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(54) APPARATUS AND METHOD

(57) A helical ramp 12 has an axis A defining a plane P orthogonal thereto, the helical ramp 12 comprising:
a first set of treads 121, including a first tread, wherein the first tread 121A of the first set of treads 121 is inclined at a first angle A1 to the plane P; and
a second set of treads 122, including a first tread, wherein the first tread 122A of the second set of treads 122 is inclined at a second angle A2 to the plane P;
wherein the first tread 121A of the first set of treads 121 and the first tread 122A of the second set of treads 122 are mutually adjacent, defining a first linear boundary 123A of a set of linear boundaries 123 therebetween.

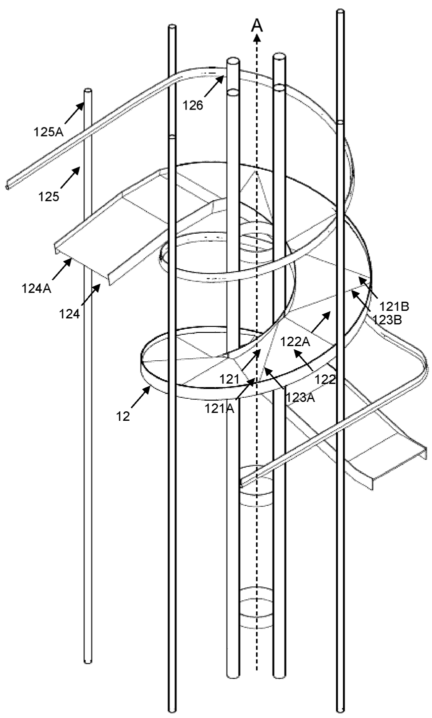

Fig. 12A

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Description

Field

[0001] The present invention relates to towers for ziplines.

Background to the invention

[0002] Typically, a zipline (also known as a zip-line, zip wire, aerial runway or aerial ropeslide) comprises an inclined cable, secured only at upper and lower ends thereof, and a trolley (also known as a bogey), including a freely-rolling pulley. A user (i.e. a load), suspended from the trolley, may be accelerated by gravity from the upper end to the lower end of the inclined cable. In use, the pulley rolls along an uppermost portion of the inclined cable. A gradient of the inclined cable is typically in a range from 1 in 20 to 1 in 30. Usually, the inclined cable sags and appropriate tensioning of the inclined cable is required to control acceleration of the user. Since the inclined cable is secured only at the upper and the lower ends thereof, the inclined cable is restricted to a linear path, without lateral deviations, such as curves or bends.

[0003] To provide a non-linear path including lateral deviations, such as curves or bends, the cable may be replaced with a rail, typically a monorail. The non-linear path enables the rail to curve around obstacles, for example, and/or to increase user enjoyment. An uppermost portion of the rail may be fixed to a framework or hung from ceiling joists or trees, for example, such that a region under the rail remains unobstructed for the trolley and the user to travel through. That is, the rail is a suspended rail, situated at a height typically in a range from 2 m to 10 m, above the ground. A typical rail includes a tube having an axial (also known as longitudinal) flange, for fixing or hanging, upstanding therefrom. The pulley is replaced by one or more freely-rolling wheels, that roll along the rail on an upper lateral portion or portions thereof, clear of the fixed uppermost portion. For example, the wheels may roll either side of the axial flange. For safety, the trolley is arranged to be captive on the rail, such that the trolley (i.e. a captive trolley) remains on the rail, in use. Two or more trolleys may be captive on the rail, such that two or more respective users may travel thereon. The rail is generally inclined, having a mean gradient typically in a range from 1 in 10 to 1 in 60, though may include one or more descending portions, ascending portions and/or horizontal portions. A total length of the rail may be in excess of 500 m, including multiple curves or bends, descending portions, ascending portions and/or horizontal portions. An installed rail may be known as a rail track. The rail may be a continuous (also known as an endless) rail, forming a closed rail track.

[0004] Depending on the terrain for outdoor ziplines and typically for indoor ziplines, towers are provided for users to ascend to starts of the ziplines, situated at a height typically in a range from 2 m to 10 m. One or more intermediate towers, between the starts and finishes of the ziplines, may also be provided, for users to ascend to restarts of the ziplines. Typically, the towers include spiral stairs for users to ascend to the starts and/or the restarts. Usually, a user is attached to a trolley on the zipline via a harness (also known as a suspension harness), which the user puts on before ascending the tower and typically checked by an operator of the zipline, for safety. In this way, the user is attached to the zipline before ascending the tower, thereby improving safety. The harness typically includes a dorsal D-ring, for example, for attaching to the trolley via a primary sling or lanyard, that is usually adjustable according to a height of the user, and typically includes a secondary sling or lanyard for safety. The user pulls the trolley up the zipline while ascending the tower. Typically, one or more non-return gates (also known as one-way gates) are included on the zipline to prevent users descending the tower, to limit congestion in the tower. A problem arises in that during ascending by a user, the primary sling or lanyard and/or the secondary sling or lanyard may become twisted, thereby compromising user safety.

[0005] Hence, there is a need to improve towers for ziplines.

Summary of the Invention

[0006] It is one aim of the present invention, amongst others, to provide a ramp for a tower for a zipline which at least partially obviates or mitigates at least some of the disadvantages of the prior art, whether identified herein or elsewhere. For instance, it is an aim of embodiments of the invention to provide a ramp that reduces, minimises and/or prevents the primary sling or lanyard and/or the secondary sling or lanyard of a harness becoming twisted during ascending by a user, thereby improving user safety.

[0007] A first aspect provides helical ramp having an axis defining a plane orthogonal thereto, the helical ramp comprising:

a first set of treads, including a first tread, wherein the first tread of the first set of treads is inclined at a first angle to the plane; and
a second set of treads, including a first tread, wherein the first tread of the second set of treads is inclined at a second angle to the plane;
wherein the first tread of the first set of treads and the first tread of the second set of treads are mutually adjacent, defining a first linear boundary of a set of linear boundaries therebetween.

[0008] A second aspect provides an assembly comprising a helical ramp according to the first aspect and a helical rail for a trolley for a zipline.

[0009] A third aspect provides a tower for a zipline comprising a helical ramp according to the first aspect.

[0010] A fourth aspect provides a method of manufacturing a helical ramp according to the first aspect and/or an assembly according to the second aspect and/or a tower according to the third aspect, comprising:

inclining the first tread of the first set of treads at the first angle to the plane; and
inclining the first tread of the second set of treads at the second angle to the plane;

wherein the first tread of the first set of treads and the first tread of the second set of treads are mutually adjacent, defining a first linear boundary of a set of linear boundaries therebetween.

Detailed Description of the Invention

[0011] According to the present invention there is provided a ramp, as set forth in the appended claims. Also provided is an assembly, a tower and a method of manufacturing. Other features of the invention will be apparent from the dependent claims, and the description that follows.

Helical ramp

[0012] The first aspect provides a helical ramp having an axis defining a plane orthogonal thereto, the helical ramp comprising:

a first set of treads, including a first tread, wherein the first tread of the first set of treads is inclined at a first angle to the plane; and
a second set of treads, including a first tread, wherein the first tread of the second set of treads is inclined at a second angle to the plane;

wherein the first tread of the first set of treads and the first tread of the second set of treads are mutually adjacent, defining a first linear boundary of a set of linear boundaries therebetween.

[0013] Without wishing to be bound by any theory, the inventors have identified that the helical ramp, rather than conventional spiral stairs, reduces, minimises and/or prevents the primary sling or lanyard and/or the secondary sling or lanyard of a harness becoming twisted during ascending by a user, thereby improving user safety. It is understood that during ascending of the conventional spiral helical stairs by a user, the relatively discontinuous path in the ascension of the user due to the conventional stairs allows and/or urges twisting of the primary sling or lanyard and/or the secondary sling or lanyard of a harness. In contrast, during ascending of the helical ramp by a user, the relatively continuous path in the ascension of the user reduces, minimises and/or prevents twisting of the primary sling or lanyard and/or the secondary sling or lanyard of a harness, thereby improving user safety.

[0014] A helix (mathematics) is a curve on the surface of a cylinder or cone such that its angle to a plane perpendicular to the axis is constant; the three-dimensional curve seen in a screw or a spiral staircase. A spiral (geometry) is a curve that is the locus of a point that rotates about a fixed point while continuously increasing its distance from that point. Generally, a helix is a shape like a corkscrew or spiral staircase. It is a type of smooth space curve with tangent lines at a constant angle to a fixed axis. A "filled-in" helix - for example, a "spiral" (helical) ramp - is a surface called helicoid. In one example, the helical ramp comprises and/or is a helicoid. The pitch of a helix is the height of one complete helix turn, measured parallel to the axis of the helix. In one example, the pitch of the helical ramp is constant. A double helix consists of two (typically congruent) helices with the same axis, differing by a translation along the axis. In one example, the helical ramp comprises and/or is a double helical ramp. A circular helix (i.e. one with constant radius) has constant band curvature and constant torsion. In one example, the helical ramp comprises and/or is a circular helical ramp. An elliptical helix (i.e. one with non-constant radius) has non-constant band curvature and/or non-constant torsion. In one example, the helical ramp comprises and/or is an elliptical helical ramp. A conic helix, also known as a conic spiral, may be defined as a spiral on a conic surface, with the distance to the apex an exponential function of the angle indicating direction from the axis. In one example, the helical ramp comprises and/or is a conical helical ramp. A curve is called a general helix or cylindrical helix if its tangent makes a constant angle with a fixed line in space. A curve is a general helix if and only if the ratio of curvature to torsion is constant. In one example, the helical ramp comprises and/or is a general helical ramp. A curve is called a slant helix if its principal normal makes a constant angle with a fixed line in space. A slant helix may be constructed by applying a transformation to the moving frame of a general helix. In one example, the helical ramp comprises and/or is a slant helical ramp. Helices can be either right-handed or left-handed. In one example, the helical ramp comprises and/or is a right-handed helical ramp. In one example, the helical ramp comprises and/or is a left-handed helical ramp.

[0015] The helical ramp has the axis defining the plane orthogonal thereto. It should be understood that the axis of the helical ramp is a fixed, longitudinal axis, as understood by the person skilled in the art. In use, the axis is typically vertical. It should be understood that the axis and the defined plane orthogonal thereto are mutually perpendicular. In use, the plane is typically horizontal.

Treads

[0016] It should be understood that the first tread included in the first set of treads and the first tread included in the second set of treads comprise and/or provide respective surfaces on which a user steps during ascending the helical ramp, as understood by the skilled person. In contrast, a riser is a vertical or near-vertical portion between treads of conventional stairs. In one example, the helical ramp does not comprise any risers.

[0017] The helical ramp comprises the first set of treads, including the first tread, wherein the first tread of the first set of treads is inclined at the first angle to the plane. It should be understood that the first tread included in the first set of treads is inclined at the first angle to the plane and hence is not horizontal or vertical in use but instead, sloped at a gradient, for example sloped at a first gradient. In one example, the first tread included in the first set of treads is inclined at the first angle to the plane, wherein the first angle to the plane is constant, for example wherein the first tread included in the first set of treads comprises and/or is a planar first tread. In one example, the first tread included in the first set of treads is inclined at the first angle to the plane, wherein the first angle to the plane is non-constant, for example wherein the first tread included in the first set of treads comprises and/or is a non-planar first tread, for example a concave or a convex first tread. In one example, the first set of treads includes M treads, including the first tread, wherein M is a natural number greater than or equal to 2, for example 2, 3, 4, 5, 6, 7, 8, 9, 10 or more. In one example, the M treads are each as described with respect to the first tread included in the first set of treads.

[0018] The helical ramp comprises the second set of treads, including the first tread, wherein the first tread of the second set of treads is inclined at the second angle to the plane. It should be understood that the first tread included in the second set of treads is inclined at the second angle to the plane and hence is not horizontal or vertical in use but instead, sloped at a gradient, for example sloped at a second gradient. In one example, the first tread included in the second set of treads is inclined at the second angle to the plane, wherein the second angle to the plane is constant, for example wherein the first tread included in the second set of treads comprises and/or is a planar first tread. In one example, the first tread included in the second set of treads is inclined at the second angle to the plane, wherein the second angle to the plane is non-constant, for example wherein the first tread included in the second set of treads comprises and/or is a non-planar first tread, for example a concave or a convex first tread. In one example, the second set of treads includes N treads, including the first tread, wherein N is a natural number greater than or equal to 2, for example 2, 3, 4, 5, 6, 7, 8, 9, 10 or more. In one example, the N treads are each as described with respect to the first tread included in the second set of treads.

[0019] The first tread of the first set of treads and the first tread of the second set of treads are mutually adjacent (for example, adjoin, abut, touch, confront), defining the first linear boundary of the set of linear boundaries therebetween. In other words, the first set of treads and the first tread of the second set of treads are contiguous, sharing a common border i.e. the first linear boundary of the set of linear boundaries therebetween. In one example, the first tread of the first set of treads and the first tread of the second set of treads are mutually adjacent, without any gap (i.e. spacing) therebetween (for example, adjoin, abut, touch). In this way, safety is improved. In one example, the first tread of the first set of treads and the first tread of the second set of treads are mutually adjacent, with a gap therebetween (for example, confront). In this way, drainage (e.g. of rain) is improved. In one example, the gap in a range from 1 mm to 100 mm, preferably in a range from 5 mm to 50 mm for example 25 mm. Alternatively, in one example, the first tread of the first set of treads and the first tread of the second set of treads are mutually adjacent, defining a first non-linear boundary of a set of non-linear boundaries therebetween. In one example, the first non-linear boundary of a set of non-linear boundaries is arcuate, for example convex or concave. Generally, linear boundaries are preferred, for manufacturability.

[0020] In one example, the first set of treads includes M treads, wherein M is a natural number greater than or equal to 2, for example 2, 3, 4, 5, 6, 7, 8, 9, 10 or more, the second set of treads includes N treads, wherein N is a natural number greater than or equal to 2, for example 2, 3, 4, 5, 6, 7, 8, 9, 10 or more, and wherein respective treads of the first set thereof and respective treads of the second set thereof are disposed periodically (for example alternate, disposed in turn repeatedly) defining respective linear boundaries of the set of linear boundaries, including the first linear boundary, therebetween, for example as described previously.

[0021] In one example, the helical ramp comprises a third set of treads, including a first tread, wherein the first tread of the third set of treads is inclined at a third angle to the plane;

wherein the first tread of the second set of treads and the first tread of the third set of treads are mutually adjacent, defining a third linear boundary of the set of linear boundaries therebetween.

[0022] The third set of treads and/or the third linear boundary may be as described with respect to the first and/or the second set of treads and/or the first linear boundary, respectively.

[0023] In one example, the first tread included in the first set of treads is a planar tread. In one example, the first tread included in the second set of treads is a planar tread. Generally, planar treads are preferred, for manufacturability.

[0024] In one example, the first tread included in the first set of treads comprises and/or is provided by a sheet material, for example tread plate (also known as checker or chequer plate), mesh, wood such as Anti-slip Phenolic Plywood, fibre-reinforced composite. In one example, a surface of the first tread included in the first set of treads has a non-slip surface, for example provided by protrusions and/or a frictional material, as understood by the skilled person.

Frame

[0025] In one example, the helical ramp comprises a frame, wherein the first tread of the first set of treads is retained on and/or in the frame whereby opposed surfaces of the first tread of the first set of treads are in tension and compression, respectively. That is, the opposed surfaces of the first tread of the first set of treads are retained and/or maintained in tension and compression, respectively, by the first tread of the first set of treads being retained on and/or in the frame. In other words, the first tread of the first set of treads is deformed elastically when retained on and/or in the frame. In this way, a planar tread precursor (for example, provided from a sheet material) may be deformed elastically into a non-planar tread. Generally, planar tread precursors are preferred, for manufacturability.

[0026] In one example, the helical ramp comprises a frame, wherein the first tread of the first set of treads is retained on and/or in the frame.

[0027] In one example, the frame is provided by equal or unequal angle, formed into inner diameter and/or outer diameter helices.

Boundaries

[0028] In one example, the first set of treads includes a second tread and the second tread included in the first set of treads and the first tread included in the second set of treads are mutually adjacent, defining a second linear boundary of the set of linear boundaries therebetween, for example as described with respect to the first linear boundary mutatis mutandis.

[0029] In one example, a first central angle between the first linear boundary and the second linear boundary is in a range from 90° to 135°, preferably in a range from 100° to 120°, for example about 110°. In this way, the first tread of the first set of treads subtends (i.e. spans) the first central angle.

[0030] In one example, the second set of treads includes a second tread and the second tread included in the first set of treads and the second tread included in the second set of treads are mutually adjacent, defining a third linear boundary of the set of linear boundaries therebetween, for example as described with respect to the first linear boundary mutatis mutandis.

[0031] In one example, a second angle between the second linear boundary and the third linear boundary is in a range from 5° to 60°, preferably in a range from 15° to 45°, for example about 30°. In this way, the first tread of the second set of treads subtends (i.e. spans) the second angle.

Angles

[0032] In one example, respective treads of the first set of treads are inclined at the first angle to the plane and respective treads of the second set of treads are inclined at the second angle to the plane, for example as described with respect to the first tread of the first set of treads and the first tread of the second set of treads, respectively.

[0033] In one example, the second angle is less than the first angle (i.e. the first angle is greater than the second angle). That is, the first tread included in the second set of treads is inclined at a relatively lower or shallower angle (i.e. has a relatively less steep gradient) than the first tread included in the first set of treads. In other words, the first tread included in the first set of treads is inclined at a relatively higher or steeper angle (i.e. has a relatively more steep gradient) than the first tread included in the second set of treads. In this way, the gradient at a given radius from the axis changes, for example alternates, between a relatively lower or shallower angle and a relatively higher or steeper angle, from the first tread included in the second set of treads to the first tread included in the first set of treads. The inventors have identified that such a pattern of the first angle and the second angle facilitates ascending of the helical ramp by users of different ages and/or heights and/or physical abilities. For example, relatively older and/or taller and/or more physically able users may ascend the helical ramp relatively more proximal the axis (i.e. at a relatively smaller radius), wherein respective lengths of arcs subtended by the first tread included in the first set of treads and the first tread included in the second set of treads are relatively shorter. For example, relatively younger and/or shorter and/or less physically able users may ascend the helical ramp relatively more distal the axis (i.e. at a relatively larger radius), wherein respective lengths of arcs subtended by the first tread included in the first set of treads and the first tread included in the second set of treads are relatively longer. Conversely, in one example, the first angle is less than the second angle (i.e. the second angle is greater than the first angle). In one example, the first angle is equal to the second angle. In this way, manufacturability is simplified since the angles are the same.

[0034] In one example, the first angle is in a range from 26° to 60°, preferably in a range from 33° to 55°, for example about 45° or 45° (i.e. a gradient of about 1 in 1 or 1 in 1). In one example, the second angle is in a range from 5° to 33°, preferably in a range from 14° to 27°, for example about 18° or 18° (i.e. a gradient of about 1 in 3 or 1 in 3).

[0035] That is, the first tread included in the second set of treads is inclined at a relatively lower or shallower angle (i.e. has a relatively less steep gradient) than the first tread included in the first set of treads. In other words, the first tread included in the first set of treads is inclined at a relatively higher or steeper angle (i.e. has a relatively more steep gradient) than the first tread included in the second set of treads. Table 1 summarises angles (°), percentages (%) and ratio (H:V) (horizontal H to vertical V; c.f. gradient is V in H) for the first angle and/or the second angle.

Table 1: Angles (°), percentages (%) and ratio (H:V) (horizontal H to vertical V; c.f. gradient is V in H).

Angle (°)	**Percent (%)**	**Ratio (H:V)**
2.5	5.0	
5.7	10.0	10:1
10.0	17.6	
14.0	25.0	4:1
18.0	33.5	3:1
19.3	35.0	
20.0	36.4	
24.2	45.0	
26.1	49.0	
26.6	50.0	2:1
30.0	57.7	
33.0	66.7	1.5:1
35.0	70.0	
38.6	80.0	
42.0	90.0	
45.0	100.0	1:1
55.0	142.8	
60.0	173.2	

Shapes

[0036] In one example, the first tread included in the first set of treads is substantially triangular and/or has two opposed linear sides (also known as edges) of equal length, for example a circular segment. In one example, the first tread included in the first set of treads has an arcuate convex, for example outer, side, for example a circular segment. In one example, the first tread included in the first set of treads has an arcuate concave, for example inner, side, for example an annular segment.

