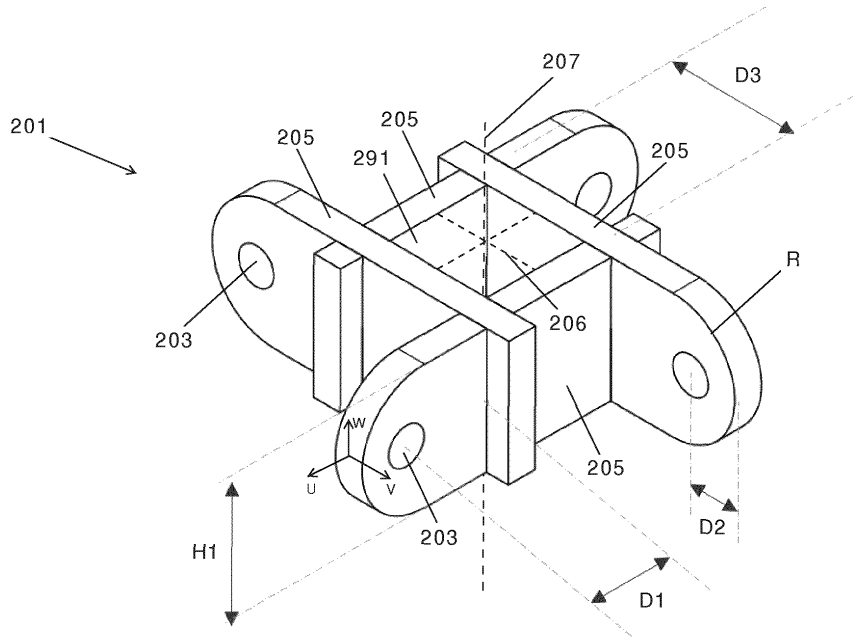

Fig. 2A

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Description

Technical field

[0001] The invention may pertain to the technical field of tents (IPC E04H 15/00) and in particular to hinges and joints for tents (IPC E04H 15/48). In an aspect, the invention may pertain to a joint for a scissor arch.

Background

[0002] WO 2006/106 168 A1 (by Felix Escrig Pallares and Jose Sánchex Sánchez, inventors) discloses a large expandable arch comprising beams that are articulated with one another at the ends thereof as well as at an intermediate connection. The structure can be easily transported and installed.

[0003] L. A. Mira, A. P. Thrall and N. De Temmerman, "Deployable scissor arch for transitional shelters", Automation in Construction, Volume 43, Pages 123-131 (2014), http://dx.doi.org/10.1016/j.autcon.2014.03.014 discloses a disaster relief shelter comprising a deployable aluminum scissor arch covered by a fabric membrane. Such an arch is advantageous as it is lightweight, can be compactly packaged, and comprises a high volume expansion ratio. Figure 6(b) of the paper (enclosed as prior art Figure 1) discloses a cross-shaped connection element (101), hereafter called the prior art cross. The prior art cross comprises four arms, whereby each arm comprises a connection hole (103) for hingedly attaching a beam (102) on one of its sides.

[0004] The prior art cross comprises limited rigidity. The prior art cross furthermore requires long arms for sufficient freedom of movement for hinging the attached beams. With too short arms, hinging beams can interfere unwantedly. The prior art cross in addition also requires long arms for enabling reaching the connection holes of the beams and/or attaching a beam onto the arm. Additionally, the prior art cross needs thick arms in order to meet the requirements for stiffness and strength as the attached beams exercise a bending moment on the cross because of their eccentricity towards the neutral axis of the arms. Also, upon folding a grid of in essence equally long beams interconnected via prior art crosses, a non-optimal compactness is reached.

[0005] The present invention aims to resolve at least some of the problems mentioned above.

Summary of the invention

[0006] In a first aspect, the invention provides a structure, according to claim 1.

[0007] In a second aspect, the invention provides a connection element for a tent framework, according to claim 13.

[0008] In a third aspect, the invention provides a method for building a tent framework, according to claim 14.

[0009] The connection element of the present invention is advantageous over the prior art cross for a plurality of reasons. The off-center positioning of arms allows for unhindered hinging of beams, allows to let the arms protrude less far from the connection element, and allows for easily reaching the hinging attachment of a beam and an arm. Furthermore, the off-center positioning also allows to build a grid of in essence equally long beams which can be compactly folded. The off-center positioning of an arm allows the hinged beams to be connected along their neutral axis thanks to two prongs. This removes unwanted bending moments due to eccentricity allowing the arms to be thin. Furthermore, because of the cavity comprising the center, the rigidity of the connection element is assured.

Brief description of the figures

[0010]

Figure 1 corresponds to Figure 6(b) of above cited prior art document in Automation in Construction, Volume 43, Pages 123-131 (2014), showing a prior art structure comprising a cross-shaped connection element.

Figures 2A and **2B** show perspective views of embodiments of connection elements according to the present invention.

Figures 3A and **3B** show a front view, along the width direction, of an arm of an embodiment of a connection element according to the present invention.

Figure 4 shows a top view, along the height direction, of an embodiment of a connection element according to the present invention.

Figure 5 shows a side view, perpendicular to the height direction, of an embodiment of a connection element according to the present invention.

Figures 6A and 6B show a side view and a perspective view, respectively, of an embodiment of a beam end portion according to the present invention. **Figure 7** shows a perspective view of an embodiment of a beam profile according to the present invention. **Figure 8A** shows a perspective view of a part of a beam according to the present invention. **Figures 8B and 8C** show a perspective view of a portion of an embodiment of a structure according to the present invention comprising beams and one or more connection elements.

Figures 9A, 9B and **9C** show, respectively, a perspective view, front view and top view of an embodiment of a scissor arch in deployed state according to the present invention.

Figures 10A, 10B and 10C show, respectively, a top view, a side view and a front view of the embodiment of the scissor arch shown in **Figures 9A, 9 B and 9C** in compacted transport state.

Figures 11A, 11B and 11C show a top view and two perspective views, respectively, of embodiments of monolithic connection elements according to the present invention.

Detailed description of the invention

[0011] The present invention concerns a structure, a connection element for a tent framework, and a method for building a tent framework. The invention was summarized in the corresponding section above. In what follows, the invention is described in detail, preferred embodiments are discussed, and the invention is illustrated by means of examples.

[0012] Unless otherwise defined, all terms used in disclosing the invention, including technical and scientific terms, have the meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. By means of further guidance, term definitions are included to better appreciate the teaching of the present invention.

[0013] As used herein, the following terms have the following meanings:
"A", "an", and "the" as used herein refers to both singular and plural referents unless the context clearly dictates otherwise. By way of example, "a compartment" refers to one or more than one compartment.

[0014] "About" as used herein referring to a measurable value such as a parameter, an amount, a temporal duration, and the like, is meant to encompass variations of +/-20% or less, preferably +/-10% or less, more preferably +/-5% or less, even more preferably +/-1% or less, and still more preferably +/-0.1% or less of and from the specified value, in so far such variations are appropriate to perform in the disclosed invention. However, it is to be understood that the value to which the modifier "about" refers is itself also specifically disclosed.

[0015] "Comprise", "comprising", and "comprises" and "comprised of" as used herein are synonymous with "include", "including", "includes" or "contain", "containing", "contains" and are inclusive or open-ended terms that specifies the presence of what follows e.g. component and do not exclude or preclude the presence of additional, non-recited components, features, element, members, steps, known in the art or disclosed therein.

[0016] The recitation of numerical ranges by endpoints includes all numbers and fractions subsumed within that range, as well as the recited endpoints.

[0017] In a first aspect, the invention provides a structure comprising multiple beams and a connection element. The connection element comprises a center and a set of elongated arms. Each arm comprises a length direction, a projection plane in essence perpendicular to the length direction, and an attachment means for hingedly attaching a beam. The projection plane thereby comprises the center. An arm of the set, and preferably each arm of the set, is positioned off-center at a distance from the center. The arm furthermore comprises a portion on each side of the projection plane of the arm via which the arm is connected to the connection element.

[0018] The arm hence comprises two portions, one on each side of the projection plane of the arm, via each of which the arm is connected to the (remainder of the) connection element.

[0019] The length direction of an elongated arm is the elongation direction of the arm. In a preferred embodiment, an arm comprises mutually perpendicular length, height and width directions, whereby the attachment means of the arm comprises a rotation axis in essence parallel to the width direction.

[0020] Preferably, the structure is a tent framework, more preferably a scissor tent framework, and most preferably a scissor arch framework.

[0021] In a second aspect, the invention provides a connection element for a tent framework. The connection element comprises a center and a set of elongated arms. Each arm comprises a length direction, a projection plane comprising the center and in essence perpendicular to the length direction, and an attachment means for hingedly attaching a beam. An arm of the set, and preferably each arm of the set, is positioned off-center at a distance from the center. The arm furthermore comprises a portion on each side of the projection plane of the arm via which the arm is connected to the connection element.

[0022] In a third aspect, the invention provides a method for building a tent framework. The method comprises several steps. Multiple beams and a connection element are provided, whereby the connection element comprises a center and a set of elongated arms, whereby each arm of the set is positioned off-center at a distance from the center. For each of the beams, the beam is hingedly attached to an arm of the set.

[0023] One of ordinary skill in the art will appreciate that a structure according to the first aspect may comprise a connection element according to the second aspect. One of ordinary skill in the art will furthermore appreciate that a method according to the third aspect may pertain to the assembly of the beams and the connection element of a structure according to the first aspect. The three aspects of the present invention are hence interrelated. Therefore, in what follows distinction between the different aspects of the invention may be left out. In addition, each feature described above or below, even if it has been described for a particular aspect of the invention, may pertain to each aspect of the invention.