[0037] In one example, the first tread included in the second set of treads is substantially rhomboidal and/or has two opposed linear sides of equal length, for example diamond-shaped or lozenge-shaped. In one example, the first tread included in the second set of treads has an arcuate convex, for example outer, side. In one example, the first tread included in the second set of treads has an arcuate concave, for example inner, side.

[0038] In one example, the first tread included in the first set of treads comprises an array of perforations, for example for drainage of water therethrough.

[0039] In one example, the helical ramp is a cylindrical helical ramp, as described previously. In one example, the helical ramp is a conical helical ramp, as described previously.

[0040] In one example, the helical ramp has a constant pitch, as described previously. In one example, the constant pitch is in a range from 1.5 m to 5 m, preferably in a range from 2 m to 3 m, for example about 2.5 m or 2.5 m. In one example, the helical ramp has a variable pitch, as described previously. In one example, the variable pitch is in a range from 1.5 m to 5 m, preferably in a range from 2 m to 3 m, for example about 2.5 m or 2.5 m.

[0041] In one example, the helical ramp comprises and/or is an annular helical ramp or annular helicoid, for example having an outer diameter and an inner diameter, wherein the inner diameter defines a cylindrical or conical volume (i.e. void or cavity).

Platforms

[0042] In one example, the helical ramp comprises a set of platforms, including a first platform, wherein respective platforms of the set thereof are substantially parallel or parallel to the plane. It should be understood that the first platform provides a start for a zipline, upon which a user may stand.

Columns

[0043] In one example, the helical ramp comprises a set of columns, including a first column, for example for supporting the helical ramp, such as disposed relatively proximal an outer and/or an inner diameter of the helical ramp, preferably only relatively proximal an inner diameter of the helical ramp. Alternatively, the helical ramp may be self-supporting, without such columns.

[0044] In one example, the first column and the axis are mutually parallel and/or coaxial. In use, the first column is thus vertical.

Risers

[0045] In one example, the first linear boundary, defined between the first tread included in the first set of treads and the first tread included in the second set of treads are mutually adjacent, excludes a riser, for example as described previously.

Roof

[0046] In one example, the helical ramp comprises a roof, for example for an outdoor tower.

Helix angle

[0047] In one example, the helical ramp has a helix angle in a range from 5° to 20° (for example for a single helix) or in a range from 20° to 45° (for example for a double helix).

Diameter

[0048] In one example, the helical ramp has a diameter, for example an external or outer diameter, in a range from 2 m to 6 m, preferably in a range from 2.5 m to 5 m, for example about 3 m, 3.5 m or 4 m.

Turns

[0049] In one example, the helical ramp has an integral or a non-integral number of turns in a range from 0.5 to 10, preferably in a range from 1 to 5, for example 1.5, 2, 2.5, 3, 3.5, 4 or 4.5. It should be understood that 1 turn corresponds with a 360° turn, as understood by the skilled person.

Assembly

[0050] The second aspect provides an assembly comprising a helical ramp according to the first aspect and a helical rail for a trolley for a zipline. It should be understood that the helical rail provides a portion of a running surface for a wheel of the trolley.

[0051] In one example, respective pitches of the helical ramp and of the helical rail are the same. In this way, the helical ramp and helical rail may be described as a double helix.

[0052] In one example, the helical rail comprises a planar (i.e. a flat) running surface, for example provided by a square or rectangular bar or hollow section and/or by an equal or unequal angle section. In one example, the helical rail comprises a non-planar, for example a convex or a concave running surface. In one example, the helical rail comprises a cylindrical (i.e. a convex) running surface defining a cylinder axis, wherein the line is substantially coincident, in use, with the cylinder axis, for example provided by a tube (i.e. a section) having a circular cross-section or a part thereof, such as a U shape channel. Hollow section is preferred, reducing a weight of the helical rail. In one example, the tube has an external diameter D_{ext} in a range from 40 mm to 100 mm, preferably in a range from 50 mm to 75 mm, for example 60.3 mm. In one example, the tube has a wall thickness in a range from 1 mm to 6 mm, preferably in a range from 2 mm to 5 mm, for example 3 mm or 4 mm, for example 3.2 mm. In one example, the tube has an internal diameter D_{int} in a range from 35 mm to 95 mm, preferably in a range from 45 mm to 70 mm.

[0053] In one example, the helical rail comprises a non-linear, for example a curved, portion. In this way, the non-linear portion enables the helical rail to curve around obstacles, for example, and/or to increase user enjoyment, as described above. It should be understood that the non-linear portion is generally sideways (i.e. transverse to a general direction of travel of a trolley), though the helical rail may curve sideways and up or down also.

[0054] In one example, the helical rail comprises two or more helical rails, for example two parallel helical rails. In one example, the helical rail is a monohelical rail (i.e. a single helical rail). A monohelical rail is preferred, reducing cost and/or weight, may be fixed readily to a framework or hung from ceiling joists or trees, for example, and/or may be formed into relatively complex shapes, including multiple non-linear and linear portions that may also ascend, descend and/or be horizontal.

[0055] In one example, the helical rail is formed from steel according to EN 10025: part 2: 2004 grade S185, S235, S275, S355 or equivalent. In one example, the tube is seamless tube. In one example, the helical rail is coated, for example powder coated, painted and/or galvanized, to improve corrosion resistance.

[0056] In one example, the helical rail comprises a flange. The flange (also known as a web or a stiffener) increases a stiffness of the helical rail, for example a resistance to bending of the helical rail.

[0057] In one example, the helical rail comprises a cylindrical tube, wherein the running surface comprises a cylindrical running surface or a part thereof and wherein the helical rail comprises a flange.

[0058] In this way, relatively complex non-linear paths may be provided, including lateral deviations, such as curves or bends, and/or one or more descending portions, ascending portions and/or horizontal portions, for example by forming, such as bending or rolling the tube. Furthermore, since the tube has cylindrical symmetry, a transverse curvature of the running surface is relatively invariant, including for relatively complex non-linear paths, thereby providing a more continuous running surface.

[0059] In one example, the flange is arranged upstanding from the tube i.e. extending away therefrom. In one example, the flange is arranged longitudinally with respect to the tube. In one example, the flange is oriented normally to the running surface. In one example, the helical rail comprises a longitudinal flange. In one example, the flange is arranged to provide a fixing means, for example a lifting eye or a perforation or a set thereof through the flange, for suspension of the helical rail therefrom. Other fixing means are known. In this way, the helical rail may be fixed to, for example suspended from, a framework or hung from ceiling joists or trees, for example, such that a region under the helical rail remains unobstructed for the trolley and the user to travel through. In one example, the longitudinal flange comprises a first set of perforations for suspension. In one example, the longitudinal flange comprises a second set of perforations, congruent with a set of perforations provided in a third part of the helical rail coupling. In one example, the longitudinal flange extends continuously along a length of the helical rail. In one example, the flange is welded to the tube, for example continuously or intermittently (i.e. stitch welding, for example on alternate sides of the flange).

[0060] In one preferred example, the helical rail comprises a cylindrical tube, wherein the running surface comprises a cylindrical running surface or a part thereof and wherein the helical rail comprises a longitudinal flange normal to the tube (i.e. upstanding therefrom) extending continuously along the tube.

[0061] In one example, a length of the flange is greater than a length of the tube. For example, the flange may extend beyond one or both ends of the tube. In one example, the flange extends beyond both ends of the tube, by distances correlating or coinciding (i.e. equal to or substantially equal to) respective lengths, or parts thereof, of the third portion of the running surface provided by the first part and/or the second part of the helical rail coupling joined thereto. In this way, the respective ends of flanges of adjacent helical rails abut or confront when the helical rail coupling is arranged in the second configuration.

[0062] In one example, the helical rail comprises a set of non-return gates, including a first non-return gate, to prevent users descending the ramp, to limit congestion on the ramp and thereby improve safety.

[0063] In one example, the helical rail comprises a set of releasable couplings, including a first releasable coupling and optionally a second releasable coupling, for example disposed at opposed ends of the helical rail respectively.

[0064] In one example, the first releasable coupling comprises and/or is a releasable rail coupling for releasably coupling a first rail (for example the helical rail) providing a first portion of a running surface for a wheel and a second rail providing a second portion of the running surface, the rail coupling comprising:

a first part having a first end comprising a first male coupling member and a second end arranged for joining to the first rail; and
a second part having a first end comprising a corresponding first female coupling member, arranged to receive the first male coupling member therein, and a second end arranged for joining to the second rail;
wherein the rail coupling is arrangeable in:

a first configuration wherein the first male coupling member and the first female coupling member are uncoupled; and
a second configuration wherein the first male coupling member and the first female coupling member are coupled by receiving the first male coupling member in the first female coupling member;
wherein the rail coupling provides a third portion of the running surface in the second configuration.

[0065] The second releasable coupling may be as described with respect to the first releasable coupling.

[0066] In this way, assembly and/or disassembly of the first rail (i.e. a first length of rail) and the second rail (i.e. a second length of rail) may be facilitated and/or errors in assembly reduced.

[0067] Particularly, the rail coupling is a releasable rail coupling, thereby substantially reducing effort and/or force required for coupling the first rail and the second rail, for example during assembly on site. Hence, the assembly of a rail may be provided by coupling such rail couplings provided between successive lengths of rail, for example on site, including in situ. That is, conventional fitting and/or welding may be avoided and/or eliminated. Furthermore, the disassembly of the rail, for example to replace a damaged length or to resite the rail, is improved, for example without requiring in situ cutting and subsequent refitting and rejoining of the rail. In addition, the rail coupling maintains and/or enhances user safety since structural integrity may be maintained, even during significant deformation, as described below in more detail. Furthermore, grub screw retention of the rail coupling on the first rail and/or the second rail, for example, is not required, facilitating assembly and disassembly while also eliminating a maintenance requirement arising from such grub screws. For example, grub screws may vibrate loose in use, compromising safety and hence requiring frequent maintenance to check and/or re-tighten.

[0068] Particularly, since coupling of the rail coupling is effected by coupling the first male coupling member and the first female coupling member, errors in the assembly may be reduced. As described above, errors such as faults and/or discontinuities may increase loadings on, and/or rates of wear of, a trolley and/or rail. These errors may adversely affect rail integrity, trolley reliability and/or user safety, for example. Faults, such as cracks, lack of welding penetration, slag lines or undercut, may compromise structural integrity of the rail. Discontinuities, such as steps or gaps between the adjacent lengths, may increase loading and/or vibration and hence wear and/or fatigue. The assembly of the rail may be performed in situ (i.e. at height), since obstructions such as preexisting structures or trees may prevent assembly of the rail on the ground before subsequent lifting to the height, complicating assembly. Hence, errors may be more prevalent and/or exacerbated for conventional in situ assembly. In contrast, by coupling the first male coupling member and the first female coupling member, such faults are avoided and/or eliminated since convention joining by welding mat not be required while discontinuities may be controlled, for example to within predetermined tolerances. In this way, rail integrity, trolley reliability and/or user safety may be improved.

[0069] The releasable rail coupling is for releasably coupling a first rail providing a first portion of a running surface for a wheel and a second rail providing a second portion of the running surface.

[0070] It should be understood that the rail coupling is a releasable rail coupling, which may be coupled and uncoupled, for example repeatedly. That is, the first rail and the second rail may be mutually attached and subsequently detached using the rail coupling.

[0071] It should be understood that the rail coupling is for releasably coupling the first rail and the second rail.

That is, the rail coupling forms a part of a rail assembly, provided by coupling the first rail and the second rail via the rail coupling, and hence contributes to a structural integrity of the rail assembly. In use, the rail assembly may be subject to forces, for example due a weight thereof, residual stresses therein, fixing thereof as described above, a trolley running thereon and/or a load, for example a user, suspended therefrom. That is, the rail coupling is for structurally, for example rigidly c.f. flexibly, and releasably coupling the first rail and the second rail. Particularly, the first male coupling member and the first female coupling member, arranged in the second configuration, effectively transfer the forces between the first rail and the second rail.

[0072] Typically, the load comprises and/or is a user, having a mass in a range from 30 kg to 120 kg and hence a weight in a range from 294 N to 1,177 N. In addition, centripetal forces due to cornering may add up to 1.5g horizontally (i.e. up to 441 N to 1,766 N). Furthermore, an increased vertical load due to down swing (for example, the user swinging from an incline to a vertical position) may add up to 0.6g vertically (i.e. up to i.e. up to 176 N to 706 N) with no horizontal component. The user may be attached to the attachment member via a harness (also known as a suspension harness), for example. The harness may be include a dorsal D-ring, for example, for attaching to the attachment member via a sling or lanyard. In this way, in use, the user may be suspended in a hang glider-type (also known as a superman) position (i.e. prone or face down). The trolley may include a handle, for the user to hold when in such a prone or face-down position.

[0073] It should be understood that, in use, the load results in (i.e. gives rise to) a downwards vertical force due to gravity, which may be imposed, at least in part, on the rail via the trolley. The load may result in (i.e. give rise to) other forces, for example due to pitching, yawing and/or rolling of the load and/or due to centripetal forces on the load, as described below, that maybe imposed on the trolley and/or on the rail via the trolley. It should be understood that the rail is generally inclined, having a mean gradient typically in a range from 1 in 10 to 1 in 60, though may include one or more descending portions, ascending portions and/or horizontal portions. For example, a rail may include an initial length having a mean gradient of about 1 in 13 (to accelerate the trolley initially), followed by an intermediate length having a mean gradient of about 1 in 25 (corresponding approximately with constant speed of the trolley) and a final length having a mean gradient of about 1 in 50 (to decelerate the trolley).

[0074] It should be understood that the first rail provides the first portion of the running surface for the wheel, for example of a trolley, and the second rail provides the second portion of the running surface. That is, the running surface is a surface for the wheel to run, for example roll, thereon. In one example, the running surface is a continuous running surface, having no, or substantially free from, discontinuities therein, for example no protrusions (i.e. convexities) thereon or depressions (i.e. concavities) therein. As described above, discontinuities may increase loading and/or vibration and hence wear and/or fatigue.

[0075] In one example a discontinuity in the running surface, measured normal and/or parallel thereto, between the first rail section and the second rail section is at most 1 mm, preferably at most 0.5 mm.

[0076] In one example, the running surface comprises a planar running surface and/or a non-planar running surface, for example a concave running surface or a convex running surface.

[0077] The rail coupling comprises the first part and the second part. It should be understood that the first part and the second part are separable parts i.e. not integrally formed or permanently coupled, for example.

[0078] The rail coupling comprises the first part having the first end comprising the first male coupling member and the second end arranged for joining to the first rail.

[0079] It should be understood that the first end of the first part and the second end of the first part are respective opposed ends of the first part.

[0080] It should be understood that the first male coupling member is arranged to be received in the corresponding first female coupling member. That is, the first male coupling member and the corresponding first female coupling member are arranged thus by configuration and/or adaption, for example shaping. In one example, the first male coupling member and the corresponding first female coupling member have corresponding shapes, for example a plug and a socket respectively.

[0081] It should be understood that the second end of the first part is suitable for joining, for example permanently joining such as by welding or non-permanently such as by adhesion or an interference fit, to the first rail, thereby structurally, securely and/or rigidly joining the first part and the first rail. It should be understood that such non-permanently joining methods may not be releasable and/or may result in damage during release and/or may preclude rejoining.

[0082] In one example, the first male coupling member comprises a protrusion, for example a plug.

[0083] In one example, the first male coupling member comprises a circular external cross-sectional shape. In one example, the first male coupling member comprises a cylindrical external shape or a frustoconical external shape. In this way, the first male coupling member may be provided, for example machined such as turned, to a high tolerance and/or surface finish. In this way, relative transverse movement between the first male coupling member and the first female coupling member is reduced, reducing discontinuities therebetween and/or wear due to movement, in use. In one example, an external diameter $D_{m1,ext}$ of the first male coupling member is provided, for example machined such as turned, to a tolerance within a range from -0.05 mm to +0.00 mm, preferably within a range from -0.02 mm to +0.00 mm, more preferably within a range from -0.01 mm to +0.00

mm of a first coupling member diameter D.

[0084] In one example, a ratio of a length of the first male coupling member to a cross-sectional dimension, for example a diameter or a width, thereof, is in a range from 0.5 : 1 to 5 : 1, preferably in a range from 1 : 1 to 3 : 1, more preferably in a range from 1.5 : 1 to 2.5 : 1. In this way, an amount of the male member received by the female member is relatively large, such that removal therefrom is requires correspondingly relatively large movement, thereby reducing likelihood of failure, in use, by uncoupling due to abnormal loading, for example, and/or better resisting large plastic deformation of the first rail and/or the second without catastrophic failure of the rail coupling and/or the rail.

[0085] The rail coupling comprises the second part having the first end comprising the corresponding first female coupling member, arranged to receive the first male coupling member therein, and the second end arranged for joining to the second rail.

[0086] The second part may be as described with respect to the first part, mutatis mutandis.

[0087] It should be understood that the first end of the second part and the second end of the second part are respective opposed ends of the second part.

[0088] It should be understood that the first female coupling member is arranged to receive the corresponding first male coupling member. That is, the first male coupling member and the corresponding first female coupling member are arranged thus by configuration and/or adaption, for example shaping. In one example, the first male coupling member and the corresponding first female coupling member have corresponding shapes, for example a plug and a socket respectively.

[0089] It should be understood that the second end of the second part is suitable for joining, for example permanently joining such as by welding or non-permanently such as by adhesion or an interference fit, to the second rail, thereby structurally, securely and/or rigidly joining the second part and the second rail. It should be understood that such non-permanently joining methods may not be releasable and/or may result in damage during release and/or may preclude rejoining. In other words, non-permanent joining is not necessarily releasable coupling, as described herein.

[0090] In one example, the first female coupling member comprises a concavity, for example a socket.

[0091] In one example, the first female coupling member comprises a circular internal cross-sectional shape i.e. a circular bore. In one example, the first female coupling member comprises a cylindrical internal shape or a frustoconical internal shape. In this way, the first female coupling member may be provided, for example machined such as turned, to a high tolerance and/or surface finish. In this way, relative transverse movement between the first male coupling member and the first female coupling member is reduced, reducing discontinuities therebetween and/or wear due to movement, in use. In one example, an internal diameter $D_{f1,int}$ of the first female coupling member is provided, for example machined such as turned, bored or drilled, to a tolerance within a range from -0.00 mm to +0.05 mm, preferably within a range from -0.00 mm to +0.02 mm, more preferably within a range from 0.00 mm to +0.01 mm of the first coupling member diameter D. In this way, the first male coupling member is received closely (i.e. close fitting) in the first female coupling member, whereby a gap therebetween is as determined by the tolerances. Particularly, a such a machined-to-machined releasably coupling effectively transfers load therethrough between adjacent rails.

[0092] In one example, a ratio of a length of the first female coupling member to a cross-sectional dimension, for example a diameter or a width, thereof, is in a range from 0.5 : 1 to 5 : 1, preferably in a range from 1 : 1 to 3 : 1, more preferably in a range from 1.5 : 1 to 2.5 : 1. In this way, an amount of the male member received by the female member is relatively large, such that removal therefrom is requires correspondingly relatively large movement, thereby reducing likelihood of failure, in use, by uncoupling due to abnormal loading, for example, and/or better resisting large plastic deformation of the first rail and/or the second without catastrophic failure of the rail coupling and/or the rail.

[0093] In one example, the first female coupling member is arranged to slidably receive, for example axially, the first male coupling member therein. In this way, coupling and uncoupling is facilitated.

[0094] In one example, the first male coupling member and the first female coupling member are arranged to interlock, for example, upon fully receiving the first male coupling member in the first female coupling member. In this way, inadvertent or accidental uncoupling may be prevented.

[0095] In one example, the first male coupling member and the first female coupling member are correspondingly threaded. In this way, load transfer between the first part and the second part may be improved.