[0024] The present invention is advantageous for several reasons. The off-center positioning of arms allows for unhindered hinging of beams, allows to let the arms protrude less far from the connection element, and allows for easily reaching the hinging attachment of a beam and an arm. Furthermore, the off-center positioning also al-

lows to build a grid of in essence equally long beams which can be compactly folded. The off-center positioning of an arm allows the hinged beams to be connected along their neutral axis thanks to two prongs. This removes unwanted bending moments due to eccentricity allowing the arms to be thin. Furthermore, because of the cavity comprising the center, the rigidity of the connection element is assured.

[0025] In a preferred embodiment, the arm is connected via each portion of the arm to another arm of the set. Preferably, the arm is connected via each portion to a different other arm of the set. Preferably, the arm is connected to at least two other arms of the set. Preferably, the portion on each side of the projection plane of the arm via which the arm is connected to the connection element is a portion on each side of the projection plane of the arm via which the arm is connected to another arm of the set. Preferably, the arm comprises two portions, one on each side of the projection plane of the arm, via each of which the arm is connected to a different other arm of the set.

[0026] In a preferred embodiment, the arms of the set form a cavity comprising the center. A connection element comprising a cavity comprising the center is advantageous as additional strength is provided via the two portions via which the arm is connected to the (remainder of the) connection element, while at the same time saving material and weight.

[0027] In a preferred embodiment, the center is a central axis. Preferably, the length directions of all arms of the set are thereby in essence perpendicular to the central axis. Preferably, the rotation axes of the attachment means of all arms of the set are thereby in essence perpendicular to the central axis. Preferably, the central axis is in essence parallel to the height direction of all arms of the set.

[0028] A connection element may be monolithic or may comprise several interlocked arms. In a preferred embodiment, a portion is a recess via which the arm is interlocked with another arm of the set. Preferably, the portion on each side of the projection plane of the arm via which the arm is connected to another arm of the set is a recess on each side of the projection plane of the arm via which the arm is interlocked with another arm of the set. Interlocking arms via recesses is advantageous as it allows to provide substantial strength against moment forces. Preferably, the arms of the set comprise metal. The arm interlocked with the other arm of the set may or may not be additionally welded to the other arm of the set.

[0029] In a preferred embodiment, the arm comprises a sidewall extending in the length and width directions from which each recess extends in the height direction. In another embodiment, the arm comprises opposing first and second sidewalls separated in the height direction and both extending in the length and width directions, whereby a recess on a first side of the projection plane extends from the first sidewall towards the second sidewall, and whereby a recess on an opposing second side of the projection plane extends from the second sidewall towards the first sidewall.

[0030] The set of elongated arms may comprise three, four, five, six, seven, eight, nine, ten, eleven, twelve, thirteen, fourteen, fifteen, sixteen, seventeen, eighteen, nineteen, twenty or more arms.

[0031] In a preferred embodiment, the set comprises two pairs of arms, i.e. four arms, whereby the arms of a pair comprise a common projection plane in essence perpendicular to the length directions of both arms of the pair. Preferably, the common projection planes of the two pairs are in essence perpendicular. Preferably, each arm comprises two cuboid recesses spaced along the length direction of the arm, for mutually interlocking the arms of the set.

[0032] In a preferred embodiment, the attachment means of the arms of a pair, preferably the attachment means of the arms of each pair, are positioned at opposing sides of the center.

[0033] In a preferred embodiment, the attachment means of an arm is a cylindrical connection hole comprising a rotation axis in essence parallel to the width direction.

[0034] In a preferred embodiment, the connection hole is positioned on the arm in essence centrally in the height direction. This is advantageous as a minimal amount of arm material is required for providing sufficient strength. By centrally positioning the connection hole along the height direction, over-dimensioning of arm material is avoided, which saves material and weight.

[0035] In a preferred embodiment, the arm comprises a height in the height direction and a rounded surface on one longitudinal end of the arm. Preferably, the rounded surface comprises a radius of curvature in essence equal to half of the height. Preferably, the rotation axis of the connection hole is positioned at a distance from the one longitudinal end of the arm in essence equal to or smaller than half of the height. This is advantageous as it allows for unhindered hinging around the one longitudinal end of the arm. In addition, by rounding the longitudinal end, over-dimensioning of arm material is avoided, which saves material and weight.

[0036] An arm may comprise a metal, an alloy, a plastic or a composite material, e.g. a fiber-reinforced material. In a preferred embodiment, an arm comprises metal, preferably aluminum or steel. Preferably, an arm consists of metal, preferably aluminum or steel.

[0037] In a preferred embodiment, an arm is monolithic. Preferably, an arm is a monolithic metal arm, preferably a monolithic aluminum or steel arm.

[0038] In a preferred embodiment, a beam comprises two prongs configured for positioning the attachment means of an arm of the connection element in between and further configured for hingedly attaching the beam to the attachment means. This configuration provides enlarged strength and stiffness over a single-sided attachment of a beam to an arm, cfr. Figure 1 (prior art).

[0039] In a preferred embodiment, each of the prongs

of a beam comprises a connection hole, whereby the connection holes of the two prongs comprise a common rotation axis for inserting an elongated member trough the connection holes of the two prongs and through the connection hole of the arm. Preferably, the connection holes of the two prongs of the beam are cylindrical. Preferably, each of the prongs comprises a rounded surface.

[0040] A beam may comprise a metal, an alloy, a plastic or a composite material, e.g. a fiber-reinforced material. In a preferred embodiment, a beam comprises metal, preferably aluminum. A beam may comprise a beam profile and an end portion comprising the two prongs. The beam profile may comprise a metal, an alloy, a plastic or a composite material, e.g. a fiber-reinforced material. An end portion may comprise a metal, an alloy, a plastic or a composite material, e.g. a fiber-reinforced material.

[0041] In a preferred embodiment, a beam comprises a beam profile, preferably an extruded beam profile, more preferably an aluminum extruded beam profile, and an end portion comprising the two prongs. The end portion is thereby partially insertable in the beam profile. Preferably, the end portion comprises metal, more preferably aluminum or steel. Preferably, the end portion consists of metal, more preferably aluminum or steel.

[0042] The invention is further described by the following non-limiting examples which further illustrate the invention, and are not intended to, nor should they be interpreted to, limit the scope of the invention.

Examples

Example 1: Embodiment of an elongated arm

[0043] Figure 3A shows a front view along the width direction (v) of an embodiment of an elongated arm (205a) according to the present invention.

[0044] The arm is a monolithic metal arm, preferably of aluminum. The arm comprises mutually perpendicular length (u), height (w) and width (v) directions. The arm comprises two opposing surfaces in essence parallel to the length (u) and height (w) directions and spaced in the width (v) direction, whereby the arm comprises a uniform thickness in the width direction and in between the surfaces. The arm furthermore comprises two opposing sidewalls in essence parallel to the length (u) and width (v) directions and spaced in the height (w) direction, whereby the arm comprises a height (H1) in between the sidewalls. The arm furthermore comprises a length (L1 = D1 + D2 + 2.D4 + D5 + D6) along the length direction, whereby the length is larger than the thickness and the height. The height is larger than the thickness.

[0045] The arm furthermore comprises two cuboid recesses, spaced (D5 > 0) in the length direction (u) and comprising a recess height (H2) in the height direction (w) in essence equal to half of the height (H1) of the arm. Each recess comprises in the length (u) and width (v) directions a recess dimension (D4 > 0) in essence equal to the thickness of the arm. Preferably, the recesses extend from the same sidewall in the height direction (w) towards the opposing sidewall. In another embodiment, a first recess extends from a first sidewall towards an opposing second sidewall, and another second recess extends from the second sidewall towards the first sidewall.

[0046] The arm furthermore comprises a cylindrical connection hole (203) comprising a rotation axis in essence parallel to the width direction (v). The rotation axis of the connection hole is positioned centrally along the height direction (w). The arm furthermore comprises on one longitudinal end a rounded surface in essence parallel to the width direction (v) and comprising a radius of curvature (R) in essence equal to half of the height of the arm (R = H2 = 0.5 H1). The rotation axis of the connection hole is located at a distance (D2) from the one longitudinal end of the arm which is equal to or smaller than half of the height of the arm (D2 $\leq$ H2 = 0.5 H1). Preferably, the rotation axis of the connection hole is located at a distance (D2) from the one longitudinal end of the arm of at least 8 mm. Preferably, the rotation axis of the connection hole is located at a distance (D1) from a recess of more than half of the height of the arm (D1 > H2 = 0.5 H1).

[0047] In the embodiment, partial length D6 may be larger than zero or equal to zero. Preferably, D6 is larger than zero.

Example 2: Embodiment of an elongated arm

[0048] Figure 3B shows a front view along the width direction (v) of an embodiment of an elongated arm (205b) according to the present invention. The features as disclosed in example 1 are also present in this embodiment of the arm.

[0049] The arm further comprises an additional connection hole (204) positioned along the length direction (u) in essence centrally (D8 = 0.5 D5) in between the two recesses for attaching additional components, such as, for example, tent fabric, wheels, lighting, and the like.

[0050] Preferably, H3 is less than half of the height of the arm (H3 < 0.5 H1).

Example 3: Dimensional aspects of an elongated arm

[0051] Referring to Example 1 and Figure 3A, table 1 comprises example dimensions of an elongated arm.