[0096] The rail coupling is arrangeable in the first configuration wherein the first male coupling member and the first female coupling member are uncoupled. That is, the first configuration is a disassembled configuration, for example, in which the first male coupling member and the first female coupling member are separate, for example spaced apart, such as by a gap.

[0097] The rail coupling is arrangeable in the second configuration wherein the first male coupling member and the first female coupling member are coupled by receiving the first male coupling member in the first female coupling member. That is, the second configuration is an assembled configuration, for example an in use configuration.

Running surface

[0098] The rail coupling provides a third portion of the running surface in the second configuration.

[0099] As described above, the first rail provides the first portion of the running surface for the wheel, for example of a trolley, and the second rail providing the second portion of the running surface. That is, the running surface is a surface for the wheel to run, for example roll, thereon. In one example, the running surface is a continuous running surface, having no, or substantially free from, discontinuities therein, for example no protrusions (i.e. convexities) thereon or depressions (i.e. concavities) therein. As described above, discontinuities may increase loading and/or vibration and hence wear and/or fatigue. In one example, the running surface comprises a planar running surface and/or a non-planar running surface, for example a concave running surface or a convex running surface.

[0100] Hence, in the second configuration, the third portion of the running surface is thus arranged between the first portion and the second portion. That is, the wheel runs on respective portions of the running surface provided successively by the first rail, the rail coupling and the second rail. Hence, rather than a single interface being defined conventionally, in use, between a first rail and a second rail, two interfaces (i.e. between the first rail and the rail coupling and between the rail coupling and the second rail) are instead defined, in use. Thus, discontinuities (particularly steps) otherwise arising at the single interface due to relatively poorer tolerancing and/misshaping of the first rail and the second rail may be averaged due to relatively tighter tolerancing of the rail coupling, for example, thereby providing a more continuous running surface.

[0101] In one example, the first end of the second part provides, at least in part, the third portion of the running surface. That is, the first female coupling member and the, at least in part, the third portion of the running surface are both at the first end. In one example, an external surface of the first female coupling member provides, at least in part, the third portion of the running surface.

[0102] In one example, the first part provides, at least in part, the third portion of the running surface. In one example, a surface of the first part proximal to the second end provides, at least in part, the third portion of the running surface. In one example, the second end of the first part comprises a second male coupling and a surface of the first part between the first end and the second end provides, at least in part, the third portion of the running surface.

[0103] In one example, the first part provides, at least in part, the third portion of the running surface and the first end of the second part provides, at least in part, the third portion of the running surface. In one example, the first part and the second part provide similar or equal parts of the third portion of the running surface.

[0104] In one example, the running surface comprises a cylindrical running surface or a part thereof, for example as provided by a tube or a half round section. In one example, the first rail comprises a first tube having an external diameter D_{ext}, whereby the first portion of the running surface comprises a first portion of a cylindrical running surface, the second rail comprises a second tube having a diameter D_{ext} (i.e. the same diameter as the first tube, at least nominally), whereby the second portion of the running surface comprises a second portion of the cylindrical running surface and the rail coupling comprises a cylindrical region or part thereof having a diameter D_{ext} (i.e. the same diameter as the first tube and the second tube, at least nominally), whereby the third portion of the running surface comprises a third portion of the cylindrical running surface.

Relief region

[0105] In one example, the first male coupling member and/or the first female coupling member comprises a relief region, arranged to facilitate moving the rail coupling between the first configuration and the second configuration. In this way, moving the rail coupling from the first configuration to the second configuration is facilitated because mutual alignment of the first male coupling member and the first female coupling member is relaxed. For example, for a plug and socket comprising such a relief region, insertion may be initially off axis and guided to coaxial full insertion.

[0106] In one example, the first male coupling member comprises a plug comprising a relief region provided in an intermediate region thereof, for example having a relatively smaller diameter than adjacent regions thereto. In one example, the first female coupling member comprises a socket comprising a relief region provided in an intermediate region thereof, for example having a relatively larger diameter than adjacent regions thereto.

Joining to end of rail

[0107] In one example, the second end of the first part is arranged for joining, for example by welding, to an end of the first rail and/or the second end of the second part is arranged for joining to an end of the second rail.

[0108] In one example, the second end of the first part comprises a second male coupling and/or a second female coupling member for joining to the first rail. In one example, the second end of the second part comprises a second male coupling and/or a second female coupling member for joining to the first rail.

[0109] In one example, the first rail comprises a first tube having an internal diameter D_{int}, the second rail comprises a second tube having an internal diameter D_{int} (i.e. the same internal diameter as the first tube, at least nominally), the second end of the first part comprises a second male coupling having an external diameter $D_{m2,ext}$ where $D_{m2,ext}$ is compatible with D_{int} and the second end of the second part comprises a second male coupling having an external diameter $D_{m2,ext}$ where $D_{m2,ext}$ is compatible with D_{int}. It should be understood that where $D_{m2,ext}$ is compatible with D_{int} means that $D_{m2,ext}$ is at most D_{int}. In one example, an external diameter $D_{m2,ext}$ of the second male coupling member is provided, for example machined such as turned, to a diameter within a range from -2.00 mm to -0.25 mm, preferably within a range from -1.50 mm to -0.50 mm, more preferably within a range from -1.00 mm to -0.75 mm with respect to D_{int}. In this way, insertion of the second male coupling into the first rail, for example, is facilitated. In contrast to the relatively close fit between the first male coupling and the first female coupling, the relatively looser fit between the second male coupling and the first rail, for example, is afforded since the first part and the first rail are joined permanently such as by welding or non-permanently such as by adhesion, thereby structurally, securely and/or rigidly joining the first part and the first rail.

Material

[0110] In one example, the rail coupling is formed from steel according to EN 10025: part 2: 2004 grade S185, S235, S275, S355 or equivalent. In one example, the rail coupling is coated, for example powder coated, painted and/or galvanized, to improve corrosion resistance.

Third part

[0111] In one example, the rail coupling comprises a third part, for example a set of fishplates including a first fishplate, for attaching to the first rail and the second rail. In this way, the first rail and the second rail may be mutually aligned. In one example, the first fish plate comprises a set of perforations therethrough for mechanically attaching, for example using mechanical fasteners such as dowels and/or threaded fasteners, to one side of respective flanges of the first rail and the second rail via a set of congruent perforations included in the respective flanges at adjacent ends of the first rail and the second rail. In one example, the set of fishplates includes the first fishplate and a second fishplate, comprising respective set of perforations therethrough, for mechanically attaching, for example using threaded fasteners, to both sides of respective flanges of the first rail and the second rail via a set of congruent perforations included in the respective flanges at adjacent ends of the first rail and the second rail. In one example, the perforations are closely toleranced, for example in a range from +0.10 to +0.20 with respect to the mechanical fasteners, for example a shank thereof. For example, the perforations may have a diameter of 14.00 mm for M14 bolts having a shank diameter of 13.80 mm or a diameter of 12.00 mm for M12 bolts having a shank diameter of 11.80 mm.

[0112] The first male coupling member and the first female coupling member (hence the first part and the second part), arranged in the second configuration, effectively transfer the forces between the first rail and the second rail. In contrast, the third part transfers only a relatively small proportion of the forces between the first rail and the second rail, such that imposed forces on the mechanical fasteners therethrough are relatively low.

[0113] In one example, the rail coupling is as described in GB2569837.

Trolley

[0114] In one example, the assembly comprises a trolley for a zipline.

[0115] In one example, the trolley comprises:

a frame;
a set of wheels, including a first wheel and a second wheel, rotatably coupled to the frame; and
an attachment member, coupled to the frame, for attachment, preferably suspension, of a load therefrom, in use;
wherein the first wheel is rotatable in a first plane about a first axis and the second wheel is rotatable in a second plane about a second axis;
wherein the first plane and the second plane define a line;
wherein the trolley is arrangeable in:

a first configuration, wherein the attachment member is arranged at a first angular displacement about the line; and
a second configuration, wherein the attachment member is arranged at a second angular displacement about the line, wherein the first angular displacement and the second angular displacement are different.

[0116] In one example, the assembly comprises a zipline, for example provided by a rail as described with respect to the helical rail mutatis mutandis.

[0117] In one example, the trolley is as described in GB2574474.

Tower

[0118] The third aspect provides a tower for a zipline comprising a helical ramp according to the first aspect.

Method of manufacturing

[0119] The fourth aspect provides a method of manufacturing a helical ramp according to the first aspect and/or an assembly according to the second aspect and/or a tower according to the third aspect, comprising:

inclining the first tread of the first set of treads at the first angle to the plane; and
inclining the first tread of the second set of treads at the second angle to the plane;

wherein the first tread of the first set of treads and the first tread of the second set of treads are mutually adjacent, defining a first linear boundary of a set of linear boundaries therebetween.

[0120] In one example, the method comprises retaining the first tread of the first set of treads on and/or in a frame whereby opposed surfaces of the first tread of the first set of treads are in tension and compression, respectively.

Definitions

[0121] Throughout this specification, the term "comprising" or "comprises" means including the component(s) specified but not to the exclusion of the presence of other components. The term "consisting essentially of" or "consists essentially of" means including the components specified but excluding other components except for materials present as impurities, unavoidable materials present as a result of processes used to provide the components, and components added for a purpose other than achieving the technical effect of the invention, such as colourants, and the like.

[0122] The term "consisting of" or "consists of" means including the components specified but excluding other components.

[0123] Whenever appropriate, depending upon the context, the use of the term "comprises" or "comprising" may also be taken to include the meaning "consists essentially of" or "consisting essentially of", and also may also be taken to include the meaning "consists of" or "consisting of".

[0124] The optional features set out herein may be used either individually or in combination with each other where appropriate and particularly in the combinations as set out in the accompanying claims. The optional features for each aspect or exemplary embodiment of the invention, as set out herein are also applicable to all other aspects or exemplary embodiments of the invention, where appropriate. In other words, the skilled person reading this specification should consider the optional features for each aspect or exemplary embodiment of the invention as interchangeable and combinable between different aspects and exemplary embodiments.

Brief description of the drawings

[0125] For a better understanding of the invention, and to show how exemplary embodiments of the same may be brought into effect, reference will be made, by way of example only, to the accompanying diagrammatic Figures, in which:

Figure 1 schematically depicts an exploded plan view of a rail assembly for an assembly according to an exemplary embodiment, including a rail coupling arranged in a first configuration;

Figure 2 schematically depicts plan view of the rail assembly of Figure 1, including the rail coupling arranged in a second configuration;

Figure 3 schematically depicts a longitudinal cross-sectional view of the rail coupling of Figure 2;

Figure 4 schematically depicts a longitudinal cross-sectional view of the rail coupling of Figure 3, in more detail;

Figure 5 schematically depicts a perspective view of a first part of the rail coupling of Figure 1;

Figure 6 schematically depicts a perspective view of a second part of the rail coupling of Figure 1;

Figure 7 schematically depicts (A) a front elevation view; (B) a side elevation view; and (C) an rear elevation view of the first part of the rail coupling of Figure 5;

Figure 8 schematically depicts (A) a front elevation view; (B) a side elevation view; (C) an rear elevation view; and (D) a longitudinal cross-sectional view of the second part of the rail coupling of Figure 6;

Figure 9 schematically depicts (A) a plan view; (B) a side elevation view; and (C) a front elevation view of a rail of the rail assembly of Figure 1;

Figure 10 schematically depicts (A) a perspective view; (B) a side elevation view; and (C) a front elevation view of a third part of the rail assembly of Figure 1;

Figure 11 schematically depicts a perspective view of the rail assembly of Figure 1, including a trolley thereon;

Figure 12A schematically depicts a perspective view from the front, above of a helical ramp according to an exemplary embodiment; and Figure 12B schematically depicts a plan view of the helical ramp;

Figure 13A schematically depicts a perspective view from the front, above of a helical ramp according to an exemplary embodiment; Figure 13B schematically depicts a perspective view from the rear, above of the helical ramp; Figure 13C schematically depicts a perspective view from the left, above of the helical ramp; Figure 13D schematically depicts a perspective view from the right, above of the helical ramp; Figure 13E schematically depicts a front elevation view of the helical ramp; Figure 13F schematically depicts a rear elevation view of the helical ramp; Figure 13G schematically depicts a left elevation view of the helical ramp; and Figure 13H schematically depicts a left elevation view of the helical ramp;

Figure 14A schematically depicts a perspective view from the front, above of a helical ramp according to an exemplary embodiment; Figure 14B schematically depicts a perspective view from the rear, above of the helical ramp; Figure 14C schematically depicts a perspective view from the left, above of the helical ramp; Figure 14D schematically depicts a perspective view from the right, above of the helical ramp; Figure 14E schematically depicts a front elevation view of the helical ramp; and Figure 14F schematically depicts a rear elevation view of the helical ramp;

Figure 15A schematically depicts a plan view of a helical ramp according to an exemplary embodiment; Figure 15B schematically depicts a perspective view from the front, above of the helical ramp; and Figure 15C schematically depicts a perspective view from the rear, below of the helical ramp; and

Figure 16A schematically depicts a perspective view from the front, above of a helical ramp according to an exemplary embodiment; and Figure 16B is a photograph of the partially-assembled helical ramp.

Detailed Description of the Drawings

Rail coupling

[0126] Figure 1 schematically depicts an exploded plan view of a rail assembly 1 according to an exemplary embodiment, including a rail coupling 1000 according to an exemplary embodiment arranged in a first configuration.

[0127] Figure 2 schematically depicts plan view of the rail assembly 1 of Figure 1, including the rail coupling 1000 arranged in a second configuration.

[0128] Figure 3 schematically depicts a longitudinal cross-sectional view of the rail coupling 1000 of Figure 2.

[0129] Figure 4 schematically depicts a longitudinal cross-sectional view of the rail coupling 1000 of Figure 3, in more detail.

[0130] The releasable rail coupling 1000 is for releasably coupling a first rail 10A providing a first portion P1 of a running surface RS for a wheel 120 and a second rail 10B providing a second portion P2 of the running surface RS. The rail coupling 1000 comprises a first part 1100 having a first end 1110 comprising a first male coupling member 1111 and a second end 1120 arranged for joining to the first rail 10A. The rail coupling 1000 comprises a second part 1200 having a first end 1210 comprising a corresponding first female coupling member 1212, arranged to receive the first male coupling member 1111 therein, and a second end 1220 arranged for joining to the second rail 10B. The rail coupling 1000 is arrangeable in a first configuration wherein the first male coupling member 1111 and the first female coupling member 1212 are uncoupled. The rail coupling 1000 is arrangeable a second configuration wherein the first male coupling member 1111 and the first female coupling member 1212 are coupled by receiving the first male coupling member 1111 in the first female coupling member 1212. The rail coupling 1000 provides a third portion P3 of the running surface RS in the second configuration.

[0131] In this way, assembly and/or disassembly of the first rail 10A (i.e. a first length of rail) and the second rail 10B (i.e. a second length of rail) may be facilitated and/or errors in assembly reduced.

[0132] Figure 5 schematically depicts a perspective view of the first part 1100 of the rail coupling 1000 of Figure 1.

[0133] Figure 6 schematically depicts a perspective view of the second part 1200 of the rail coupling 1000 of Figure 1.

[0134] Figure 7 schematically depicts (A) a front elevation view; (B) a side elevation view; and (C) an rear elevation view of the first part 1100 of the rail coupling 1000 of Figure 5.

[0135] Figure 8 schematically depicts (A) a front elevation view; (B) a side elevation view; (C) an rear elevation view; and (D) a longitudinal cross-sectional view of the second part 1200 of the rail coupling 1000 of Figure 6.

[0136] In this example, the first male coupling member 1111 and the corresponding first female coupling member 1212 have corresponding shapes, particularly a plug and a socket respectively.

[0137] In this example, the first male coupling member 1111 comprises a cylindrical external shape i.e. a plug. In this example, an external diameter $D_{m1,ext}$ of the first male coupling member 1111 is turned to a tolerance within a range from -0.02 mm to +0.00 mm of a first coupling member diameter D of 51.00 mm.

[0138] In this example, a ratio of a length L_{m1} of the first male coupling member 1111 to the external diameter $D_{m1,ext}$ thereof is about 2.4 : 1.

[0139] The second part 1200 is as described with respect to the first part 1100, mutatis mutandis.

[0140] In this example, the first female coupling member 1212 comprises a cylindrical internal shape. In this example, an internal diameter $D_{f1,int}$ of the first female coupling member 1212 is bored to a tolerance within a range from -0.00 mm to +0.02 mm of the first coupling member diameter D of 51.00 mm.

[0141] In this example, a ratio of a length L_{f1} of the first female coupling member 1212 to the internal diameter $D_{f1,int}$ thereof is about 2.5 : 1.

[0142] In this example, the first female coupling member 1212 is arranged to slidably receive, axially, the first male coupling member 1111 therein.

Running surface

[0143] In this example, the running surface RS is a continuous running surface RS, having no, or substantially free from, discontinuities therein, for example no protrusions (i.e. convexities) thereon or depressions (i.e. concavities) therein. In this example, the running surface RS comprises a convex, particularly a cylindrical, running surface RS.

[0144] In this example, the first part 1100 provides, at least in part, the third portion P3 of the running surface RS and the first end 1110 of the second part 1200 provides, at least in part, the third portion P3 of the running surface RS. In this example, the first part 1100 and the second part 1200 provide similar or equal parts of the third portion P3 of the running surface RS. In this example, an external surface of the first female coupling member 1212 provides, at least in part, the third portion P3 of the running surface RS.

[0145] In this example, the running surface RS comprises a cylindrical running surface RS or a part thereof, for example as provided by a tube 11. In this example, the first rail 10A comprises a first tube 11 having an external diameter D_{ext} of 60.3 mm, whereby the first portion P1 of the running surface RS comprises a first portion P1 of a cylindrical running surface RS, the second rail 10B comprises a second tube 11 having a diameter D_{ext} (i.e. the same diameter as the first tube 11, at least nominally), whereby the second portion P2 of the running surface RS comprises a second portion P2 of the cylindrical running surface RS and the rail coupling 1000 comprises a cylindrical region or part thereof having a diameter D_{ext} (i.e. the same diameter as the first tube 11 and the second tube 11, at least nominally), whereby the third portion P3 of the running surface RS comprises a third portion P3 of the cylindrical running surface RS.

Relief region

[0146] In this example, the first female coupling member 1212 comprises a socket comprising a relief region 1213 provided in an intermediate region thereof, having a relatively larger diameter than adjacent regions thereto. In this example, an internal diameter $D_{f1,rr}$ of the relief region 1213 of the first female coupling member 1212 is bored to within a range from +2.00 mm to +2.50 mm of the internal diameter $D_{f1,int}$.

Joining to end of rail

[0147] In this example, the second end 1120 of the first part 1100 comprises a second male coupling 1121 for joining to the first rail 10A. In this example, the second end 1220 of the second part 1200 comprises a second male coupling 1221 for joining to the second rail 10B.

[0148] In this example, the first rail 10A comprises a first tube 11A having an internal diameter D_{int} of 53.9 mm the second rail 10B comprises a second tube 11B having an internal diameter D_{int} (i.e. the same internal diameter as the first tube 11A, at least nominally), the second end 1120 of the first part 1100 comprises a second male coupling 1121 having an external diameter $D_{m2,ext}$ where $D_{m2,ext}$ is compatible with D_{int} and the second end 1120 of the second part 1200 comprises a second male coupling 1221 having an external diameter $D_{m2,ext}$ where $D_{m2,ext}$ is compatible with D_{int}. It should be understood that where $D_{m2,ext}$ is compatible with D_{int} means that $D_{m2,ext}$ is at most D_{int}. In this example, an external diameter $D_{m2,ext}$ of the second male coupling member 1121 is turned to within a range from -1.00 mm to -0.75 mm with respect to D_{int}. In this way, insertion of the second male coupling 1121 into the first rail 10A, for example, is facilitated.

Material

[0149] In this example, the rail coupling 1000 is formed from steel according to EN 10025: part 2: 2004 grade S355. In this example, the rail coupling 1000 is powder coated.

Third part

[0150] Figure 10 schematically depicts (A) a perspective view; (B) a side elevation view; and (C) a front elevation view of a third part 1300 of the rail assembly 1 of Figure 1.

[0151] In this example, the rail coupling 1000 comprises a third part 1300, particularly a set of fishplates, for attaching to the first rail 10A and the second rail 10B, particularly to respective flanges thereof. In this way, the first rail 10A and the second rail 10B may be mutually aligned. In this example, the first fish plate 1300 comprises a set of perforations 1303 therethrough for mechanically attaching, for example using mechanical fasteners such as dowels and/or threaded fasteners, to one side of respective flanges 12A, 12B of the first rail 10A and the second rail 10B via the set of congruent perforations 13 included in the respective flanges 12A, 12B at adjacent ends of the first rail and the second rail. In this example, the set of fishplates includes the first fishplate and a second fishplate, comprising respective set of perforations therethrough, for mechanically attaching, for example using threaded fasteners, to both sides of respective flanges of the first rail and the second rail via a set of congruent perforations included in the respective flanges at adjacent ends of the first rail and the second rail. In this example, the perforations are closely toleranced, for example in a range from +0.10 to +0.20 with respect to the mechanical fasteners, for example a shank thereof. For example, the perforations may have a diameter of 14.00 mm for M14 bolts having a shank diameter of 13.80 mm or a diameter of 12.00 mm for M12 bolts having a shank diameter of 11.80 mm.

Rail

[0152] Figure 9 schematically depicts (A) a plan view; (B) a side elevation view; and (C) a front elevation view of the rail 10 of the rail assembly 1 of Figure 1.

[0153] In this example, the rail 10 (i.e. the first rail 10A and/or the second rail 10B) comprises a cylindrical (i.e. a convex) running surface RS. In this example, the rail comprises a cylindrical tube 11, wherein the running surface RS comprises a cylindrical running surface RS or a part thereof and wherein the rail comprises a flange 12.

In this example, the tube 11 has an external diameter D_{ext} of 60.3 mm. In this example, the tube 11 has a wall thickness of 3.2 mm. In this example, the tube 11 has an internal diameter D_{int} of 53.9 mm.

[0154] In this example, the rail 10 is a monorail (i.e. a single rail).

[0155] In this example, the rail 10 is formed from steel according to EN 10025: part 2: 2004 grade S275 or equivalent. In this example, the tube 11 is seamless tube 11. In this example, the rail 10 is powder coated.

[0156] In this example, the flange 12, having a thickness of 12 mm and a height of 100 mm, is arranged upstanding from the tube 11 i.e. extending away therefrom. In this example, the flange 12 is arranged longitudinally with respect to the tube 11. In this example, the flange 12 is oriented normally to the running surface RS. In this example, the rail comprises a longitudinal flange 12. In this example, the flange 12 is arranged to provide a fixing means, particularly a first set of four perforations 13 through the flange 12. In this example, the longitudinal flange 12 comprises a second set of four perforations through the flange 12. In this example, the longitudinal flange 12 extends continuously along a length of the rail. In this example, the flange 12 is welded to the tube 11, for example continuously or intermittently (i.e. stitch welding, for example on alternate sides of the flange 12).

[0157] In this example, a length of the flange 12 is greater than a length of the tube 11. In this example, the flange 12 extends beyond both ends of the tube 11, by distances correlating or coinciding (i.e. equal to or substantially equal to) respective lengths, or parts thereof, of the third portion P3 of the running surface RS provided by the first part 1100 and/or the second part 1200 of the rail coupling 1000 joined thereto.

Trolley

[0158] Figure 11 schematically depicts a perspective view of the rail assembly 1 of Figure 1, including a trolley 100 thereon.

[0159] In this example, the trolley 100 comprises a frame 110; a set of wheels 120, including the first wheel 110A and a second wheel 120B, rotatably coupled to the frame 110; and an attachment member (not shown), coupled to the frame 110, for attachment, preferably suspension, of the load L therefrom, in use. The first wheel 110A is rotatable in a first plane about a first axis and the second wheel is rotatable in a second plane about a second axis. The first plane and the second plane define a line. The trolley 100 is arrangeable in: a first configuration, wherein the attachment member (not shown) is arranged at a first angular displacement about the line; and a second configuration, wherein the attachment member (not shown) is arranged at a second angular displacement about the line, wherein the first angular displacement and the second angular displacement are different.

[0160] In this example, the trolley 100 is a captive trolley 100, as described above. In this example, the set of wheels 120 are arranged to retain the trolley 100 on a rail.

[0161] Figure 12A schematically depicts a perspective view from the front, above of a helical ramp 12 according to an exemplary embodiment; and Figure 12B schematically depicts a plan view of the helical ramp 12.

[0162] The helical ramp 12 has an axis A defining a plane P orthogonal thereto, the helical ramp 12 comprising:

> a first set of treads 121, including a first tread, wherein the first tread 121A of the first set of treads 121 is inclined at a first angle A1 to the plane P; and
> a second set of treads 122, including a first tread, wherein the first tread 122A of the second set of treads 122 is inclined at a second angle A2 to the plane P;

wherein the first tread 121A of the first set of treads 121 and the first tread 122A of the second set of treads 122 are mutually adjacent, defining a first linear boundary 123A of a set of linear boundaries 123 therebetween.

[0163] In this example, the helical ramp 12 comprises and/or is a helicoid. In this example, the pitch of the helical ramp 12 is constant. In this example, the helical ramp 12 comprises and/or is a circular helical ramp 12. In this example, the helical ramp 12 comprises and/or is a right-handed helical ramp 12.

Treads

[0164] In this example, the first tread 121A included in the first set of treads 121 is inclined at the first angle A1 to the plane P, wherein the first angle A1 to the plane P is constant, for example wherein the first tread 121A included in the first set of treads 121 comprises and/or is a planar first tread. In this example, the first set of treads 121 includes M treads, including the first tread, wherein M is equal to 4. In this example, the M treads are each as described with respect to the first tread 121A included in the first set of treads 121.

[0165] In this example, the first tread 122A included in the second set of treads 122 is inclined at the second angle A2 to the plane P, wherein the second angle A2 to the plane P is constant, for example wherein the first tread 122A included in the second set of treads 122 comprises and/or is a planar first tread. In this example, the second set of treads 122 includes N treads, including the first tread, wherein N is equal to 4. In this example, the N treads are each as described with respect to the first tread 122A included in the second set of treads 122.

[0166] In this example, the first tread 121A of the first set of treads 121 and the first tread 122A of the second set of treads 122 are mutually adjacent, without any gap (i.e. spacing) therebetween (for example, adjoin, abut, touch).

[0167] In this example, the first set of treads 121 includes M treads, wherein M is equal to 4, the second set of treads 122 includes N treads, wherein N is equal to 4, and wherein respective treads of the first set thereof and respective treads of the second set thereof are disposed periodically (for example alternate, disposed in turn repeatedly) defining respective linear boundaries of the set of linear boundaries 123, including the first linear boundary 123A, therebetween, for example as described previously.

[0168] In this example, the first tread 121A included in the first set of treads 121 is a planar tread. In this example, the first tread 122A included in the second set of treads 122 is a planar tread.

[0169] In this example, the first tread 121A included in the first set of treads 121 is Anti-slip Phenolic Plywood. In this example, the first tread 122A included in the second set of treads 122 is Anti-slip Phenolic Plywood.

Frame

[0170] In this example, the helical ramp 12 comprises a frame, wherein the first tread 121A of the first set of treads 122 is retained on and/or in the frame. In this example, the frame is provided by equal angle steel, formed into inner diameter and outer diameter helices.

Boundaries

[0171] In this example, the first set of treads 121 includes a second tread 121B and the second tread 121B included in the first set of treads 121 and the first tread 122A included in the second set of treads 122 are mutually adjacent, defining a second linear boundary 123B of the set of linear boundaries 123 therebetween, for example as described with respect to the first linear boundary 123A mutatis mutandis.

[0172] In this example, a first central angle between the first linear boundary 123A and the second linear boundary 123B is in a range from 90° to 135°, for example about 110°.

[0173] In this example, the second set of treads 122 includes a second tread 122B and the second tread 122B included in the first set of treads 121 and the second tread 122B included in the second set of treads 122 are mutually adjacent, defining a third linear boundary 123C of the set of linear boundaries 123 therebetween, for example as described with respect to the first linear boundary 123A mutatis mutandis.

[0174] In this example, a second angle A2 between the second linear boundary and the third linear boundary is in a range from 5° to 60°, for example about 30°. In this way, the first tread 122A of the second set of treads 122 subtends (i.e. spans) the second angle A2.

Angles

[0175] In this example, the first angle A1 is greater than the second angle A2.

[0176] In this example, the first angle A1 is in a range from 26° to 60°, for example about 45° or 45° (i.e. a gradient of about 1 in 1 or 1 in 1). In this example, second angle A2 is in a range from 5° to 33°, for example about 18° or 18° (i.e. a gradient of about 1 in 3 or 1 in 3).

Shapes

[0177] In this example, the first tread 121A included in the first set of treads 121 is substantially triangular and has two opposed linear sides (also known as edges) of equal length, for example a circular segment. In this example, the first tread 121A included in the first set of treads 121 has an arcuate convex, for example outer, side, for example a circular segment. In this example, the first tread 121A included in the first set of treads 121 has an arcuate concave, for example inner, side, for example an annular segment.

[0178] In this example, the first tread 122A included in the second set of treads 122 is substantially rhomboidal and has two opposed linear sides of equal length, for example diamond-shaped or lozenge-shaped. In this example, the first tread 122A included in the second set of treads 122 has an arcuate convex, for example outer, side. In this example, the first tread 122A included in the second set of treads 122 has an arcuate concave, for example inner, side. In this example, the substantially rhomboidal first tread 122A is shown as two substantially triangular portions of the first tread 122A.

[0179] In this example, the first tread 121A included in the first set of treads 121 comprises an array of perforations, for example for drainage of water therethrough.

[0180] In this example, the helical ramp 12 is a cylindrical helical ramp 12, as described previously.

[0181] In this example, the helical ramp 12 has a constant pitch, as described previously. In this example, the constant pitch is in a range from 1.5 m to 5 m, for example about 2.5 m or 2.5 m.

[0182] In this example, the helical ramp 12 comprises and/or is an annular helical ramp 12 or annular helicoid, for example having an outer diameter and an inner diameter, wherein the inner diameter defines a cylindrical or conical volume V (i.e. void or cavity).

Platforms

[0183] In this example, the helical ramp 12 comprises a set of platforms 124, including a first platform 124A, wherein respective platforms of the set thereof are substantially parallel or parallel to the plane P.

Columns

[0184] In this example, the helical ramp 12 comprises a set of columns 125, including a first column 125A, for example for supporting the helical ramp 12, such as disposed relatively proximal an outer and/or an inner diameter of the helical ramp 12. In this example, the set of columns includes nine columns (five columns disposed relatively proximal an outer diameter of the helical ramp

12 and four columns disposed relatively proximal an inner diameter of the helical ramp 12).

[0185] In this example, the first column 125A and the axis A are mutually parallel and/or coaxial. In use, the first column 125A is thus vertical.

Risers

[0186] In this example, the first linear boundary 123A, defined between the first tread 121A included in the first set of treads 121 and the first tread 122A included in the second set of treads 122 are mutually adjacent, excludes a riser, for example as described previously.

Helix angle

[0187] In one example, the helical ramp has a helix angle in a range from 5° to 20° (for example for a single helix) or in a range from 20° to 45° (for example for a double helix).

Diameter

[0188] In this example, the helical ramp 12 has a diameter, for example an external or outer diameter, in a range from 2 m to 6 m, for example about 3 m, 3.5 m or 4 m.

Turns

[0189] In this example, the helical ramp 12 has a non-integral number of turns in a range from 0.5 to 10, for example 1.5. It should be understood that 1.5 turns corresponds with a 540° turn, as understood by the skilled person.

[0190] The helical ramp 12 is comprised in an assembly comprising the helical ramp 12 and a helical rail 126 for a trolley for a zipline.

[0191] In this example, respective pitches of the helical ramp 12 and of the helical rail 126 are the same.

[0192] In this example, the helical rail 126 is formed from steel according to EN 10025: part 2: 2004 grade S185, S235, S275, S355 or equivalent. In this example, the tube is seamless tube. In this example, the helical rail 126 is coated, for example powder coated, painted and/or galvanized, to improve corrosion resistance.

[0193] In this example, the helical rail 126 comprises a cylindrical tube, wherein the running surface comprises a cylindrical running surface or a part thereof and wherein the helical rail comprises a longitudinal flange normal to the tube (i.e. upstanding therefrom) extending continuously along the tube.

[0194] In this example, the helical rail 126 comprises a set of non-return gates (not shown), including a first non-return gate.

[0195] In this example, the helical rail 126 comprises a set of releasable couplings (not shown), including a first releasable coupling and optionally a second releasable coupling, for example disposed at opposed ends of the helical rail 126 respectively.

Tower

[0196] In this example, the helical ramp 12 is comprised in a tower for a zipline.

[0197] Figure 13A schematically depicts a perspective view from the front, above of a helical ramp 13 according to an exemplary embodiment; Figure 13B schematically depicts a perspective view from the rear, above of the helical ramp 13; Figure 13C schematically depicts a perspective view from the left, above of the helical ramp 13; Figure 13D schematically depicts a perspective view from the right, above of the helical ramp 13; Figure 13E schematically depicts a front elevation view of the helical ramp 13; Figure 13F schematically depicts a rear elevation view of the helical ramp 13; Figure 13G schematically depicts a left elevation view of the helical ramp 13; and Figure 13H schematically depicts a left elevation view of the helical ramp 13.

[0198] The helical ramp 13 is generally as described with respect to the helical ramp 12, description of which is not repeated for brevity.

[0199] In this example, the helical ramp 13 comprises a roof 135, for example for an outdoor tower.

[0200] Figure 14A schematically depicts a perspective view from the front, above of a helical ramp 14 according to an exemplary embodiment; Figure 14B schematically depicts a perspective view from the rear, above of the helical ramp 14; Figure 14C schematically depicts a perspective view from the left, above of the helical ramp 14; Figure 14D schematically depicts a perspective view from the right, above of the helical ramp 14; Figure 14E schematically depicts a front elevation view of the helical ramp 14; and Figure 14F schematically depicts a rear elevation view of the helical ramp 14.

[0201] The helical ramp 14 is generally as described with respect to the helical ramp 13, description of which is not repeated for brevity.

[0202] Figure 15A schematically depicts a plan view of a helical ramp 15 according to an exemplary embodiment; Figure 15B schematically depicts a perspective view from the front, above of the helical ramp 15; and Figure 15C schematically depicts a perspective view from the rear, below of the helical ramp 15.

[0203] The helical ramp 15 is generally as described with respect to the helical ramp 12, description of which is not repeated for brevity.

[0204] Figure 16A schematically depicts a perspective view from the front, above of a helical ramp 16 according to an exemplary embodiment; and Figure 16B is a photograph of the partially-assembled helical ramp 16.

[0205] The helical ramp 16 is generally as described with respect to the helical ramp 15, description of which is not repeated for brevity.

[0206] Although a preferred embodiment has been shown and described, it will be appreciated by those skilled in the art that various changes and modifications might be made without departing from the scope of the invention, as defined in the appended claims and as described above.

[0207] Attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

[0208] All of the features disclosed in this specification (including any accompanying claims and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at most some of such features and/or steps are mutually exclusive.

[0209] Each feature disclosed in this specification (including any accompanying claims, and drawings) may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

[0210] The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

Claims

1. A helical ramp having an axis defining a plane orthogonal thereto, the helical ramp comprising:

   a first set of treads, including a first tread, wherein the first tread of the first set of treads is inclined at a first angle to the plane; and
   a second set of treads, including a first tread, wherein the first tread of the second set of treads is inclined at a second angle to the plane;
   wherein the first tread of the first set of treads and the first tread of the second set of treads are mutually adjacent, defining a first linear boundary of a set of linear boundaries therebetween; and
   optionally, wherein the first angle is greater than the second angle.

2. The helical ramp according to claim 1, comprising a frame, wherein the first tread of the first set of treads is retained on and/or in the frame whereby opposed surfaces of the first tread of the first set of treads are in tension and compression, respectively.

3. The helical ramp according to any previous claim, wherein respective treads of the first set of treads are inclined at the first angle to the plane and wherein respective treads of the second set of treads are inclined at the second angle to the plane.

4. The helical ramp according to any previous claim, wherein the first set of treads includes a second tread and wherein the second tread included in the first set of treads and the first tread included in the second set of treads are mutually adjacent, defining a second linear boundary of the set of linear boundaries therebetween.

5. The helical ramp according to claim 4, wherein a first central angle between the first linear boundary and the second linear boundary is in a range from 90° to 135°, preferably in a range from 100° to 120°, for example about 110°.

6. The helical ramp according to any previous claim, wherein the first set of treads includes M treads, wherein M is a natural number greater than or equal to 2, for example 2, 3, 4, 5, 6, 7, 8, 9, 10 or more, wherein the second set of treads includes N treads, wherein N is a natural number greater than or equal to 2, for example 2, 3, 4, 5, 6, 7, 8, 9, 10 or more, wherein respective treads of the first set thereof and respective treads of the second set thereof are disposed periodically, defining respective linear boundaries of the set of linear boundaries, including the first linear boundary, therebetween.

7. The helical ramp according to any previous claim, wherein the second angle is in a range from 5° to 33°, preferably in a range from 14° to 27°, for example about 18° or 18° and /or wherein the first angle is in a range from 26° to 60°, preferably in a range from 33° to 55°, for example about 45° or 45°.

8. The helical ramp according to any previous claim, wherein the first tread included in the first set of treads is substantially triangular and/or has two opposed linear sides of equal length, optionally wherein the first tread included in the first set of treads has an arcuate concave side.

9. The helical ramp according to any previous claim, wherein the first tread included in the second set of treads is substantially rhomboidal and/or has two opposed linear sides of equal length, optionally wherein the first tread included in the second set of treads has an arcuate convex side.

10. The helical ramp according to any previous claim, wherein the first tread included in the first set of treads is a planar tread and/or wherein the first tread included in the first set of treads comprises an array of perforations.

11. The helical ramp according to any previous claim, wherein the helical ramp is a cylindrical helical ramp and/or wherein the helical ramp has a constant pitch.

12. The helical ramp according to any previous claim, comprising a set of platforms, including a first platform, wherein respective platforms of the set thereof are parallel to the plane; and/or comprising a set of columns, including a first column, optionally wherein the first column and the axis are mutually parallel and/or coaxial.

13. The helical ramp according to any previous claim, wherein first linear boundary defined between the first tread included in the first set of treads and the first tread included in the second set of treads are mutually adjacent excludes a riser.

14. An assembly comprising a helical ramp according to any previous claim and a helical rail for a trolley for a zipline; or a tower for a zipline comprising a helical ramp according to any previous claim.

15. A method of manufacturing a helical ramp according to any of claims 1 to 13 and/or an assembly according 14 and/or a tower according to claim 14, the method comprising:

inclining the first tread of the first set of treads at the first angle to the plane; and
inclining the first tread of the second set of treads at the second angle to the plane;

wherein the first tread of the first set of treads and the first tread of the second set of treads are mutually adjacent, defining a first linear boundary of a set of linear boundaries therebetween.