Table 1 - Example dimensions of an elongated arm

Parameter	Value (mm)
H1	28.00
H2	14.00
D1	18.00
D2	10.00
D4	6.00

(continued)

Parameter	Value (mm)
D5	22.00
D6	5.00
R	14.00
Diameter Z of connection hole	8.00
Thickness	6.00

Example 4: Embodiment of a connection element

[0052] Figure 2A shows a perspective view of an embodiment of a connection element according to the present invention. Figure 4 shows a top view along the common height direction of the arms of the connection element, and figure 5 shows a side view of the connection element perpendicular to the height direction.

[0053] The connection element (201) comprises a set of two pairs of arms (205) according to any one of the previous examples 1, 2 and 3. The arms of each pair are in essence parallel, i.e. the length directions of the arms of each pair are in essence parallel, the height directions of the arms of each pair are in essence parallel, and the width directions of the arms of each pair are in essence parallel. The arms of each pair comprise a common projection plane (206) in essence perpendicular to the length directions (u) of the arms of the pair. The common projection planes of the two pairs are in essence perpendicular. The connection element comprises a central axis (207), which is in essence parallel to the height directions (w) of all four arms of the set. The common projection planes intersect in the central axis.

[0054] Each arm of the set is positioned off-center, i.e. at a distance from the central axis, thereby forming a cavity (291) in between the arms which comprises the center. This distance is preferably half of the distance in between the two cuboid recesses of an arm (0.5 D5). Each arm comprises a recess on each side of the projection plane of the arm via which the arm is interlocked with another arm of the set.

[0055] Depending on whether the cuboid recesses extend from the same sidewall or from opposing sidewalls, the connection element (201) comprises in essence two-fold or in essence four-fold rotational symmetry around the central axis.

[0056] The arms of a pair are spaced over a distance of at least 5 mm, preferably at least 10 mm, more preferably at least 15 mm, and most preferably at least 20 mm. The centers in the width direction of the arms of a pair are spaced over a distance (D3 = D5 + D4) of at least 10 mm, preferably at least 15 mm, more preferably at least 20 mm, and most preferably at least 25 mm.

Example 5: Dimensional aspects of a connection element

[0057] A connection element according to Example 4 and as shown in Figures 2A, 4 and 5 may comprise in addition to the example dimensions listed in Table 1, the additional example dimensions as enclosed in Table 2.

Table 2 - Additional example dimensions of a connection element

Parameter	Value (mm)
D3	28.00
D7	14.00
D1 + D2	28.00
L1	67.00
L2	90.00

Example 6: Embodiment of a connection element

[0058] Figure 2B shows a perspective view of an embodiment of a connection element according to the present invention. The features as disclosed in example 4 are also present in this embodiment of the arm.

[0059] However, partial length D6 is in this case zero. This has the advantage of reducing material and weight and avoiding a corresponding protrusion. The interlocking arms are then preferably additionally welded to obtain sufficient strength.

Example 7: Embodiment of a beam

[0060] Figures 6A and 6B show a side view and a perspective view, respectively, of an embodiment of a beam end portion (211) according to the present invention. Figure 7 shows a perspective view of an embodiment of a beam profile (210) according to the present invention. Figure 8A shows a perspective view of a part of a beam (600) according to the present invention. Figures 8B and 8C show a perspective view of a portion of an embodiment of a structure according to the present invention comprising beams (600) and one or more connection elements (201).

[0061] The structure comprises a connection element (201) and a beam (600). The beam (600) comprises an aluminum extruded beam profile (210) comprising two attachment holes (224). The beam further comprises an end portion (211) comprising two prongs (230), each comprising a cylindrical connection hole (212) and a rounded surface (299). The connection holes comprise a common rotation axis. The end portion further comprises protruding rims (223) for placement against the beam profile (210) upon insertion of the end portion in the beam profile (210). The end portion also comprises a set of barbs (298) for contact with one or more inner surfaces of the beam profile (210). Through each of the attachment

holes (224) a rivet (296) may be inserted for attachment of the end portion (211) to the beam profile (210).

[0062] An arm of the connection element (201) comprises a connection hole (203). The arm may or may not be provided with a bearing in the connection hole. The arm may or may not comprise a rim on one or both sides of the connection hole. The connection hole (203) of the arm may be placed in between the connection holes (212) of the two prongs, and an elongate member (243) may be inserted through all three connection holes (i.e. of the two prongs and the arm) for hingedly attaching the beam (600) to the connection element (201).

Example 8: Embodiment of a scissor arch framework

[0063] Figures 9A, 9B and 9C show, respectively, a perspective view, front view and top view of an embodiment of a scissor arch in deployed state according to the present invention. Figures 10A, 10B and 10C show, respectively, a top view, a side view and a front view of the embodiment of the scissor arch shown in Figures 9A, 9B and 9C in compacted transport state. Due to the particular design of the connection element, the scissor arch may be folded to a compacted transport state in which the beams are adjacent.

Example 9: Dimensional aspects of a scissor arch framework

[0064] Referring to example 10, the scissor arch framework comprises in an embodiment a height (H9) of 3404 mm, a depth (W9) of 4150 mm and a span (L9) of 7019 mm. This scissor arch may be folded to a compacted cuboid transport state comprising the dimensions of 2065 mm (H20) x 448 mm (D20) x 232 mm (D21), whereby the largest dimension (H20) is in essence determined by the beams.

[0065] To reduce the dimensions further, telescoping beams may be provided. A telescoping beam may comprise a central beam profile wherein two extension profiles are telescopically inserted on opposing ends. Alternatively, the extension profiles may be telescopically mounted on the outside of the central beam profile. Relative fixation may be ensured, via elongate fixation members such as, for example, pins, bolts, screws, and the like.

Example 10: Monolithic connection element

[0066] Figures 11A, 11B and 11C show a top view and two perspective views, respectively, of embodiments of monolithic connection elements (201", 201"', 201"") according to the present invention.

[0067] The connection element comprises a central axis and two pairs of in essence parallel elongated arms (205", 205"', 205""). Each arm comprises a length direction (u), a width direction (v) and a height direction (w) which are mutually orthogonal. The height direction of each arm is in essence parallel to the central axis. Each arm further comprises a projection plane comprising the central axis and in essence perpendicular to the length direction. Each arm of the set is positioned off-center at a distance from the central axis and comprises a portion on each side of the projection plane of the arm via which the arm is connected to the connection element. Each arm further comprises an attachment means (203"', 203"") for hingedly attaching a beam.

[0068] The connection element furthermore comprises a cavity (291", 291"', 291"") which comprises the central axis. Preferably the cavity is cylindrical, whereby the cylindrical cavity comprises said central axis. Preferably, the connection element comprises four-fold rotation symmetry around the central axis.

[0069] Preferably, the attachment means is a cylindrical connection hole (203"") comprising a rotation axis in essence parallel to the width direction (v). The rotation axis of the connection hole is positioned centrally along the height direction (w). The arm (Figure 11c) furthermore comprises a height in the height direction and on one longitudinal end a rounded surface in essence parallel to the width direction (v) and comprising a radius of curvature in essence equal to half of the height of the arm. The rotation axis of the connection hole is located at a distance from the one longitudinal end of the arm which is equal to or smaller than half of the height of the arm. Preferably, the rotation axis of the connection hole is located at a distance from the one longitudinal end of the arm of at least 8 mm.

Claims

1. Structure, preferably the structure being a tent framework, comprising multiple beams (600) and a connection element (201) comprising a center (207) and a set of elongated arms (205) each comprising a length direction (u), a projection plane (206) comprising the center and in essence perpendicular to the length direction, and an attachment means (203) for hingedly attaching a beam, **characterized in that,** an arm of the set, preferably each arm of the set, is positioned off-center at a distance from the center and comprises a portion on each side of the projection plane of the arm via which the arm is connected to the connection element.

2. Structure according to preceding claim 1, whereby said portion on each side of the projection plane of the arm via which the arm is connected to the connection element is a portion on each side of the projection plane of the arm via which the arm is connected to another arm of the set.

3. Structure according to preceding claim 2, whereby said portion on each side of the projection plane of the arm via which the arm is connected to another

arm of the set is a recess on each side of the projection plane of the arm via which the arm is interlocked with another arm of the set.

4. Structure according to preceding claim 3, whereby said arm, preferably each arm of the set, comprises mutually perpendicular length, height and width directions, whereby the attachment means of the arm comprises a rotation axis in essence parallel to the width direction, and whereby the arm comprises a sidewall extending in the length and width directions from which each recess extends in the height direction.

5. Structure according to any one of the preceding claims, whereby the arms of the set form a cavity comprising the center.

6. Structure according to any one of the preceding claims, whereby the center is a central axis.

7. Structure according to any one of the preceding claims, whereby the set comprises two pairs of arms, whereby the arms of a pair comprise a common projection plane in essence perpendicular to the length directions of both arms of the pair, and whereby the common projection planes of the arms of the two pairs are in essence perpendicular.

8. Structure according to preceding claim 7, whereby the attachment means of the arms of a pair, preferably the attachment means of the arms of each pair, are positioned at opposing sides of the center.

9. Structure according to any one of the preceding claims, whereby said arm, preferably each arm of the set, comprises mutually perpendicular length, height and width directions, whereby the attachment means of the arm is a cylindrical connection hole comprising a rotation axis in essence parallel to the width direction.

10. Structure according to preceding claim 9, whereby the connection hole is positioned on the arm in essence centrally in the height direction.