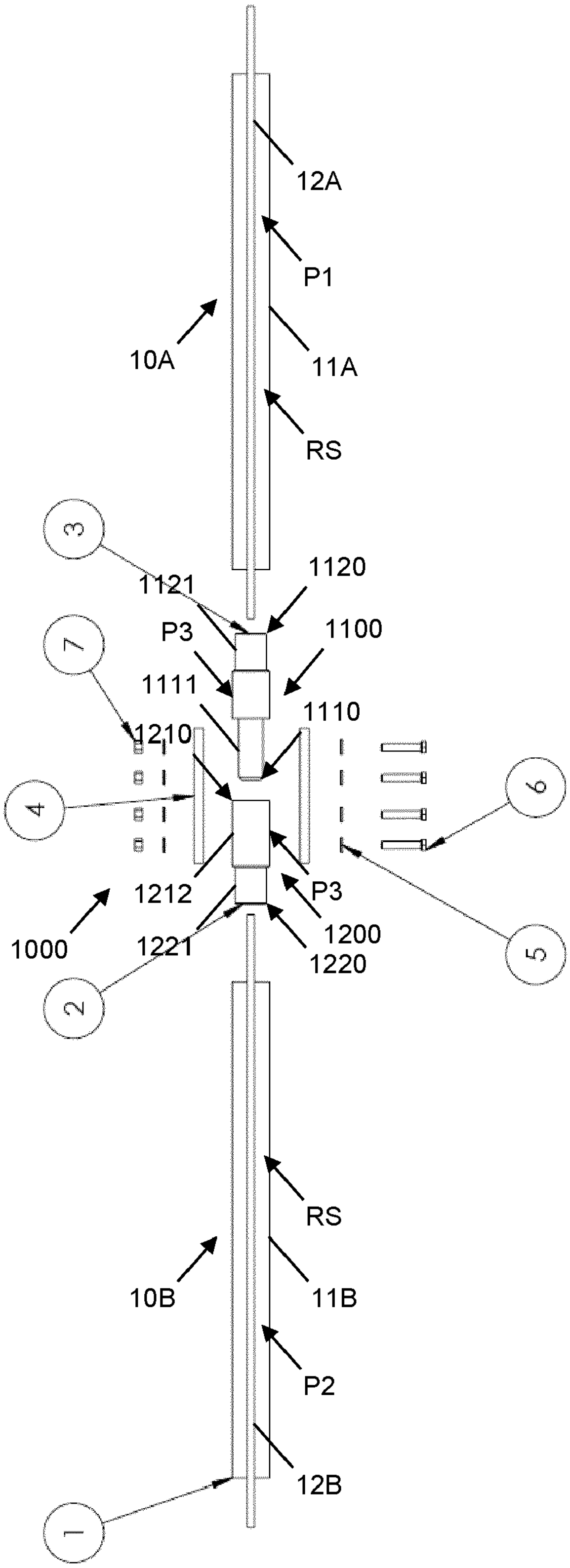
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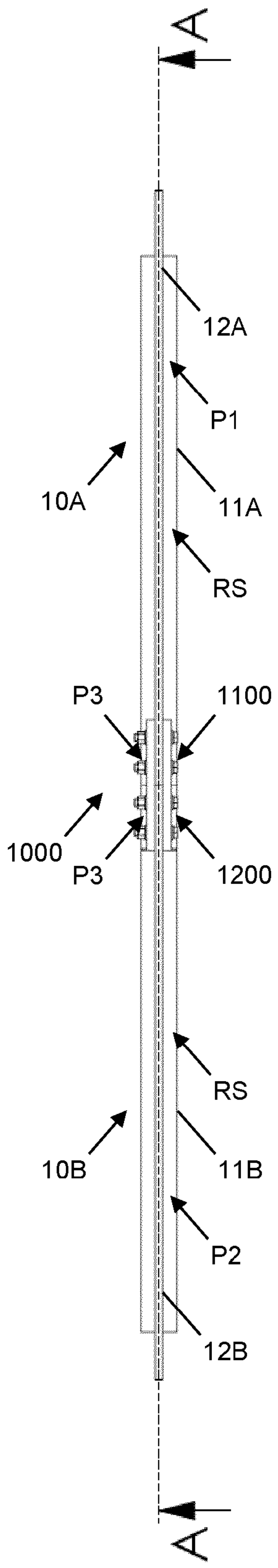
Fig. 1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P3
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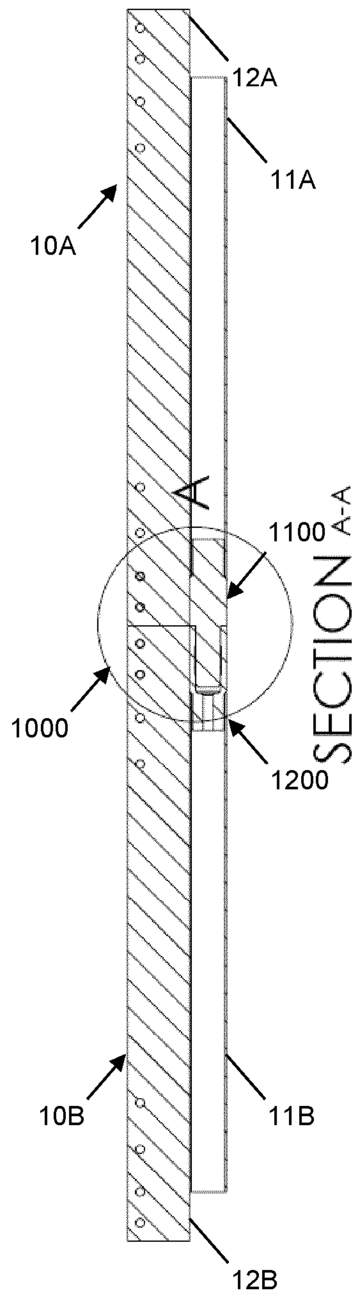
P3
1200
RS
10B
11B
P2
12B
A

Fig. 2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11A
10A
A
1100
SECTION A-A
1000
1200
10B
11B
12B

Fig. 3

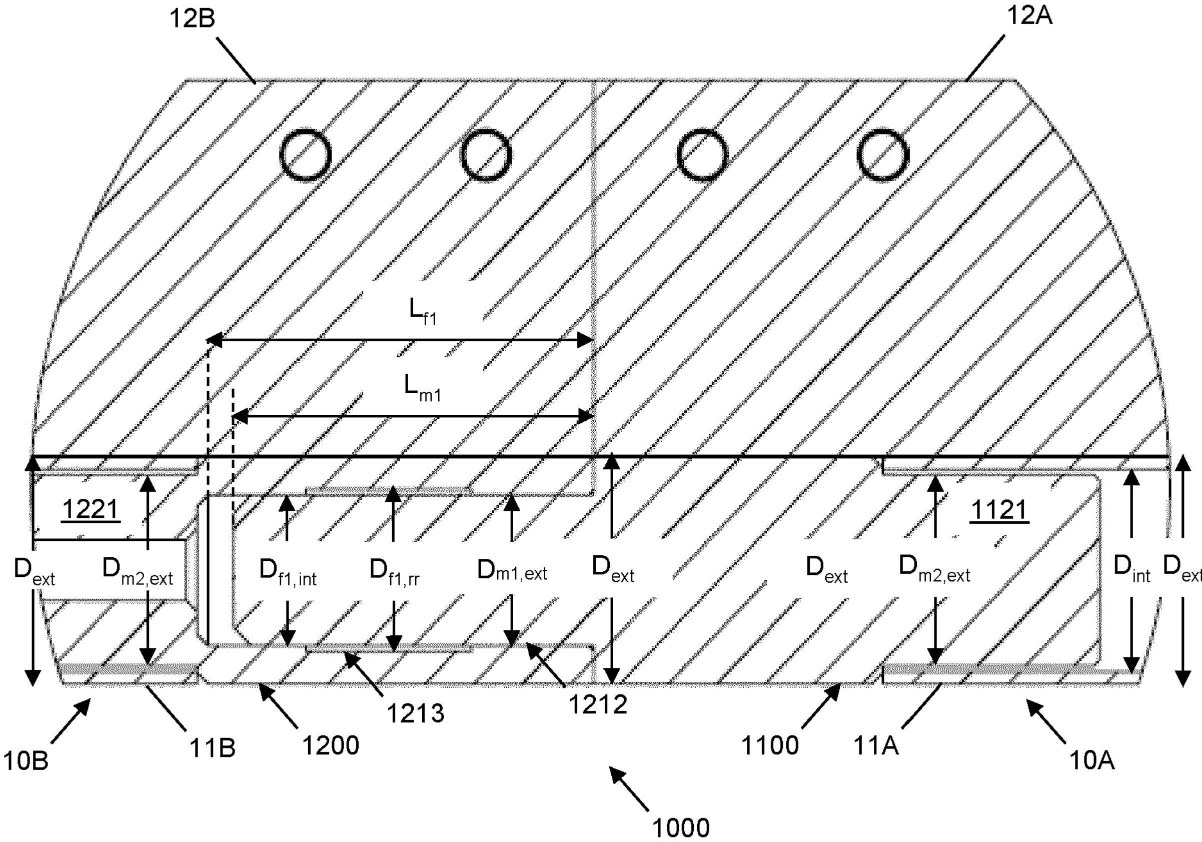
12B
12A
Lf1
Lm1
1221
1121
Dext
Dm2,ext
Df1,int
Df1,rr
Dm1,ext
Dext
Dext
Dm2,ext
Dint
Dext
10B
11B
1200
1213
1212
1100
11A
10A
1000

Fig. 4

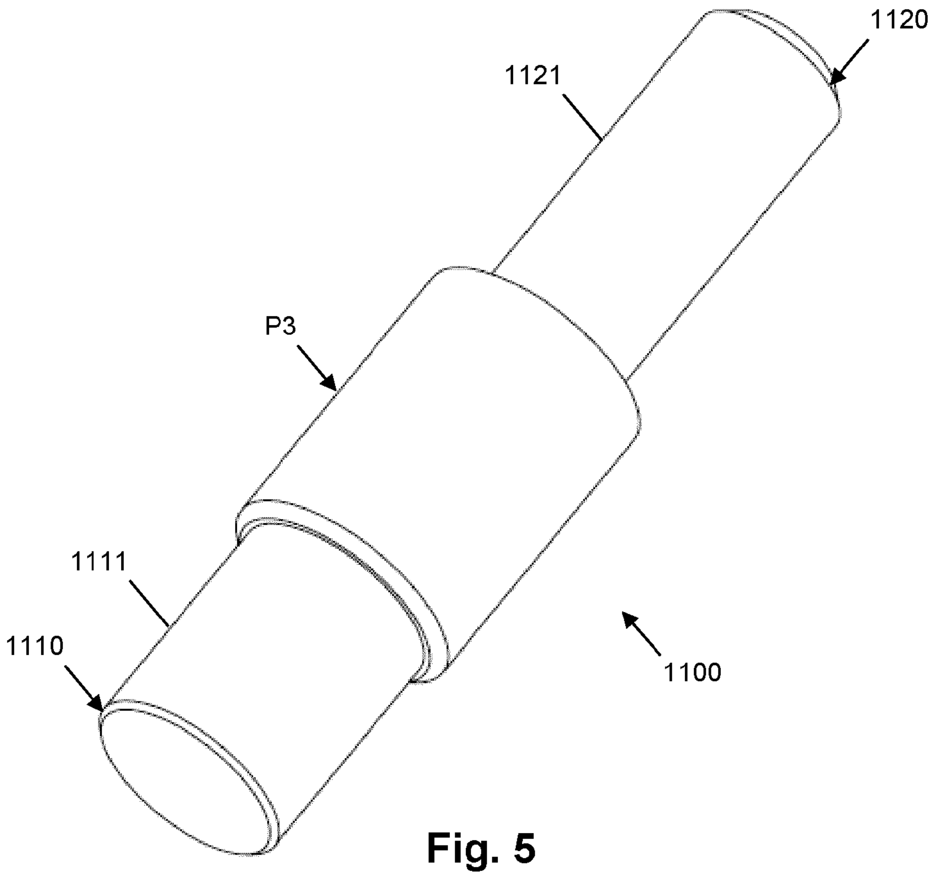

Fig. 5

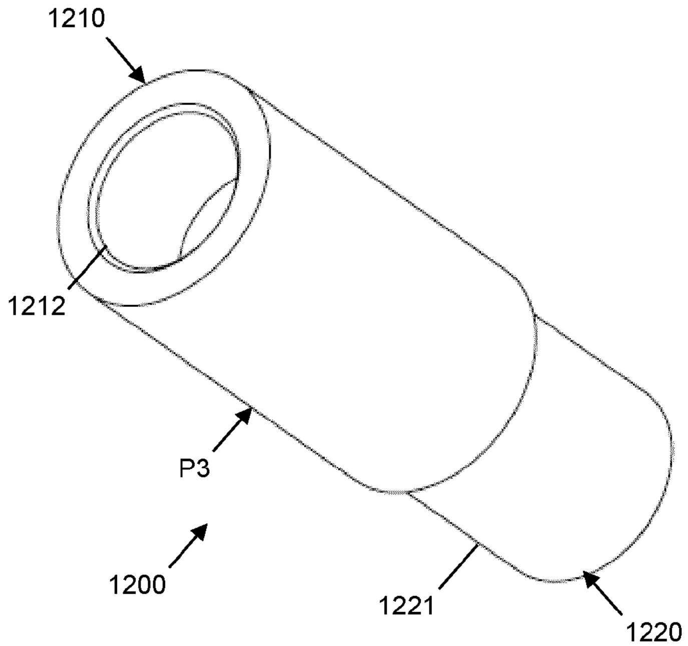

Fig. 6

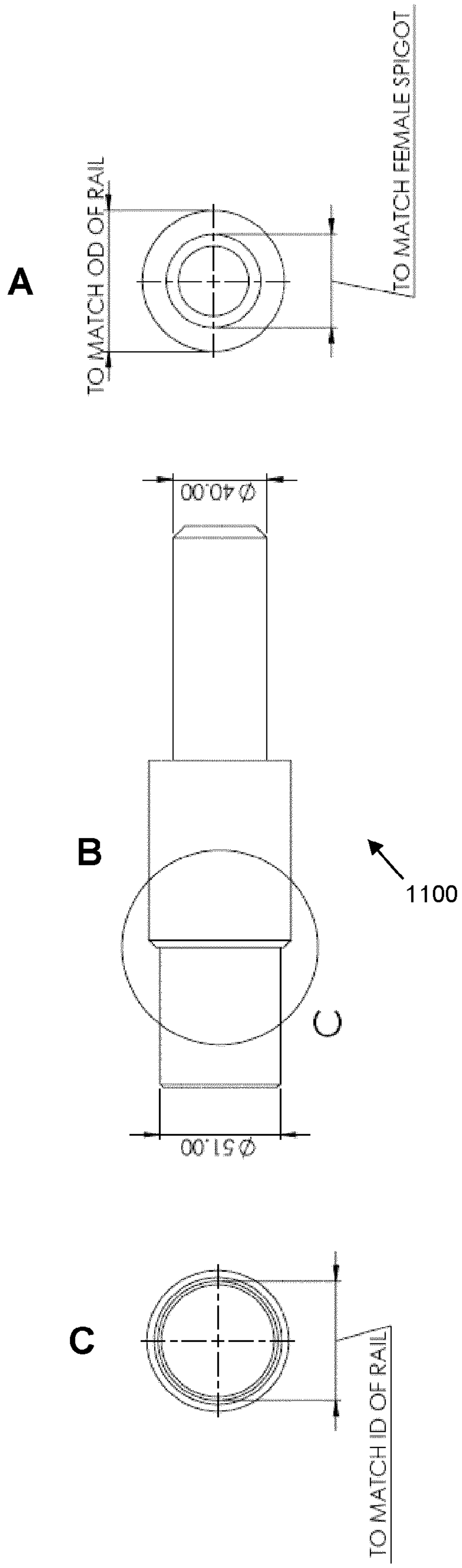
A
TO MATCH OD OF RAIL
TO MATCH FEMALE SPIGOT
Ø40.00
B
1100
C
Ø51.00
C
TO MATCH ID OF RAIL

Fig. 7

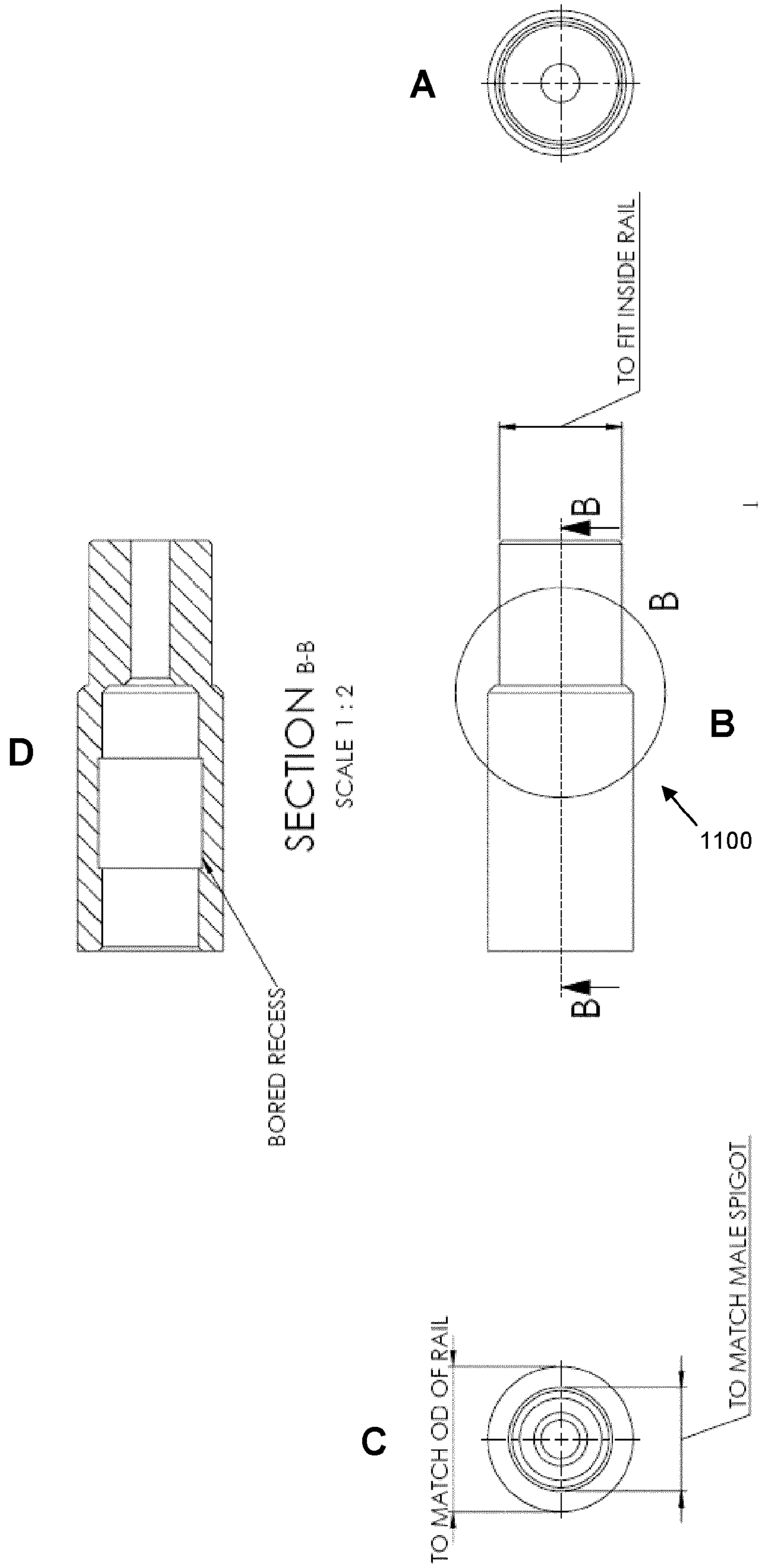
A
TO FIT INSIDE RAIL
B
B
B
B
1100
D
SECTION B-B
SCALE 1 : 2
BORED RECESS
TO MATCH MALE SPIGOT
C
TO MATCH OD OF RAIL