11. Structure according to any one of preceding claims 9 and 10, whereby the arm comprises a height (H1) in the height direction and a rounded surface on one longitudinal end of the arm, whereby the rounded surface comprises a radius of curvature (R) in essence equal to half of the height, whereby the rotation axis of the connection hole is positioned at a distance (D2) from the one longitudinal end of the arm, whereby the distance (D2) is in essence equal to or smaller than half of the height.

12. Structure according to any one of the preceding claims, wherein a beam (600) comprises an end portion (211) comprising two prongs (230) configured for positioning the attachment means (203) of an arm (205) of the connection element in between and further configured (212) for hingedly attaching the beam to the attachment means (203).

13. Connection element for a tent framework, the connection element (201) comprising a center (207) and a set of elongated arms (205) each comprising a length direction (u), a projection plane (206) comprising the center and in essence perpendicular to the length direction, and an attachment means (203) for hingedly attaching a beam, **characterized in that,** an arm of the set, preferably each arm of the set, is positioned off-center at a distance from the center and comprises a portion on each side of the projection plane of the arm via which the arm is connected to the connection element.

14. Method for building a tent framework, comprising the steps of:

- providing multiple beams;
- providing a connection element comprising a center and a set of elongated arms, each arm of the set positioned off-center at a distance from the center and connected to at least two other arms of the set; and
- for each of the beams, hingedly attaching the beam to an arm of the set.

15. Method according to preceding claim 14, wherein each beam (600) comprises an end portion (211) comprising two prongs (230), wherein each arm comprises an attachment means (203), wherein the method comprises for each of the beams the steps of:

- positioning the attachment means (203) of an arm of the connection element in between the prongs (230) of the beam; and
- hingedly attaching the beam to the attachment means (203).

Figures

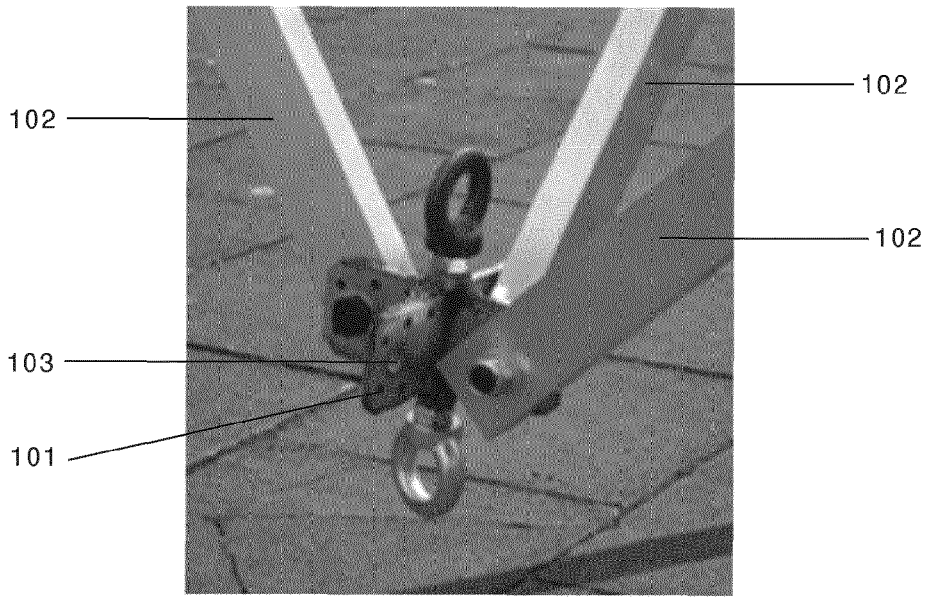

Fig. 1 – prior art

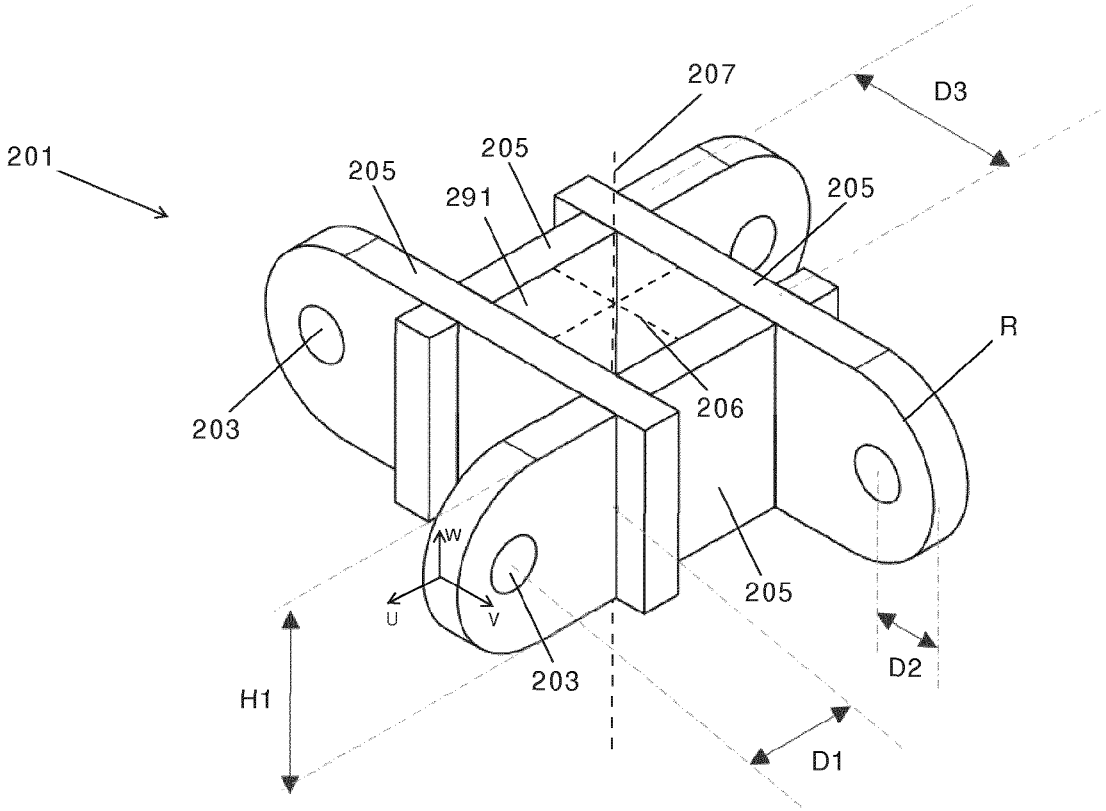

Fig. 2A

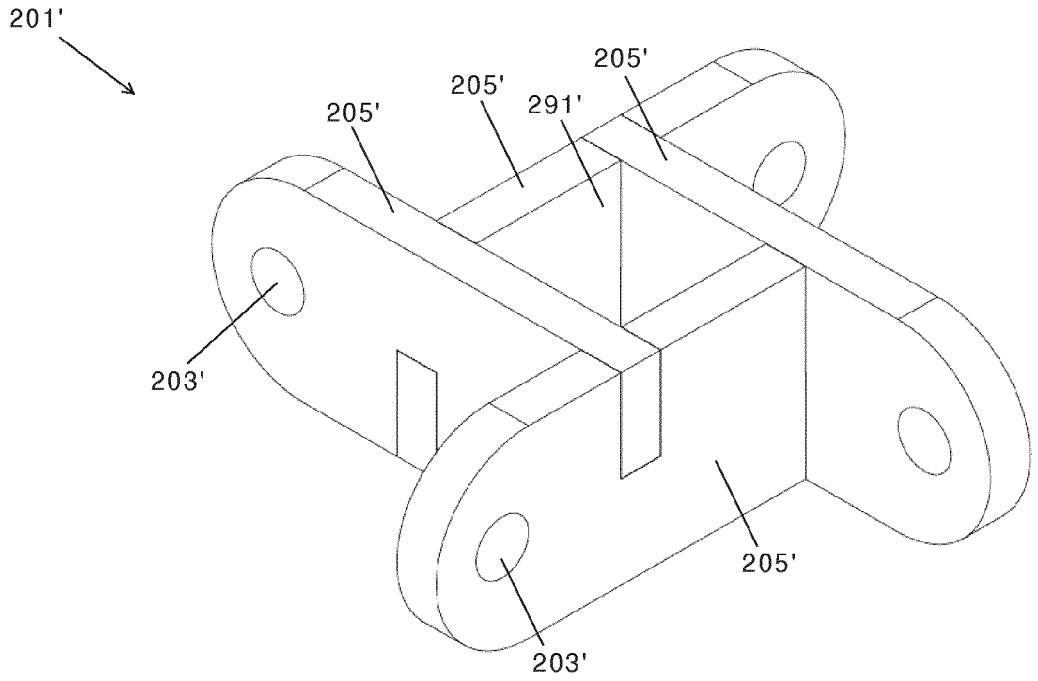

Fig. 2B

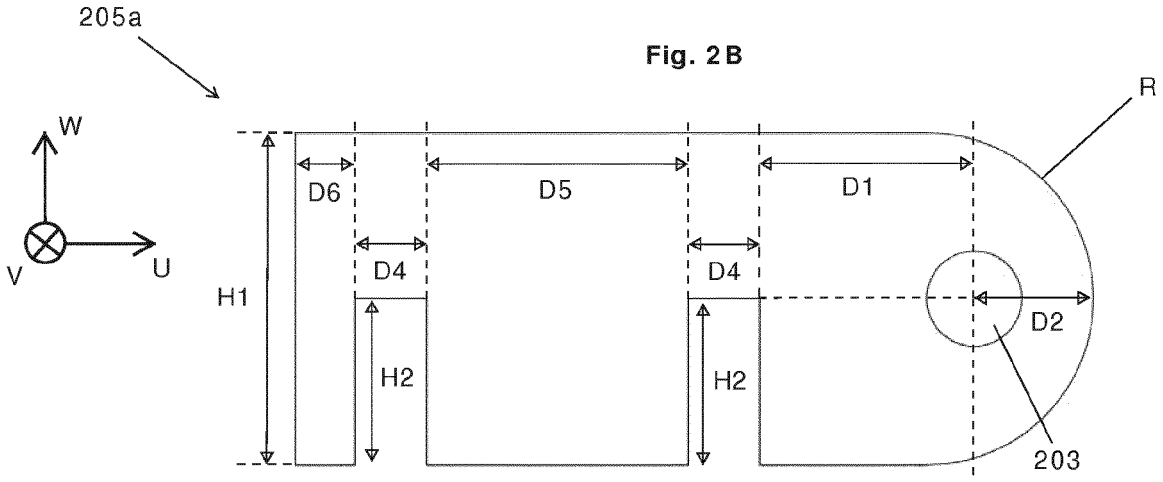

Fig. 3A

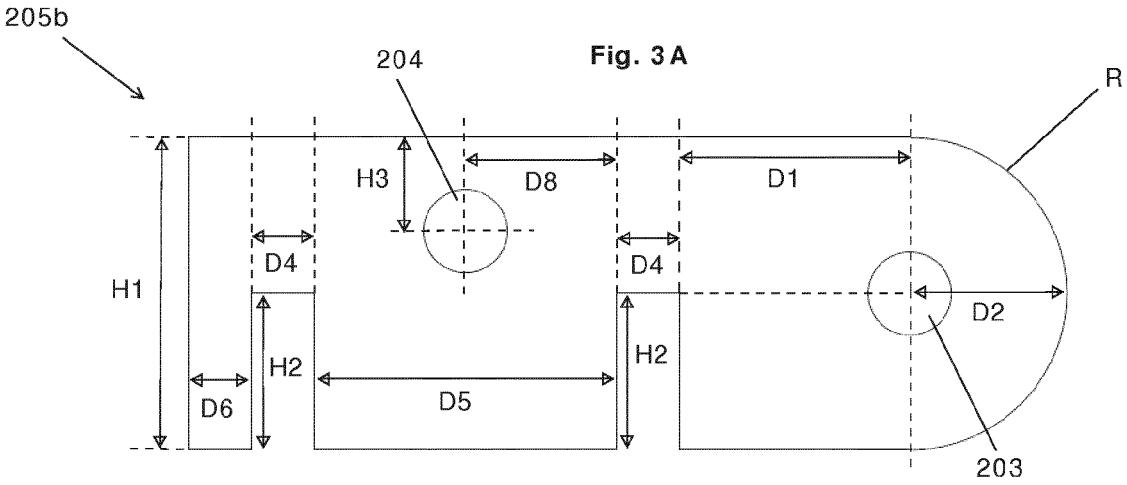

Fig. 3B

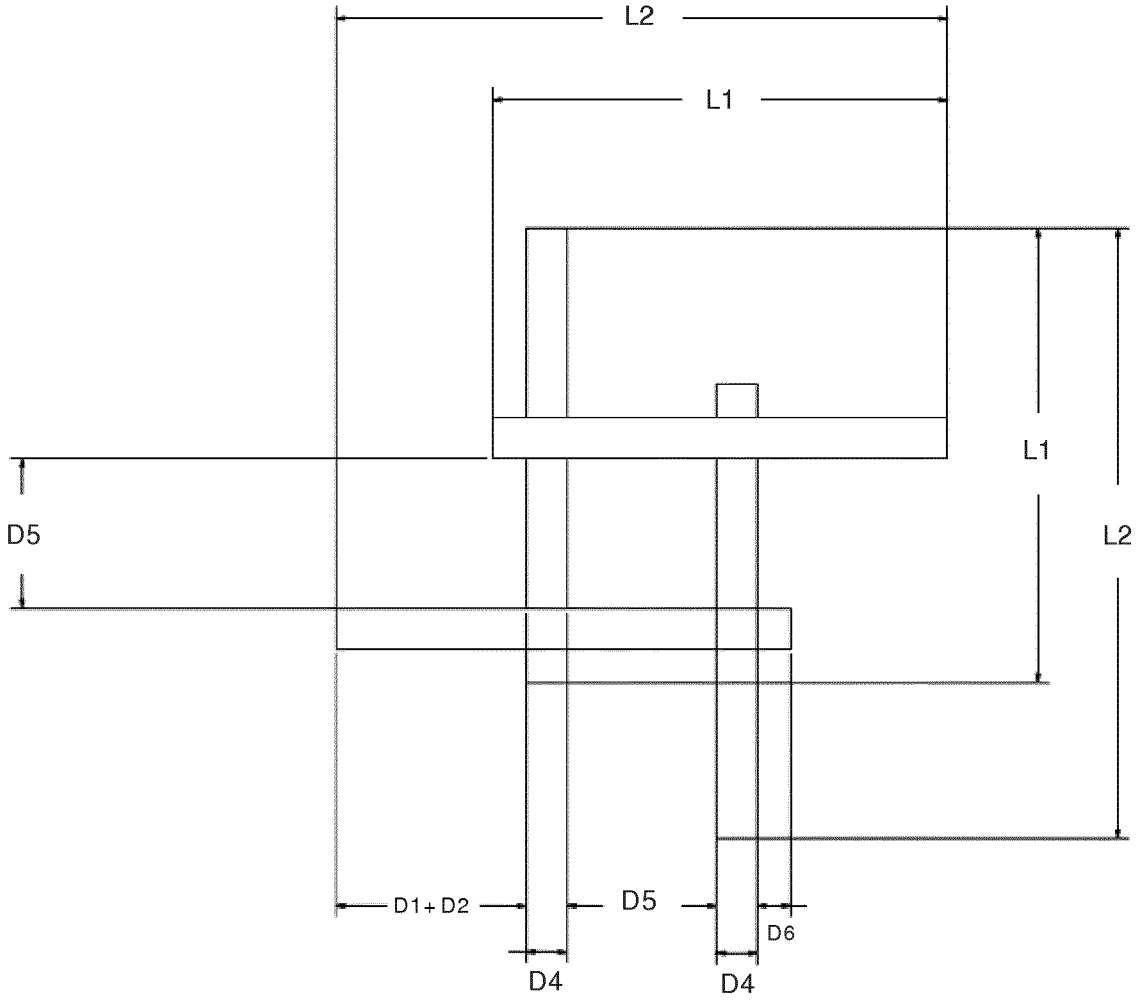

Fig. 4

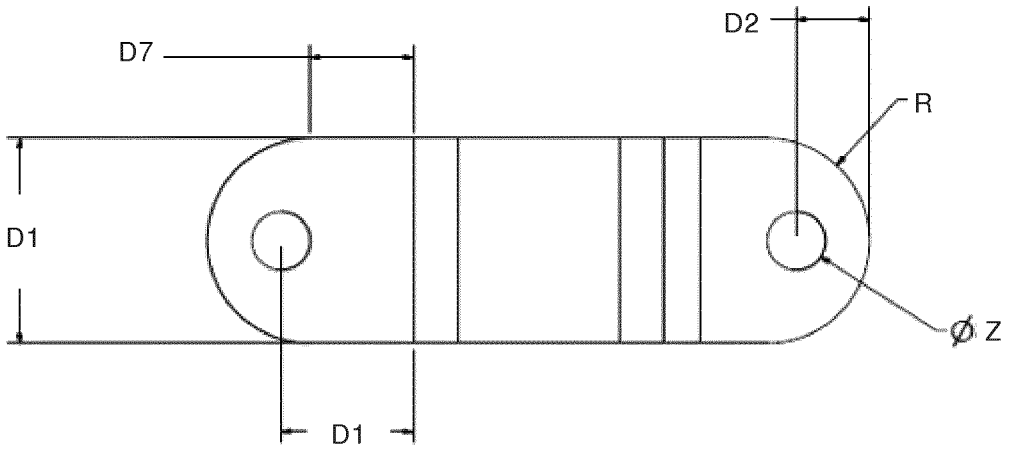

Fig. 5

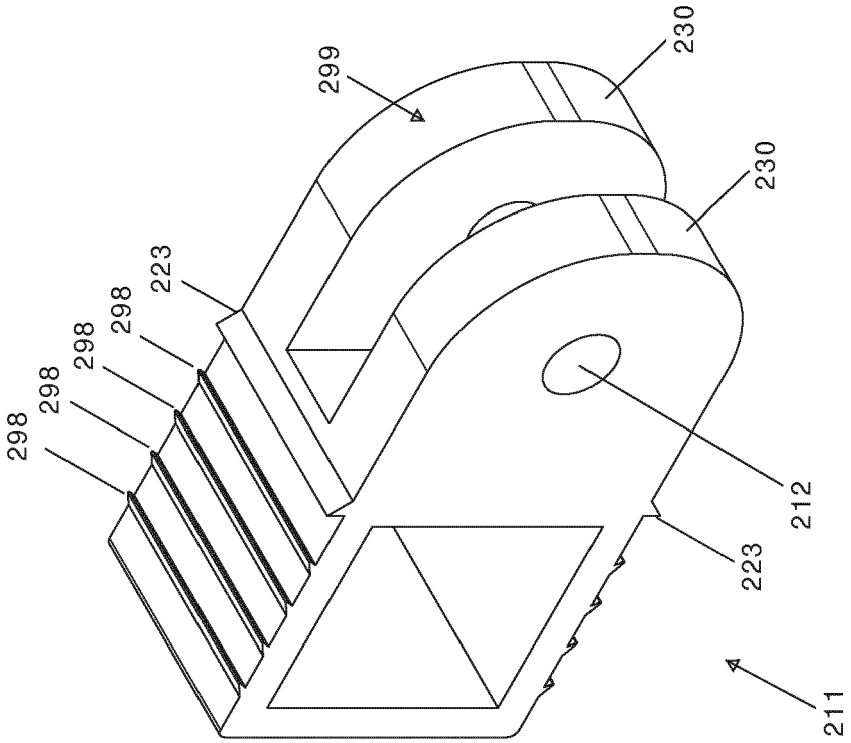
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Fig. 6B