Fig. 8

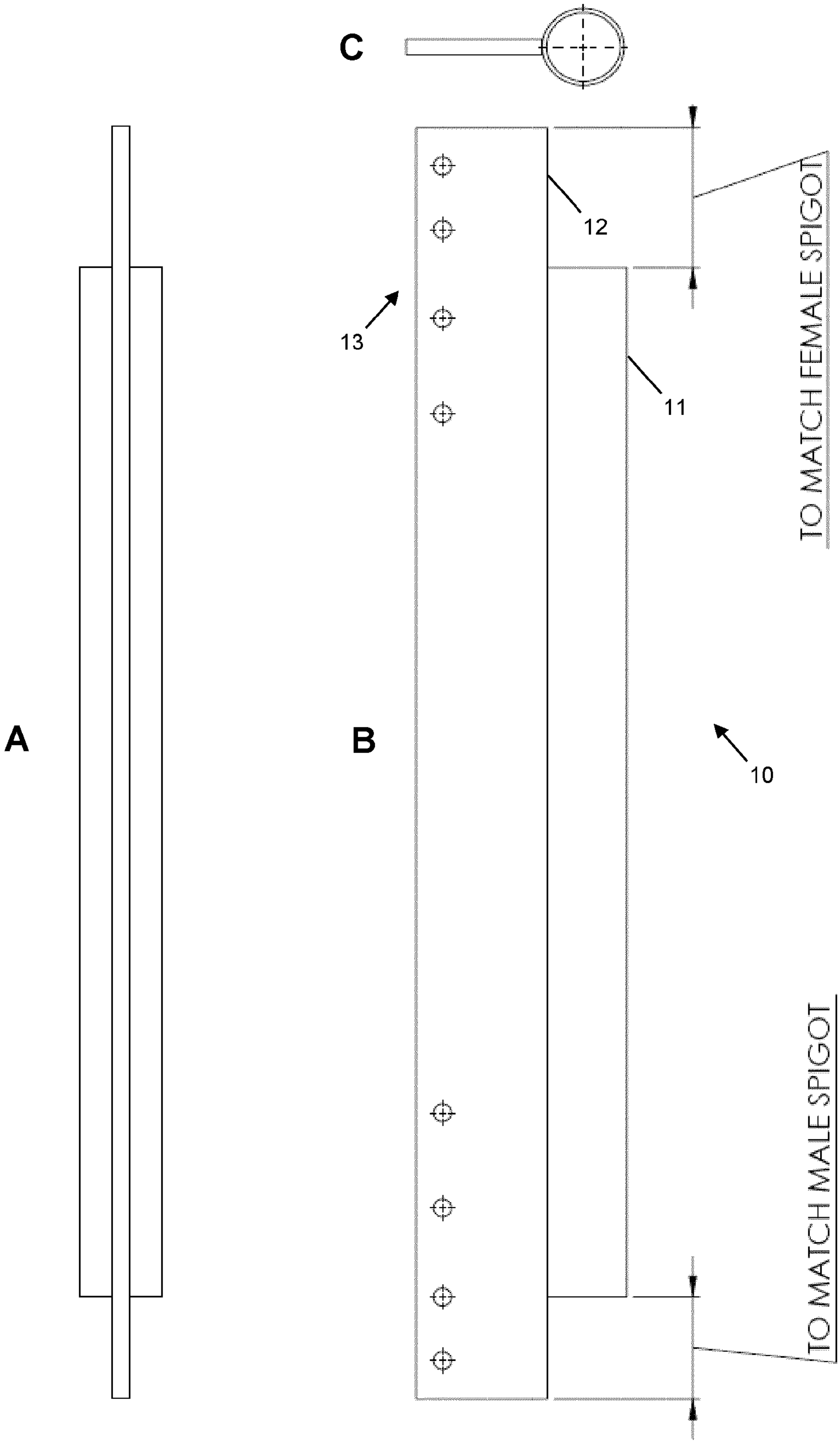

Fig. 9

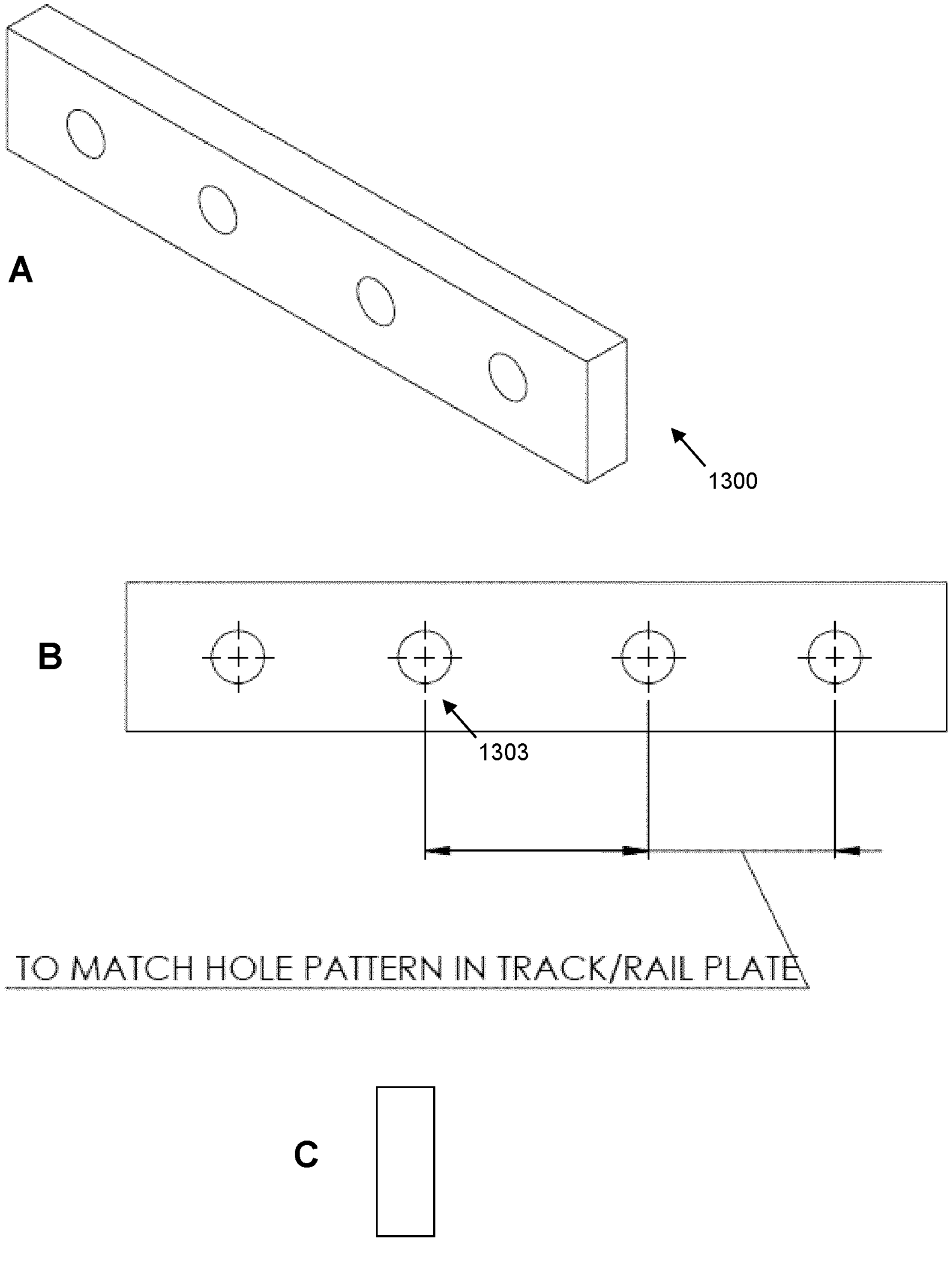

Fig. 10

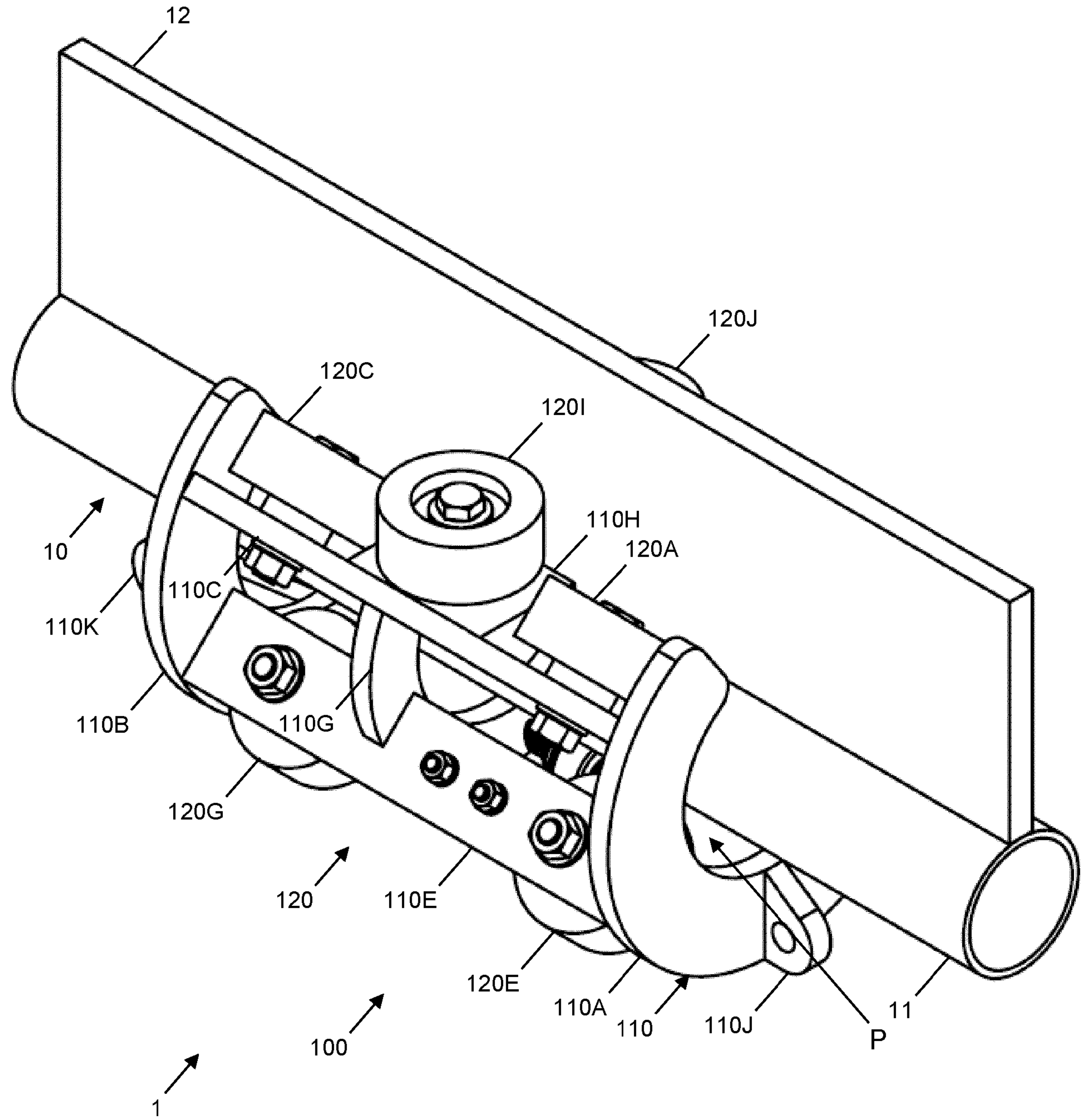
12
120J
120C
120I
110H
120A
10
110C
110K
110B
110G
120G
120
110E
120E
110A
110
110J
P
11
100
1

Fig. 11

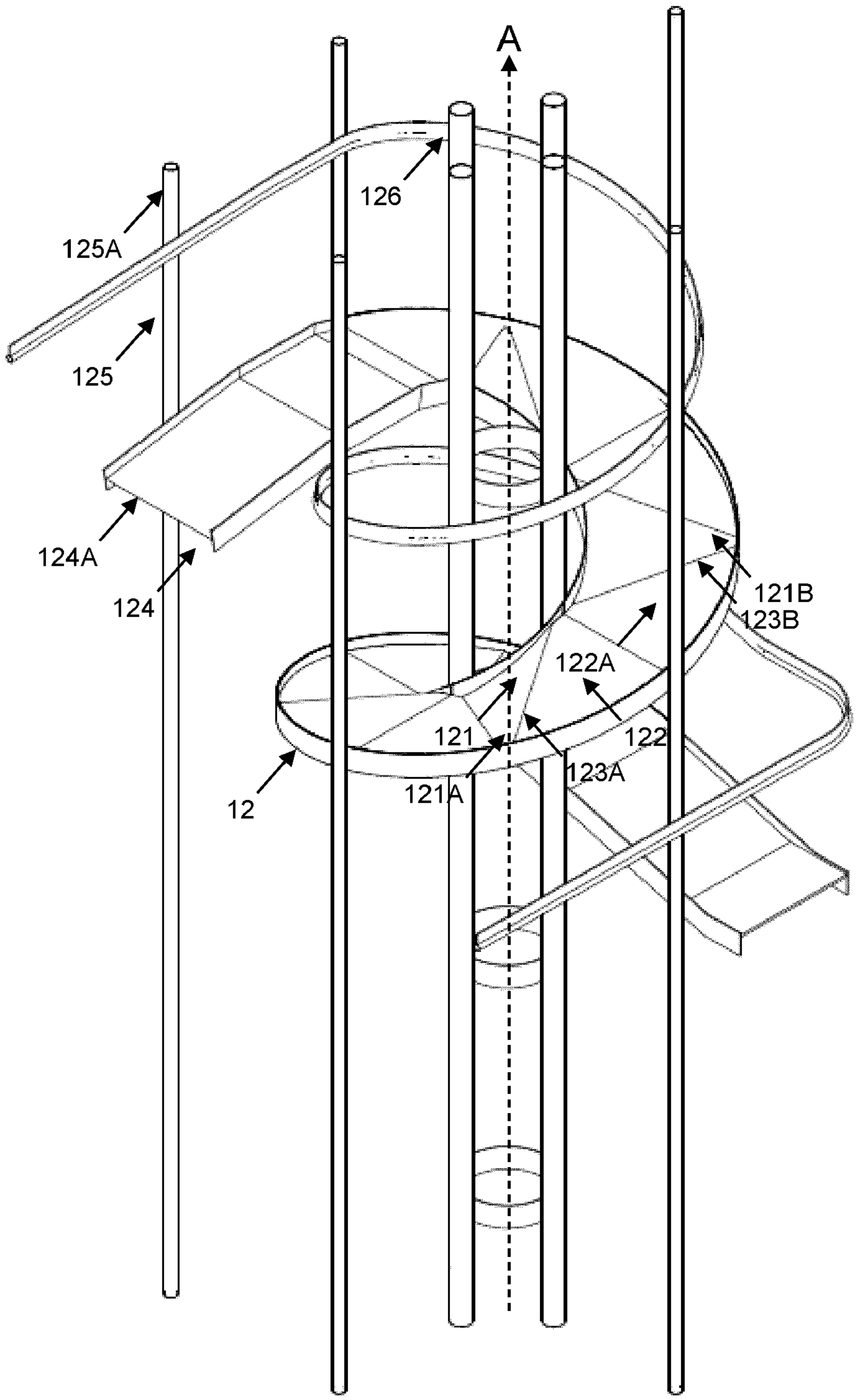

Fig. 12A

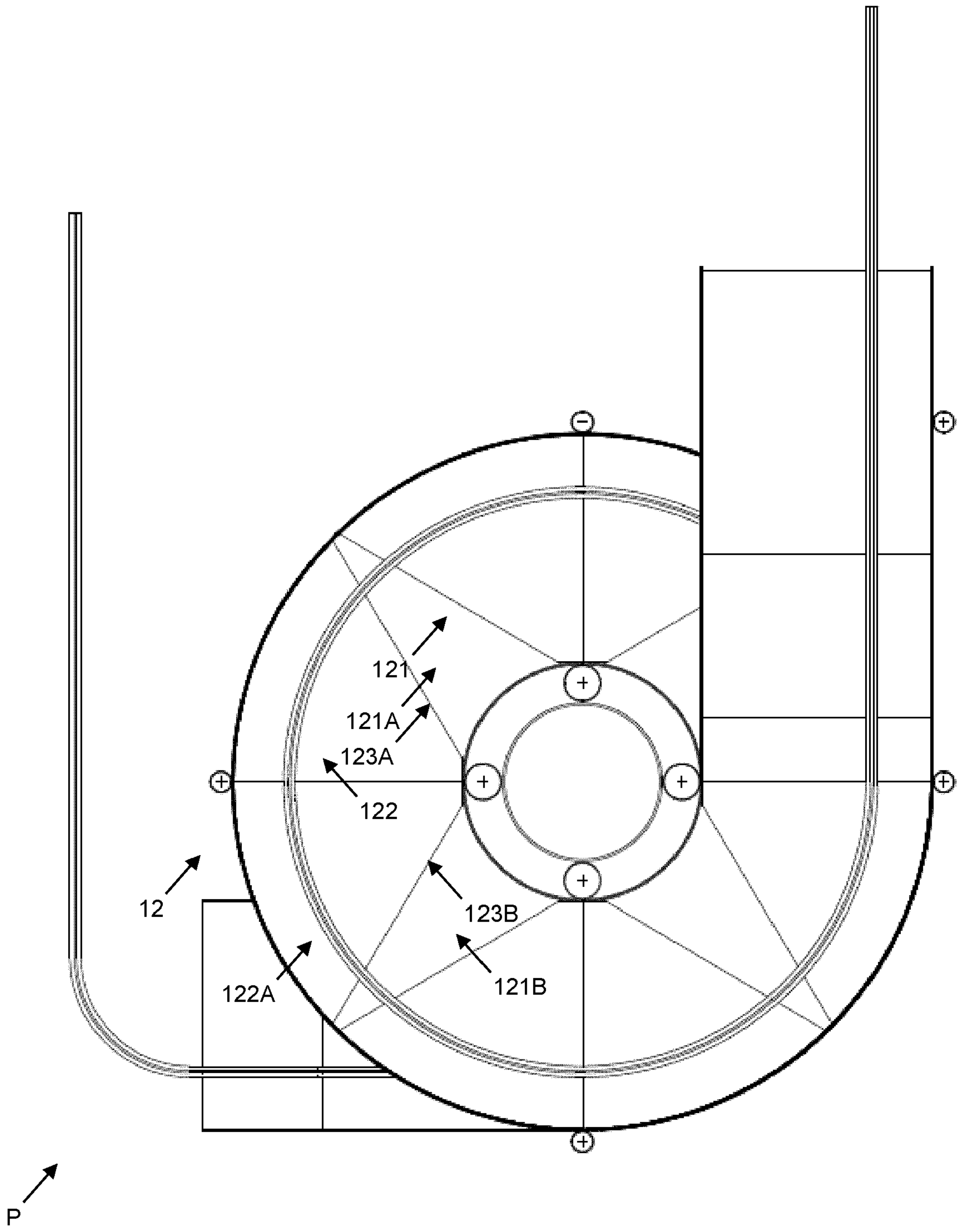

Fig. 12B

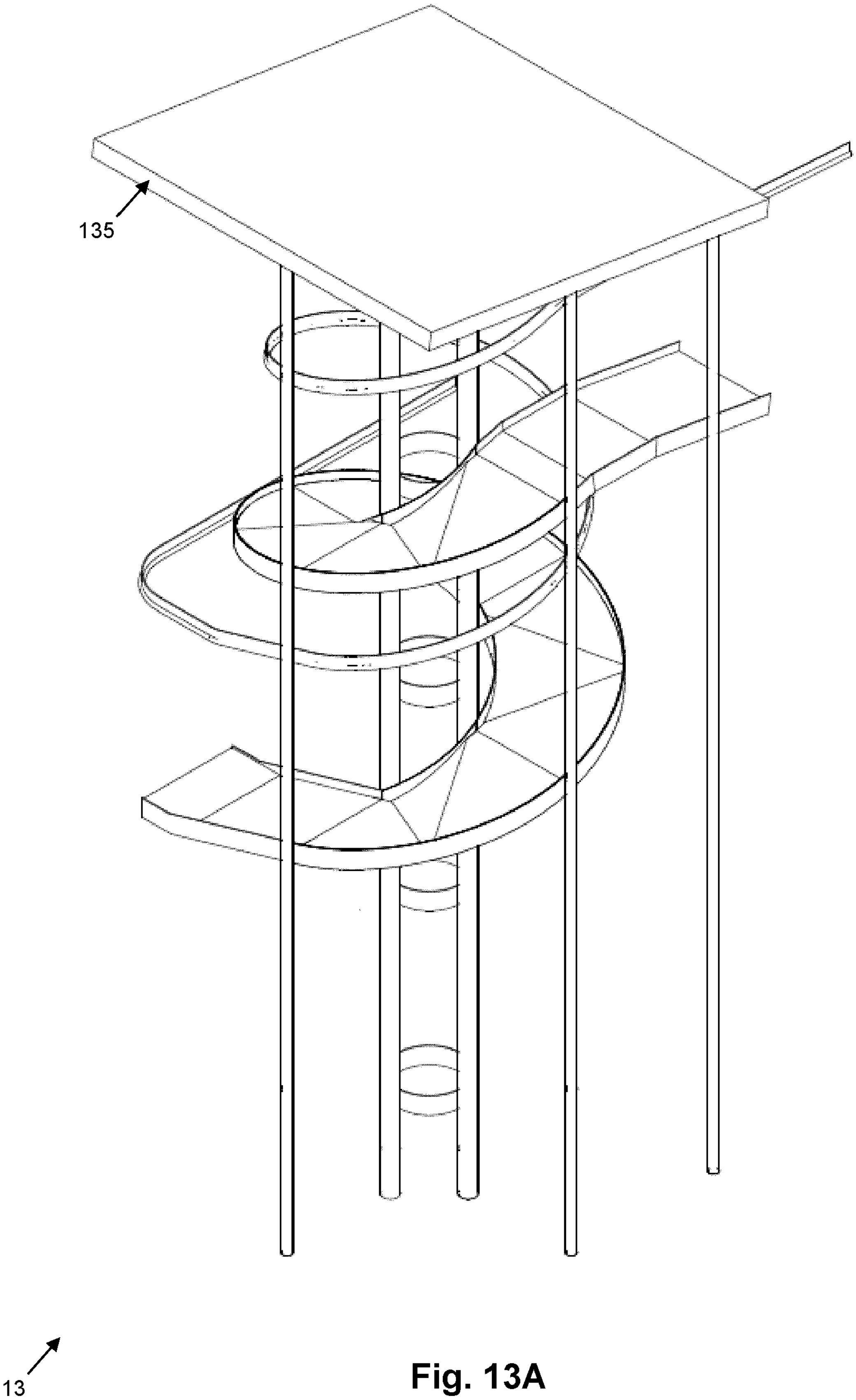

Fig. 13A

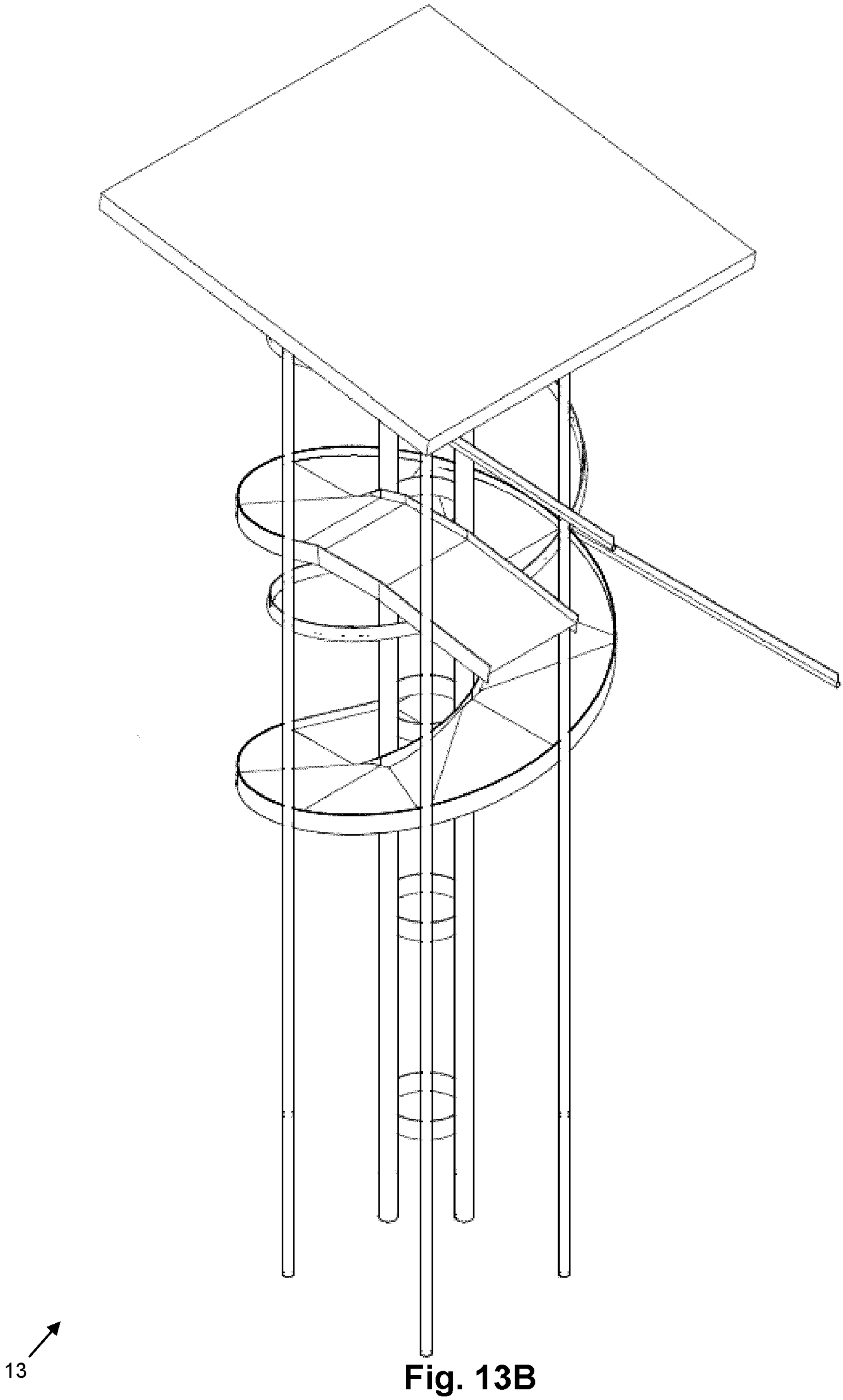

Fig. 13B

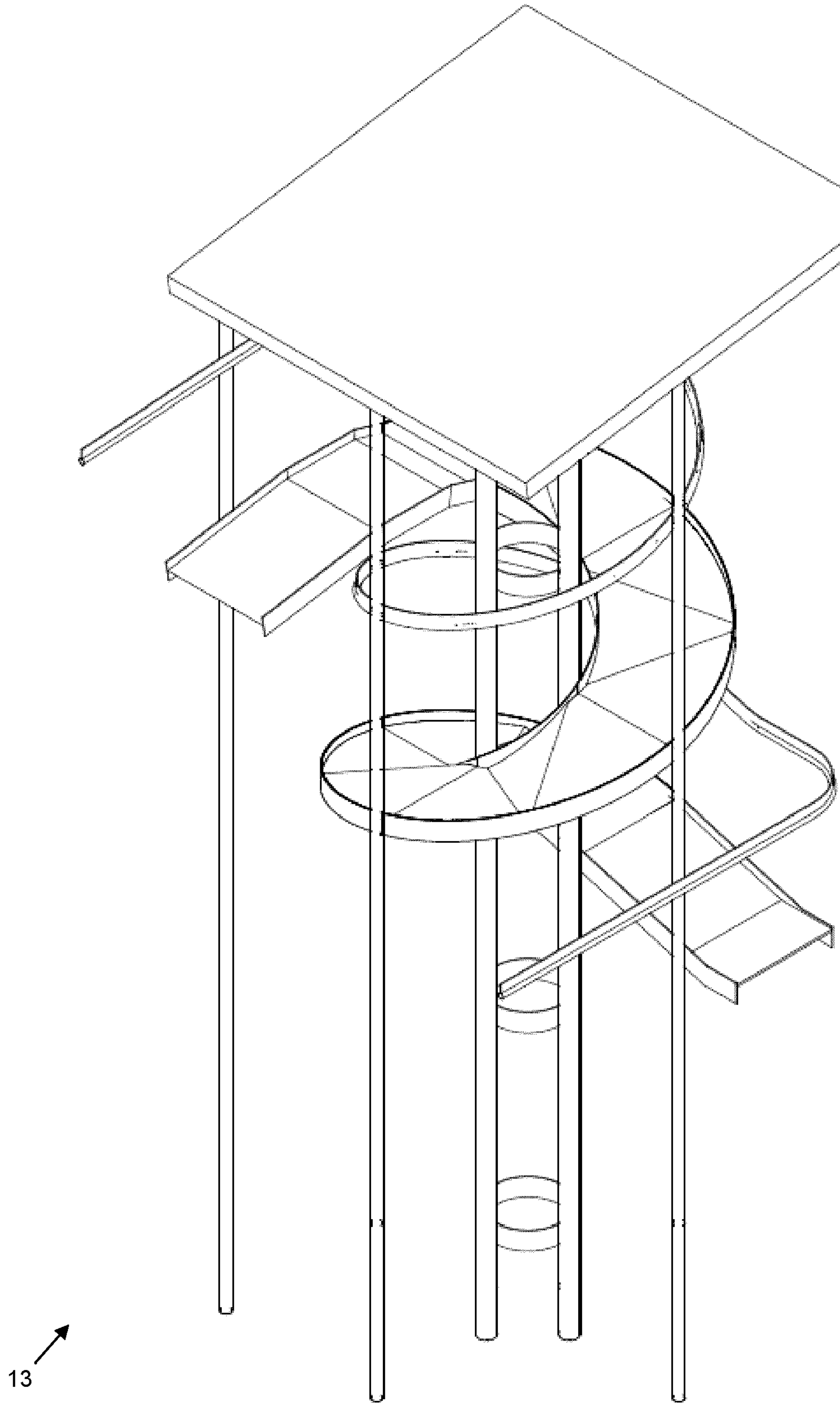

Fig. 13C

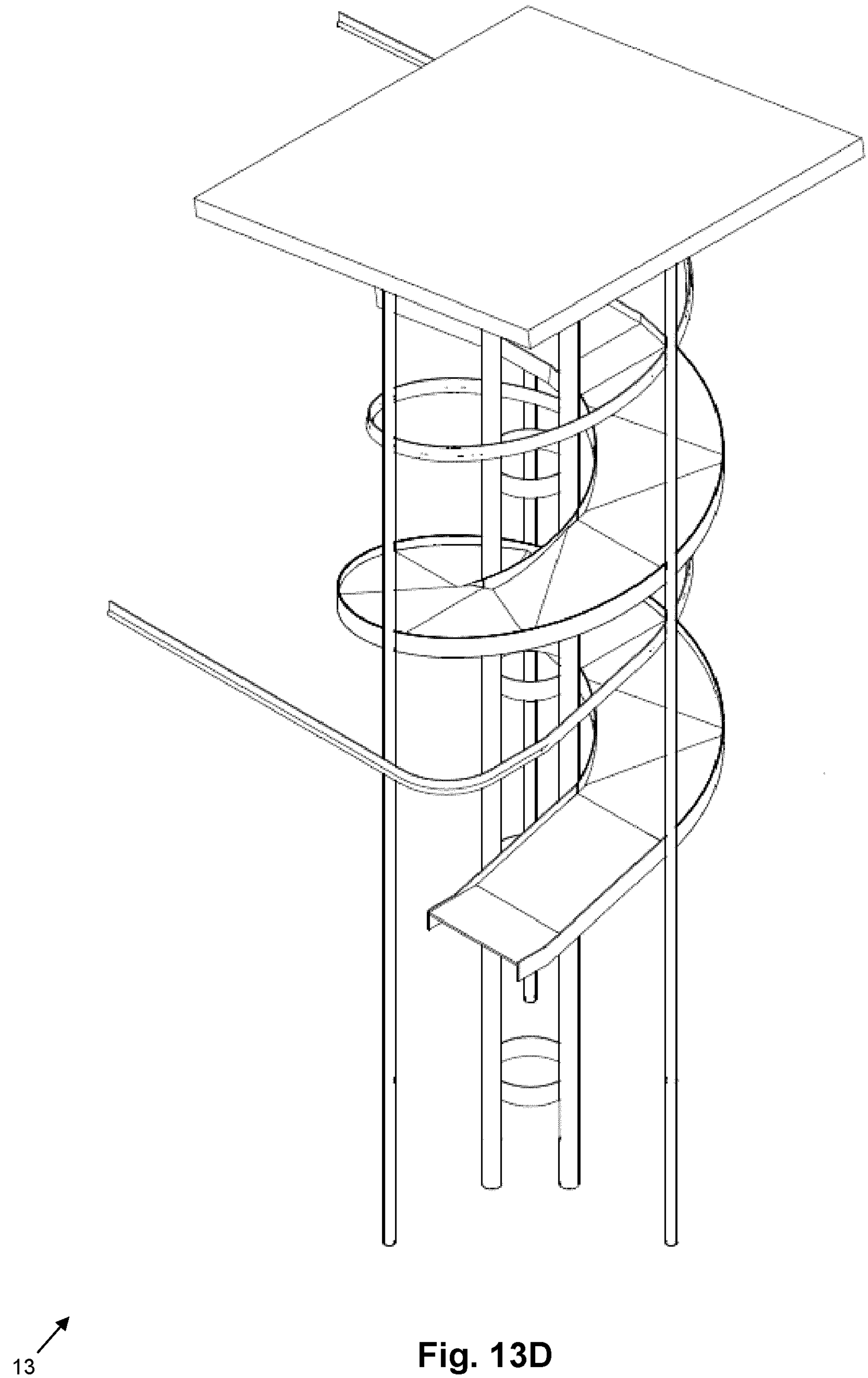

Fig. 13D

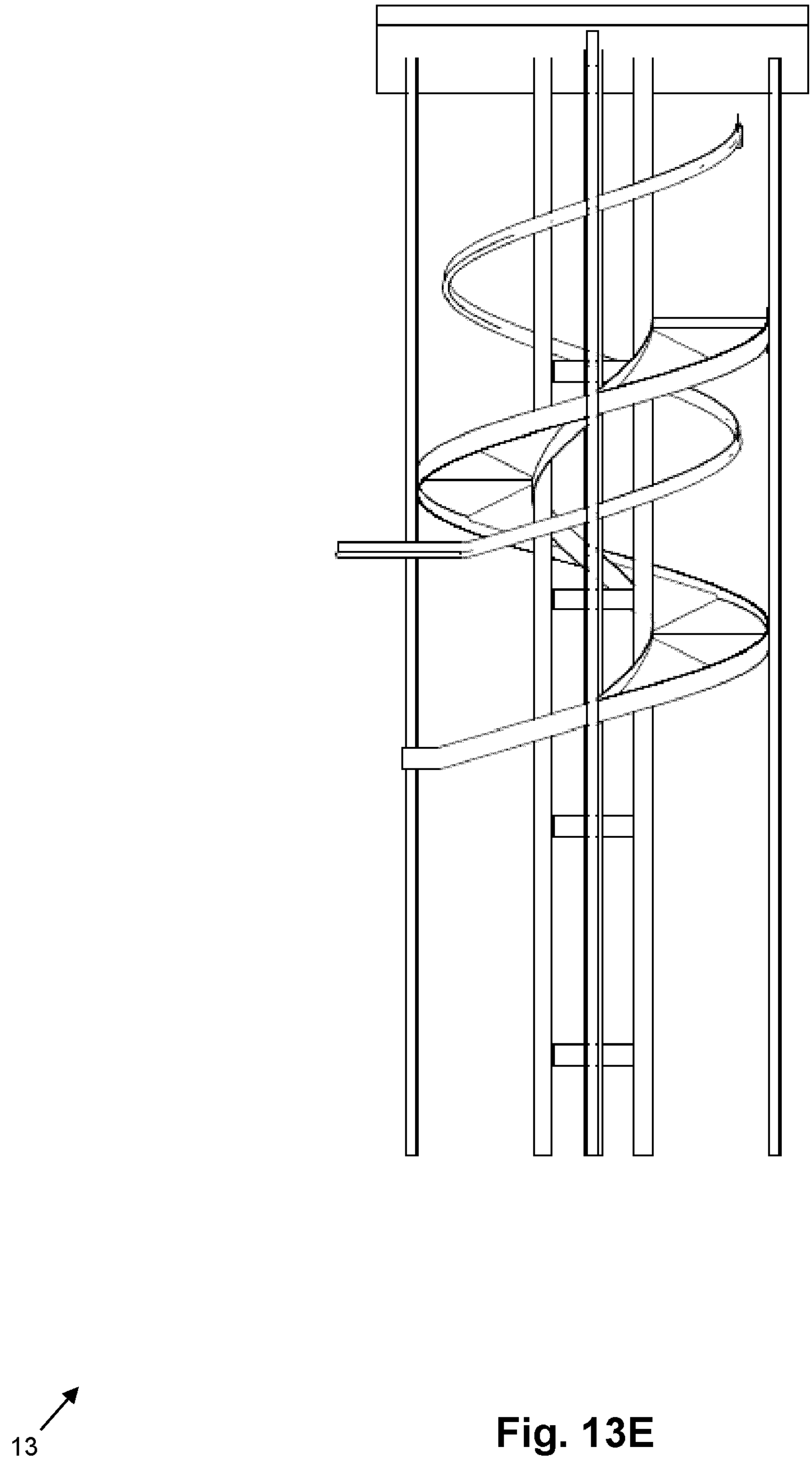

Fig. 13E

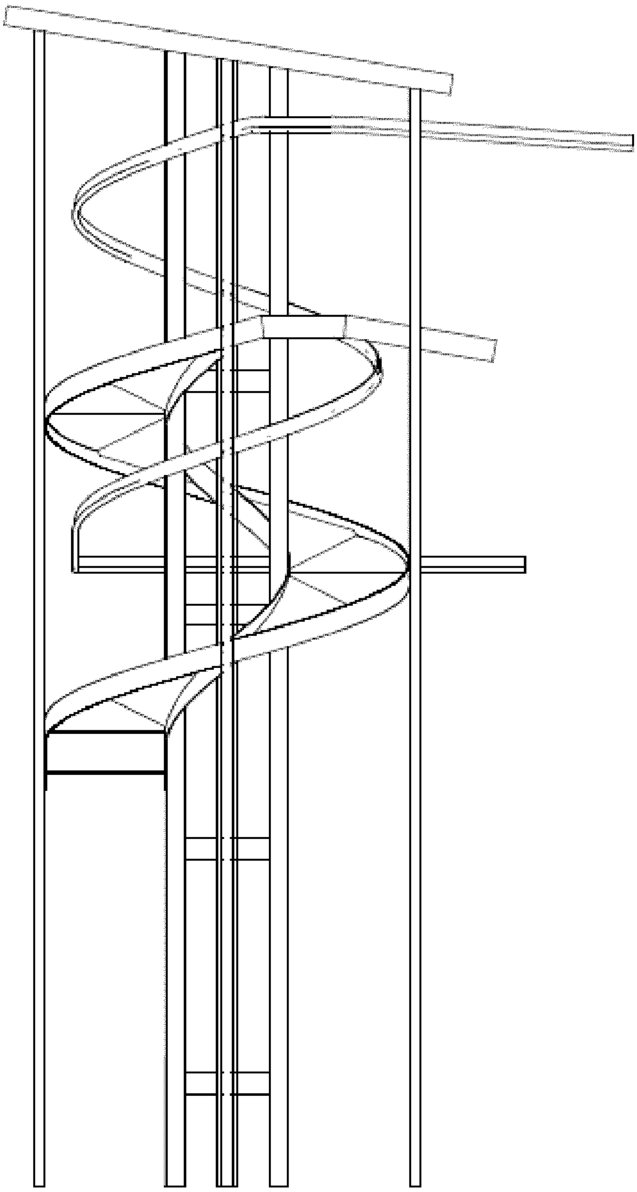

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Fig. 13F