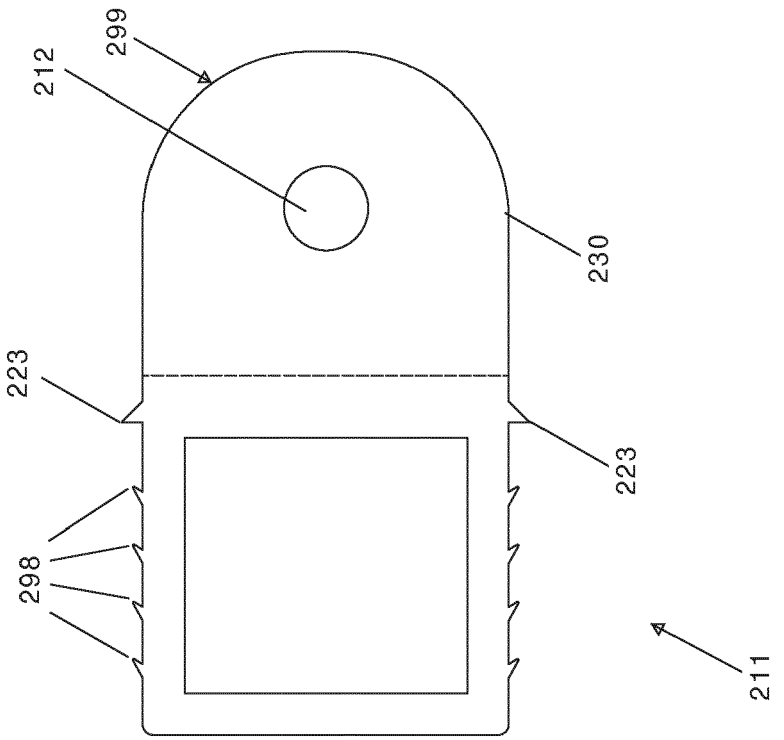
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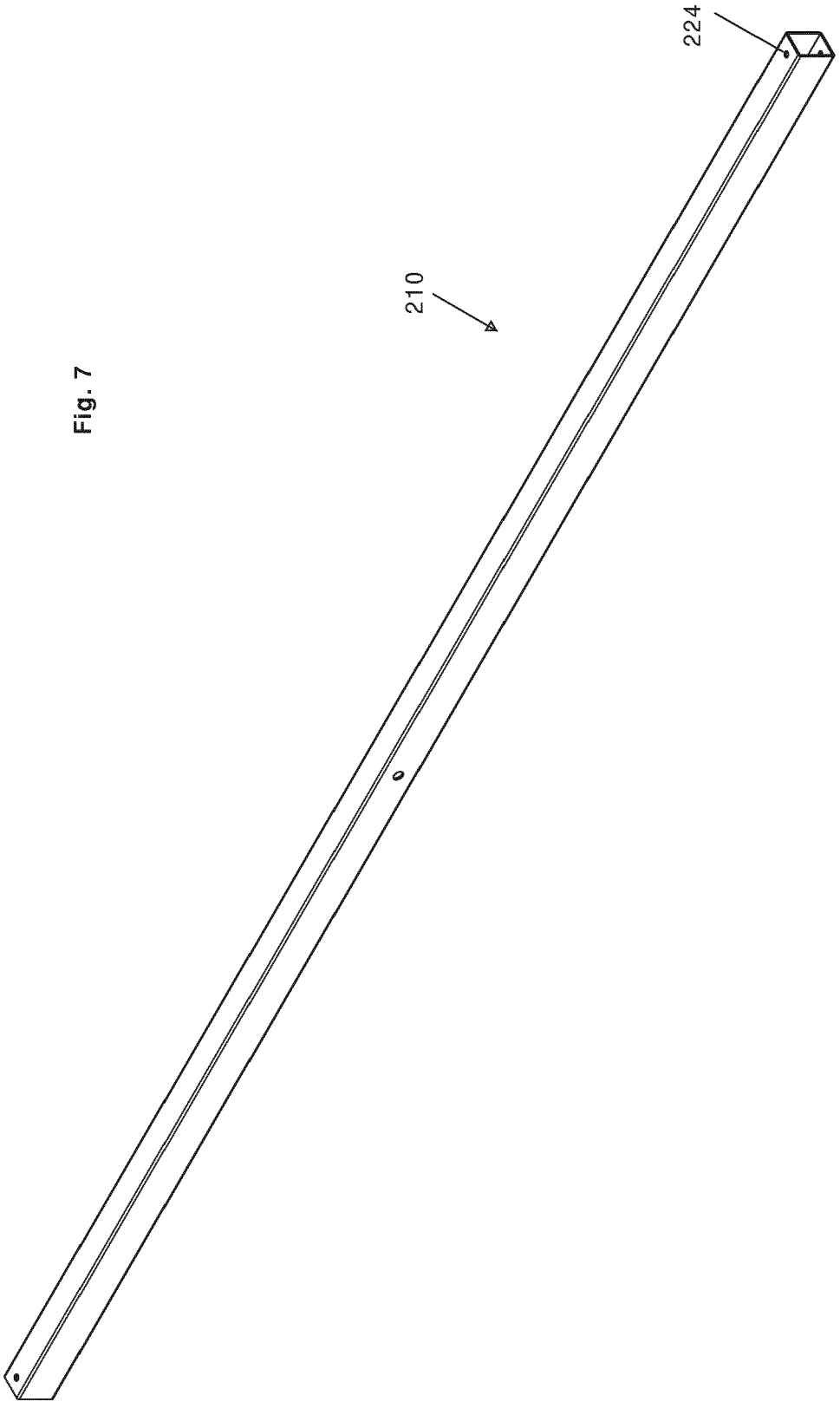
Fig. 6A

Fig. 7



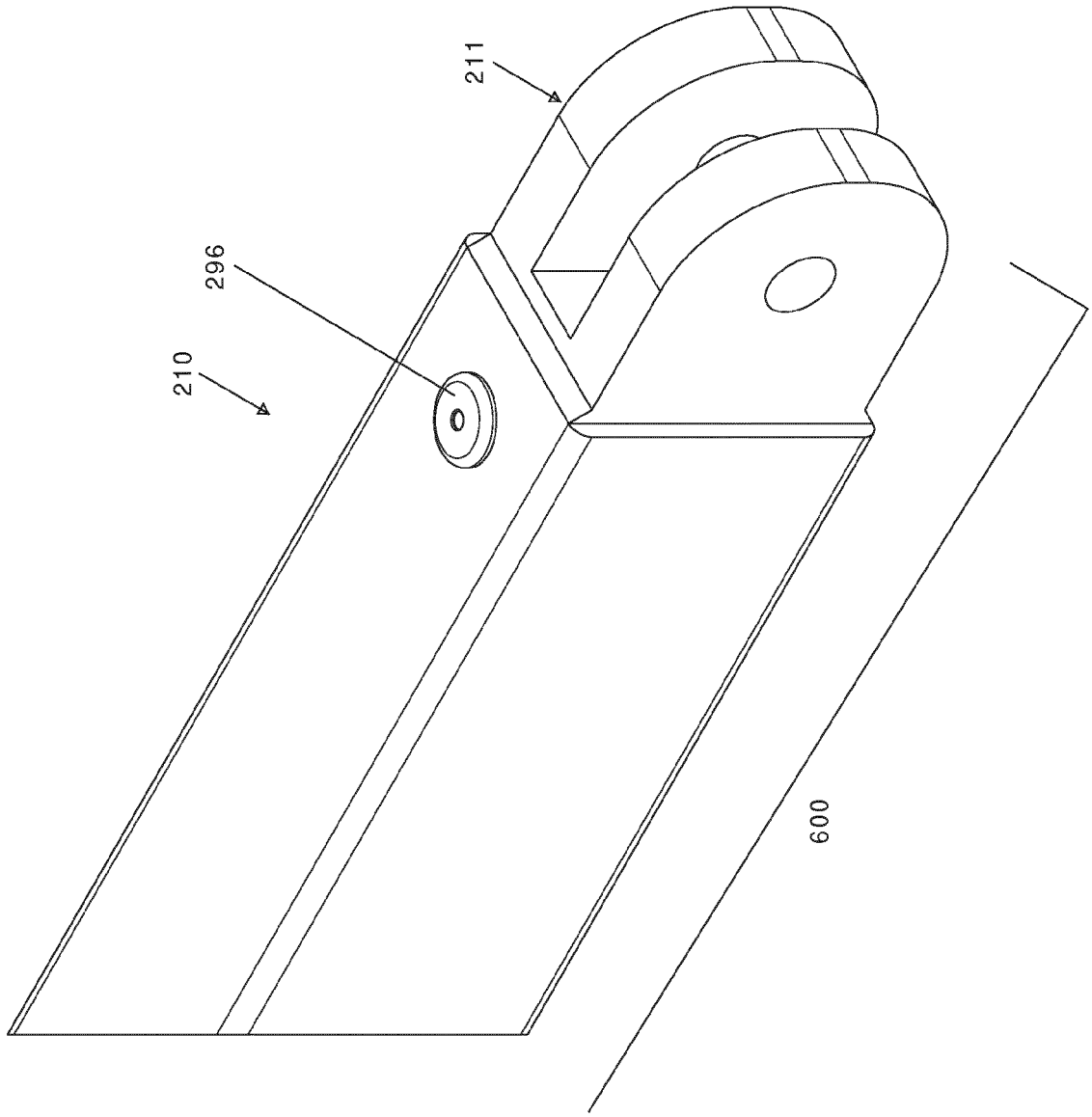


Fig. 8A

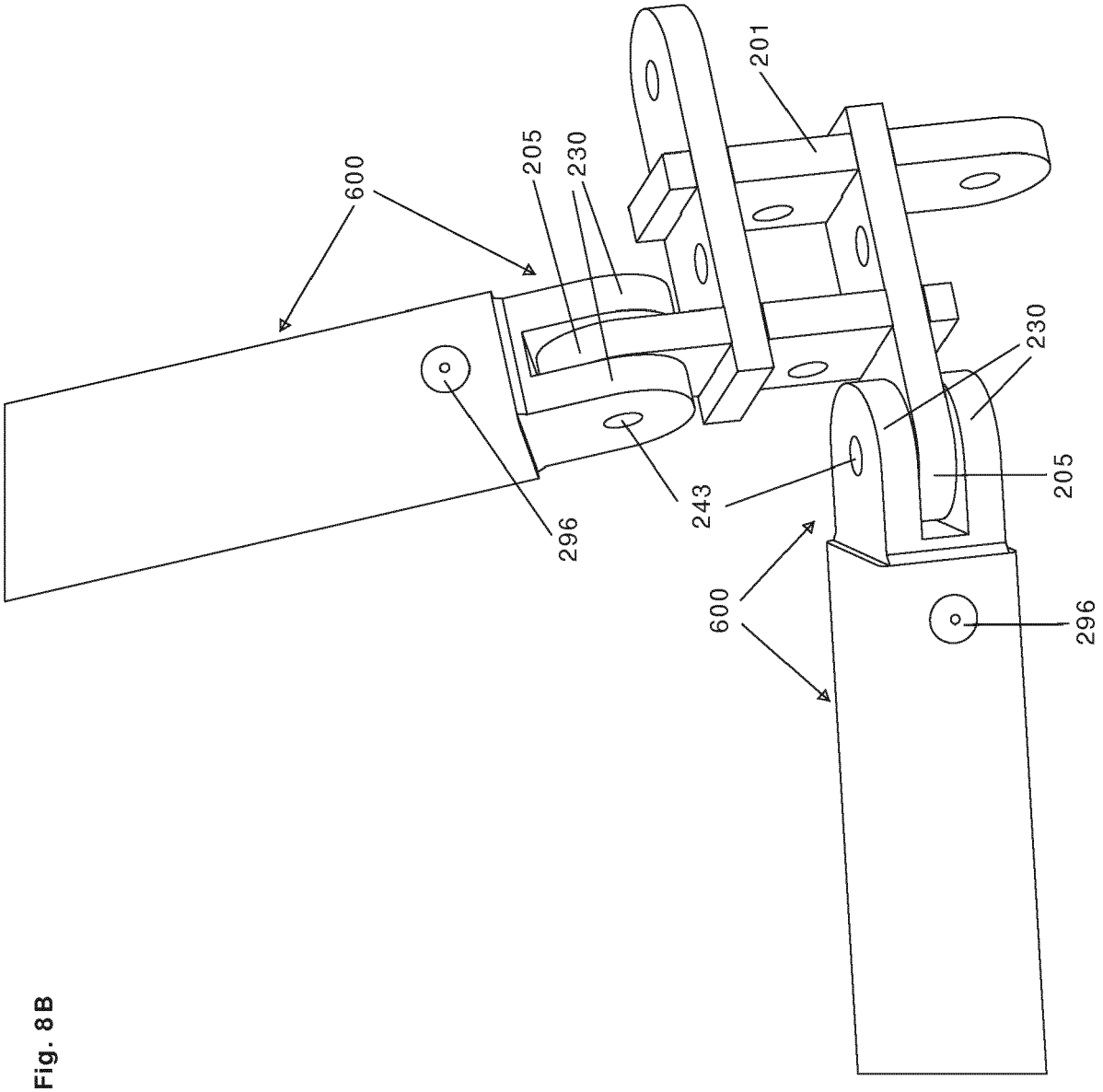


Fig. 8B

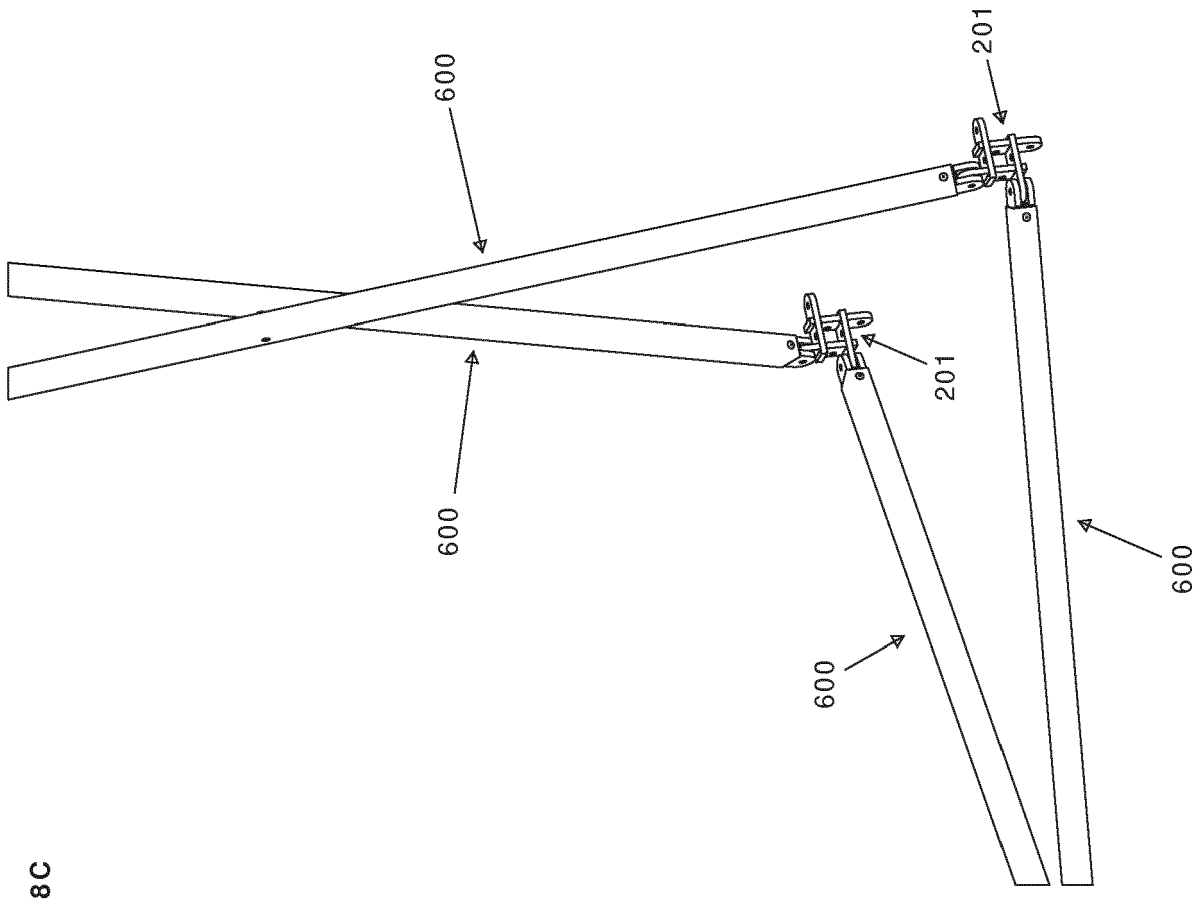


Fig. 8C

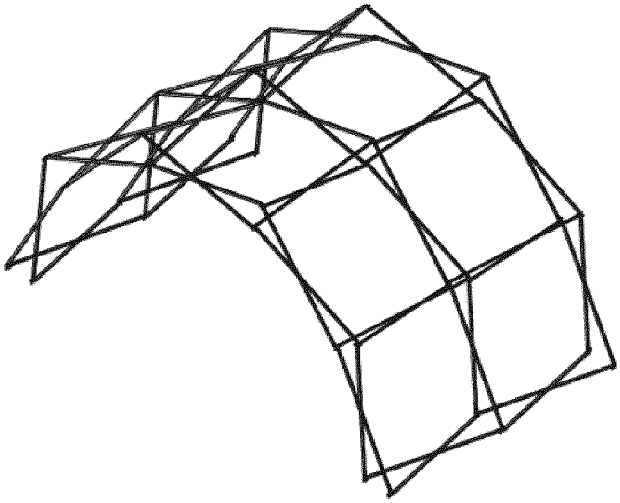


Fig. 9A

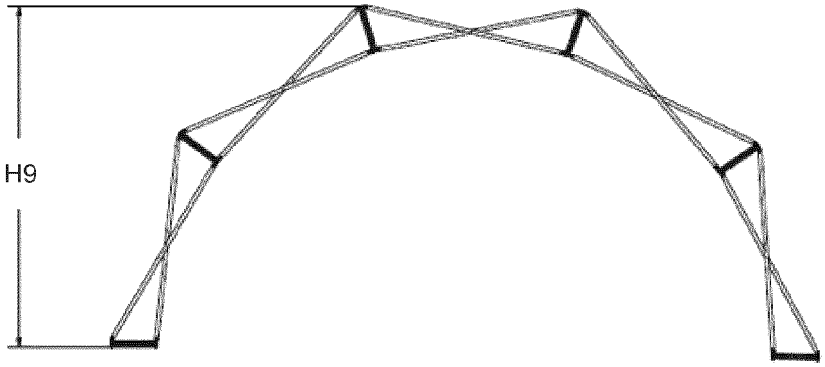


Fig. 9B

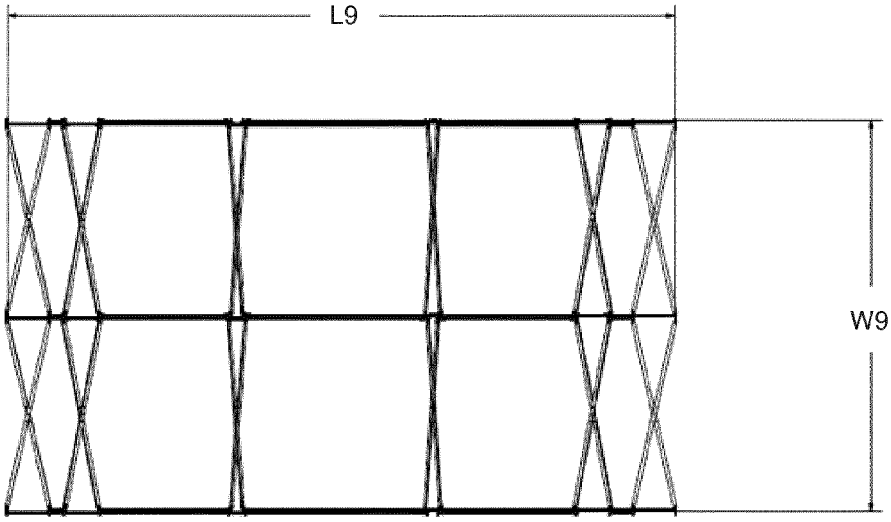
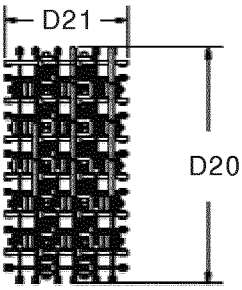


Fig. 9C

Fig. 10A



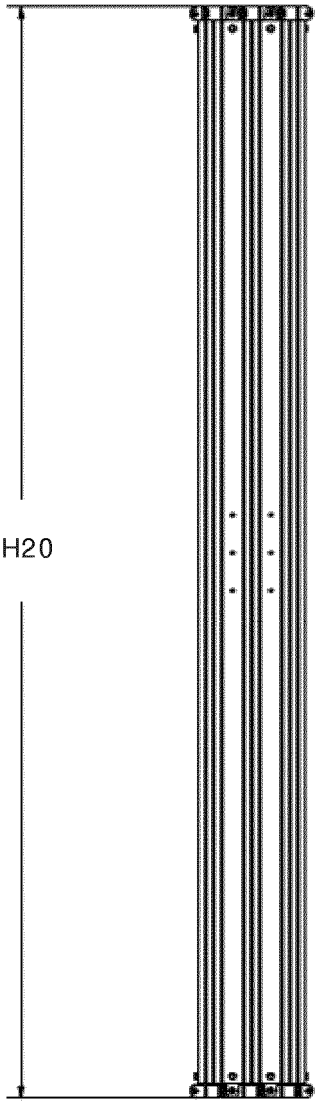


Fig. 10B

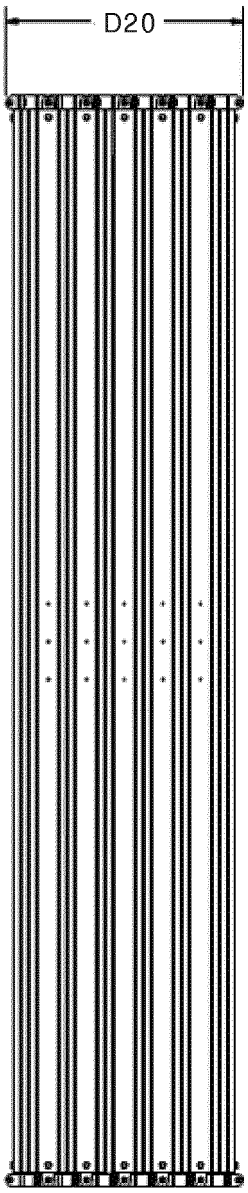


Fig. 10C

Fig. 11C

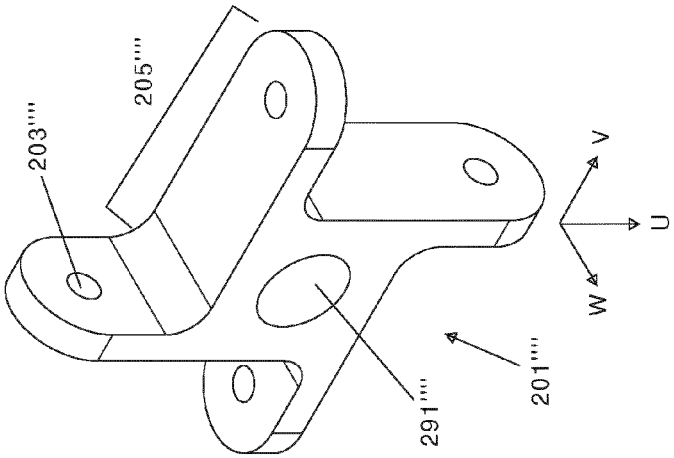


Fig. 11B

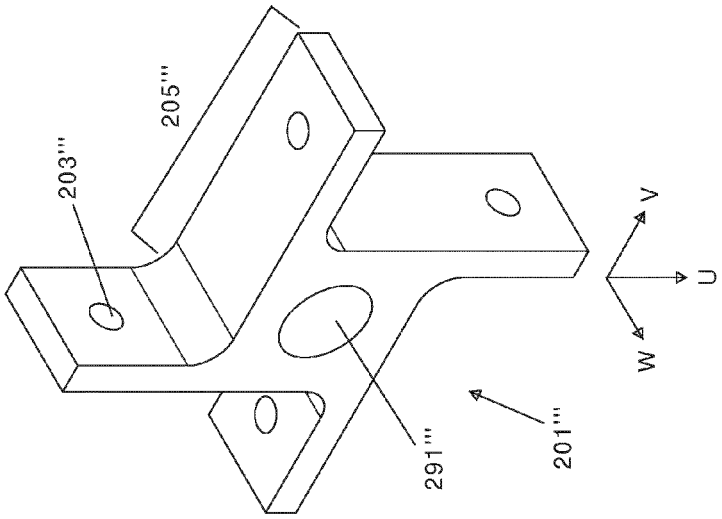
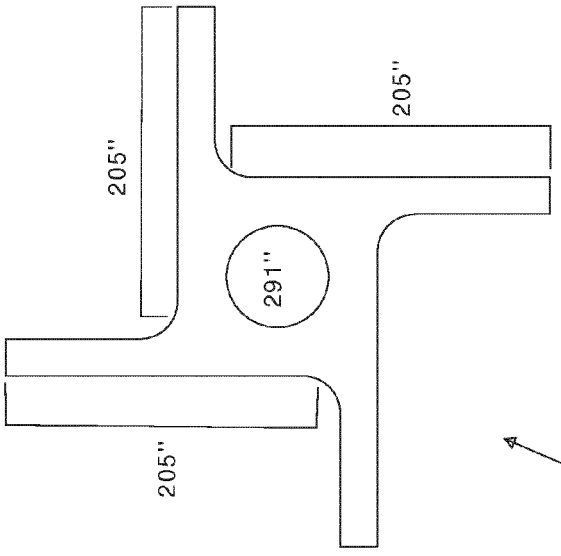


Fig. 11A



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EUROPEAN SEARCH REPORT

Application Number
EP 18 16 6929

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2 928 404 A (KLAGES JOHN W) 15 March 1960 (1960-03-15) * claim 1; figures 5,6 *	1-3,5,6, 9,10,13, 14	INV. E04H15/48
X	US 9 163 425 B1 (KUBICA RYAN L [US] ET AL) 20 October 2015 (2015-10-20) * claim 1; figures 1,2 *	1-10,13, 14	
X	US 2003/172966 A1 (DOTTERWEICH MARTIN J [US] ET AL) 18 September 2003 (2003-09-18) * figures 2,7 *	1,2, 5-11,13, 14	
X	US 2007/240748 A1 (BAE SANG-JIN [KR]) 18 October 2007 (2007-10-18) * claim 1; figures 1,4,11 *	1,2,5-9, 12-15	
A	US 2017/241159 A1 (LYON AARON [US]) 24 August 2017 (2017-08-24) * figures 6a-c *	12,15	

TECHNICAL FIELDS SEARCHED (IPC)

E04H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	26 September 2018	Rosborough, John

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26-09-2018

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- **L. A. MIRA ; A. P. THRALL ; N. DE TEMMERMAN.** Deployable scissor arch for transitional shelters. *Automation in Construction,* 2014, vol. 43, 123-131 **[0003]**