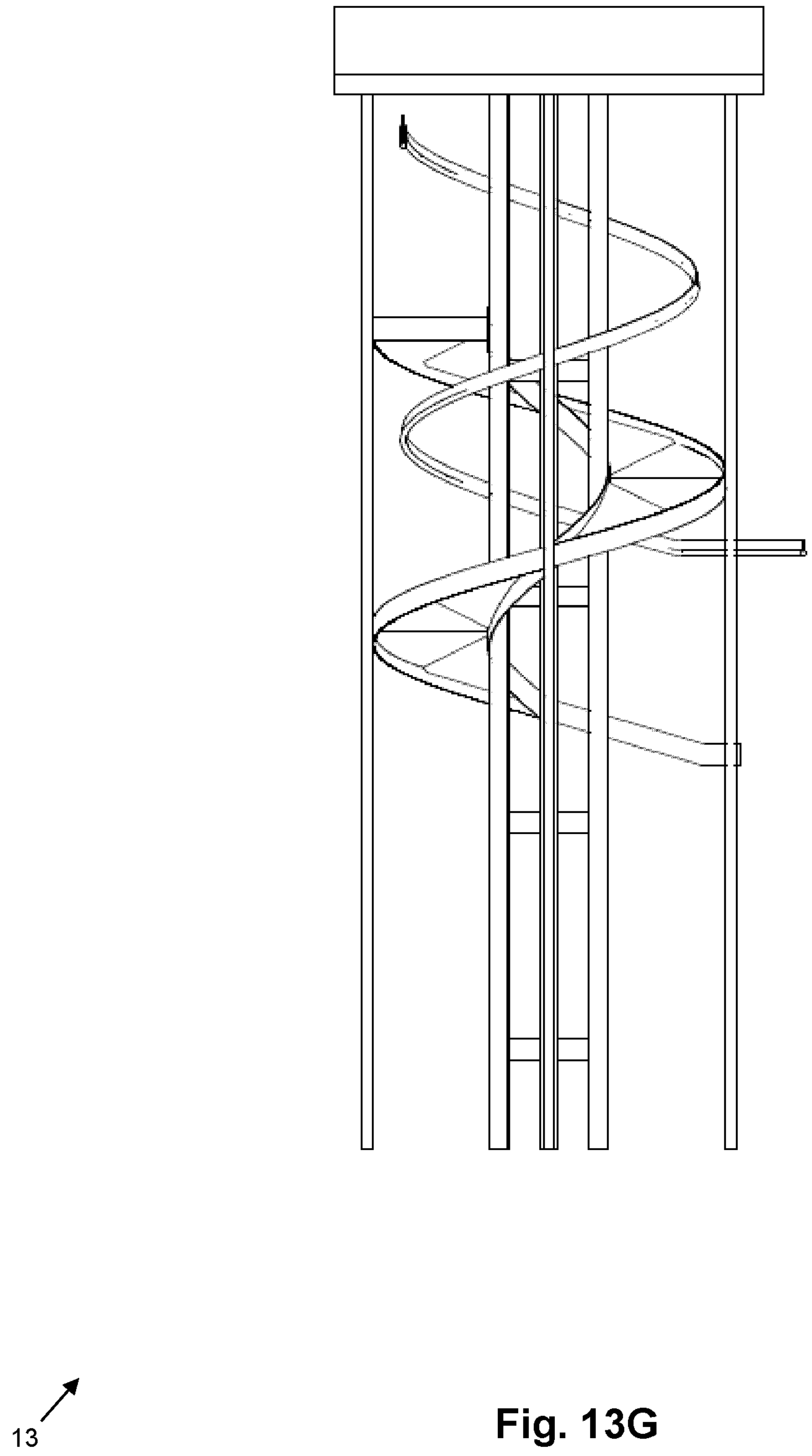

Fig. 13G

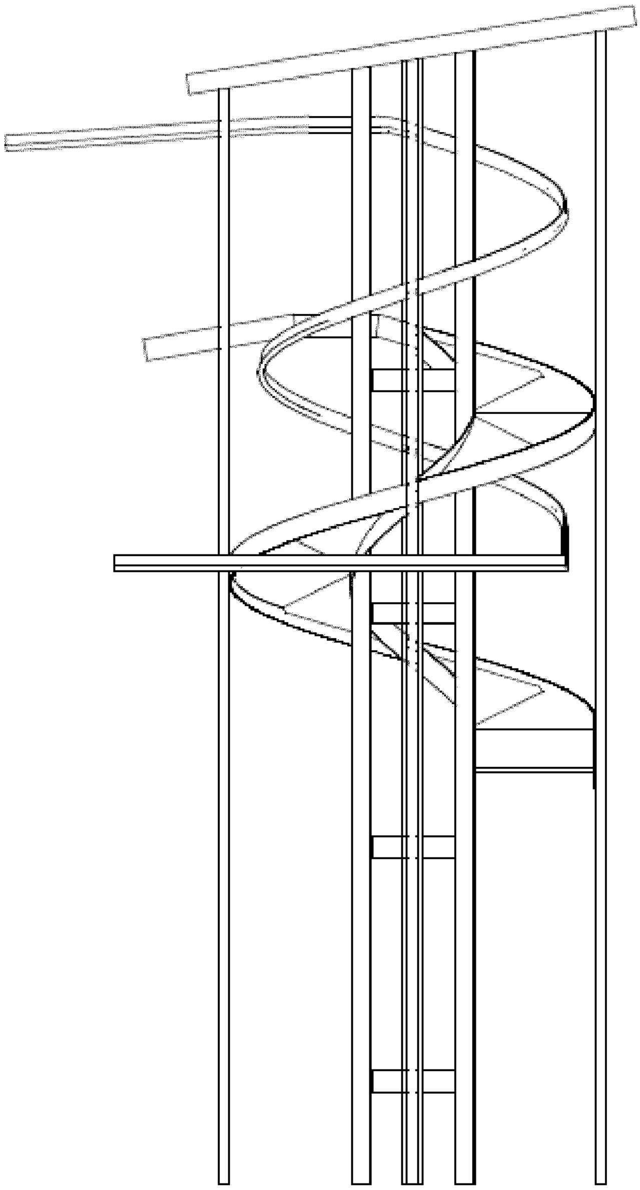

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Fig. 13H

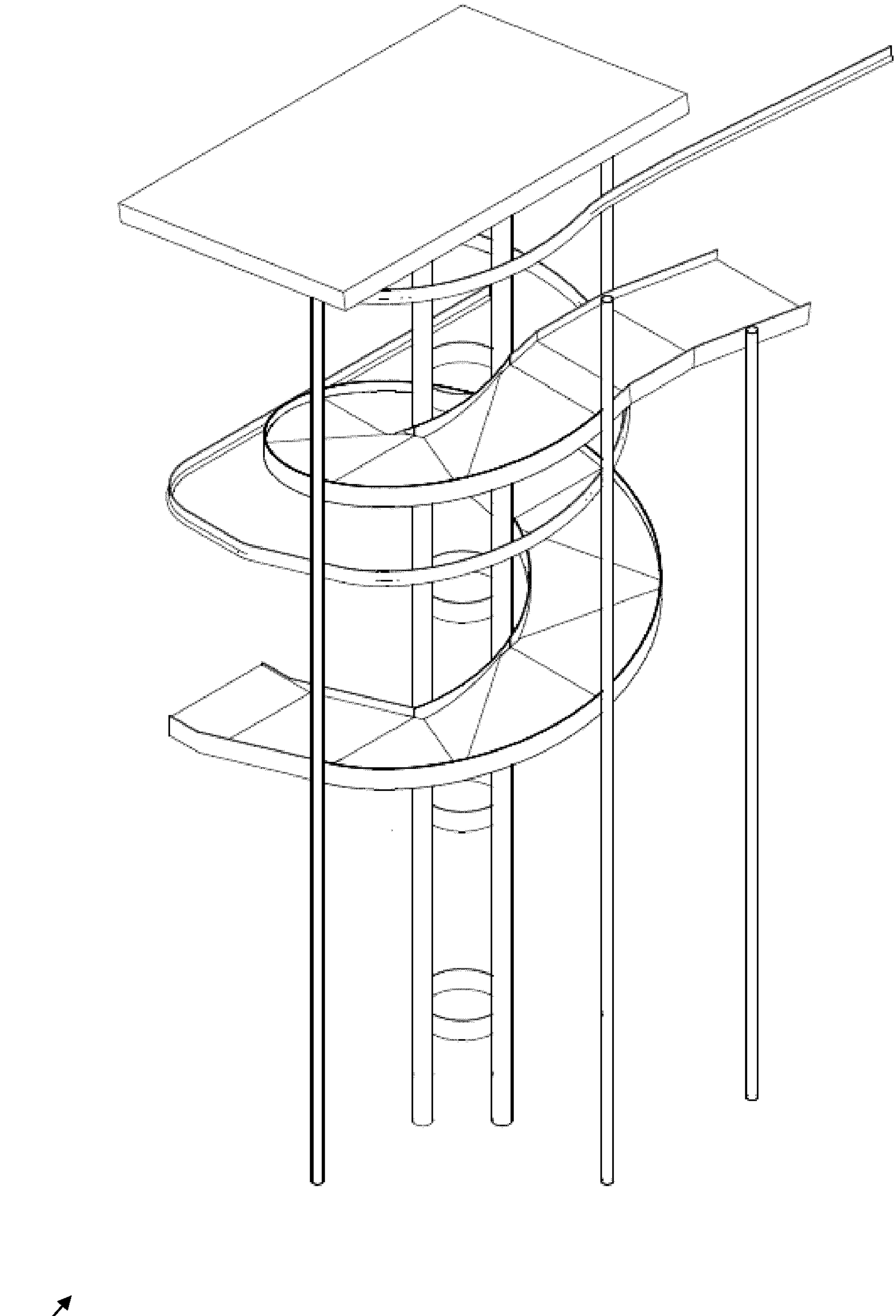

Fig. 14A

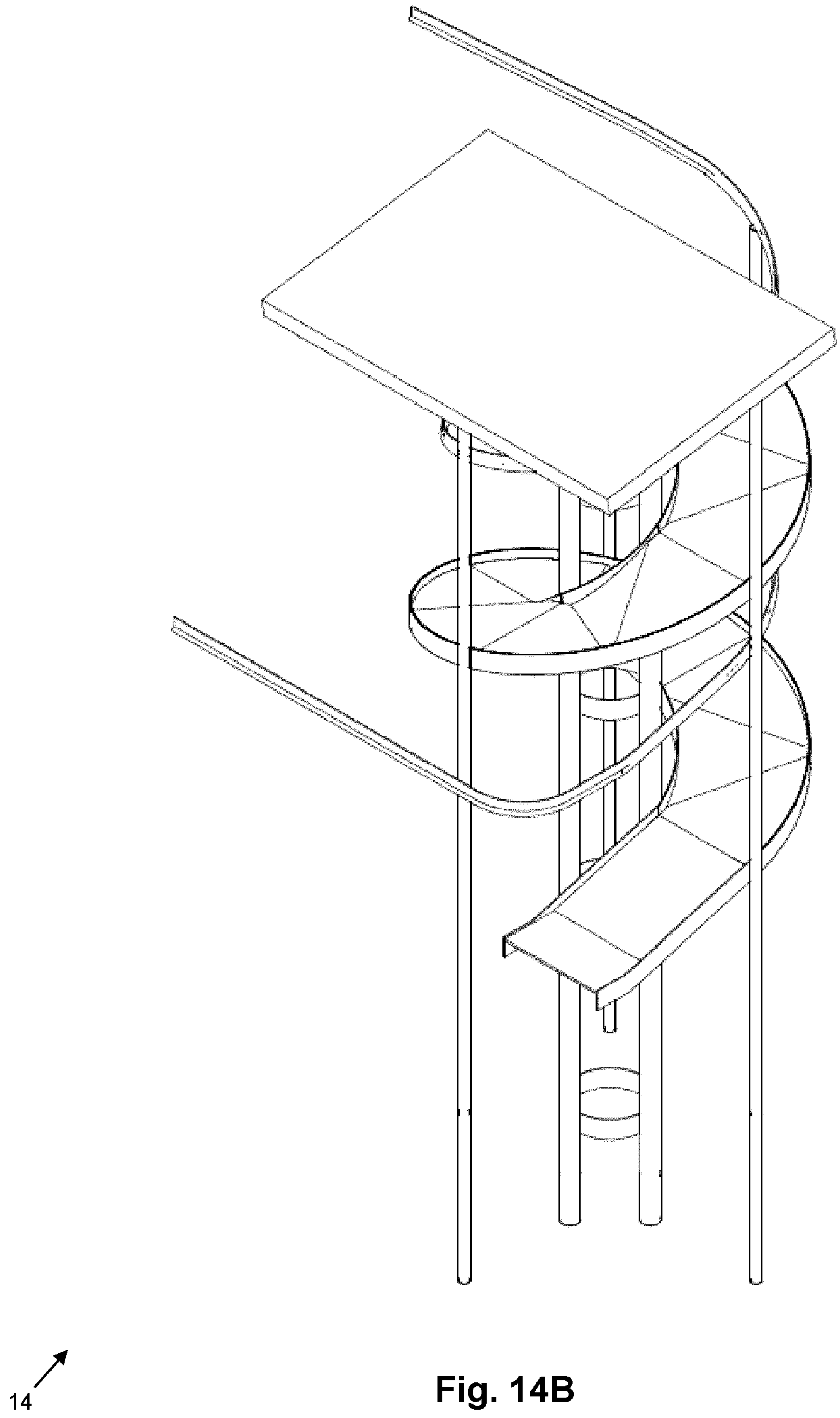

Fig. 14B

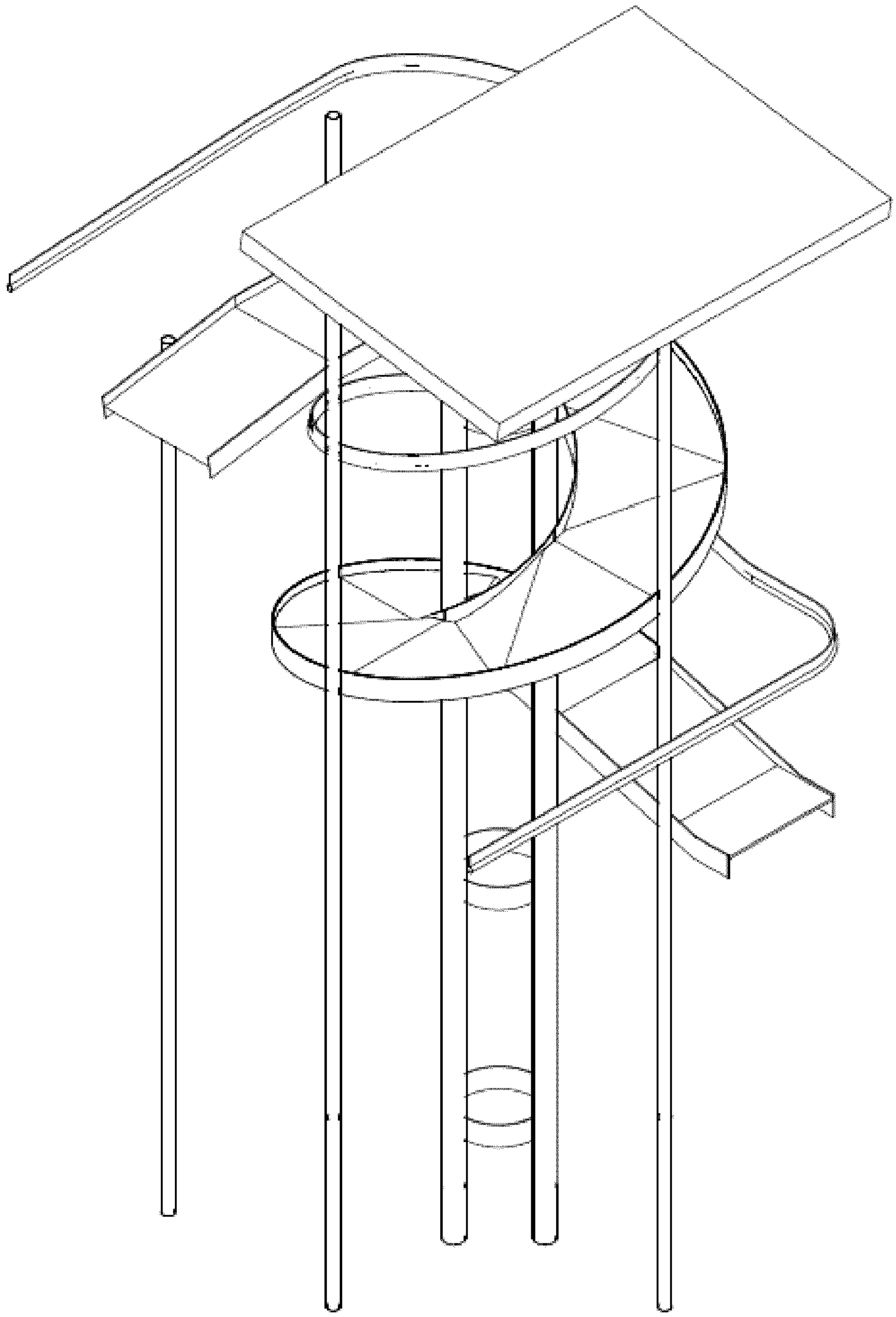

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Fig. 14C

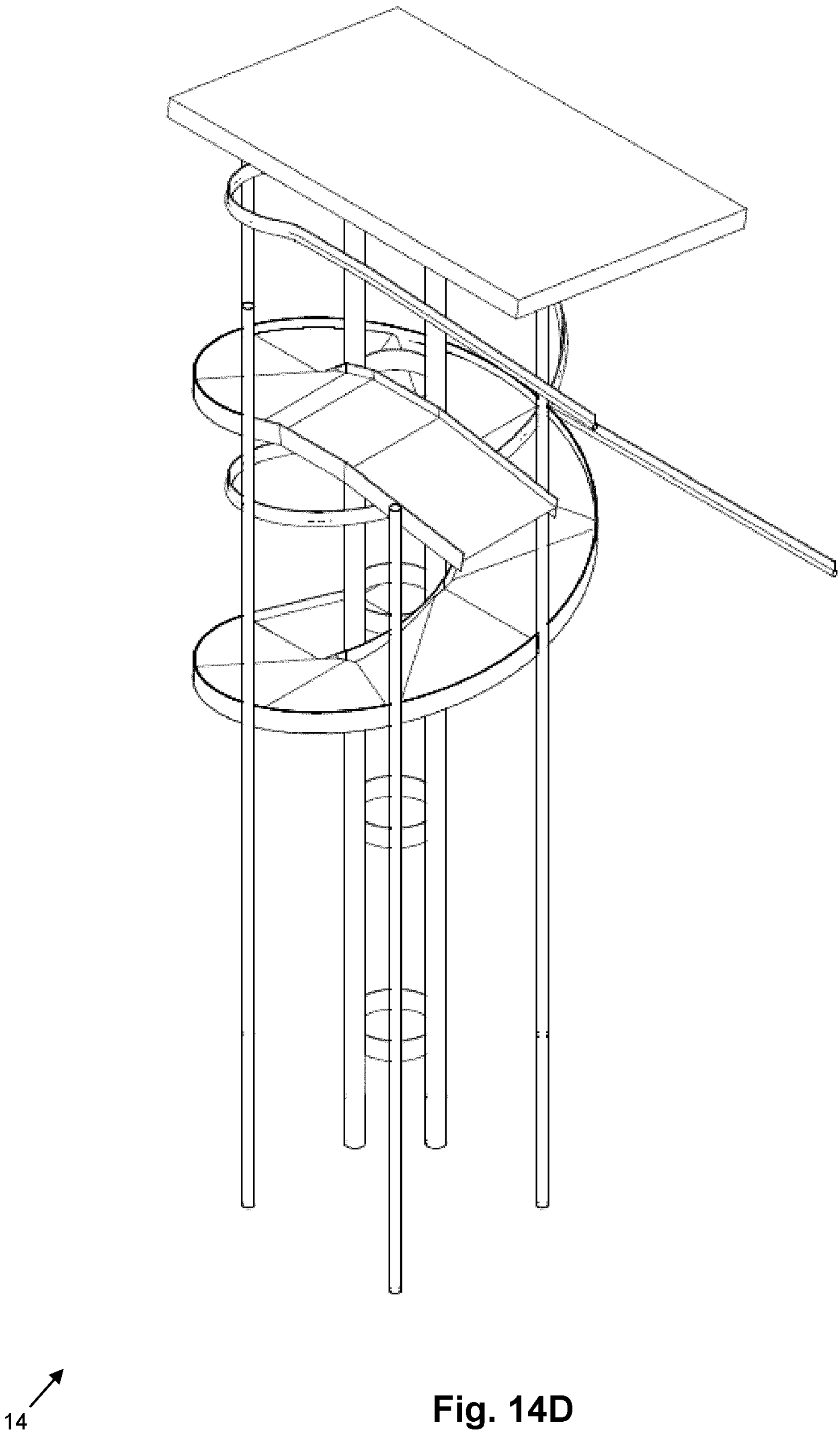

Fig. 14D

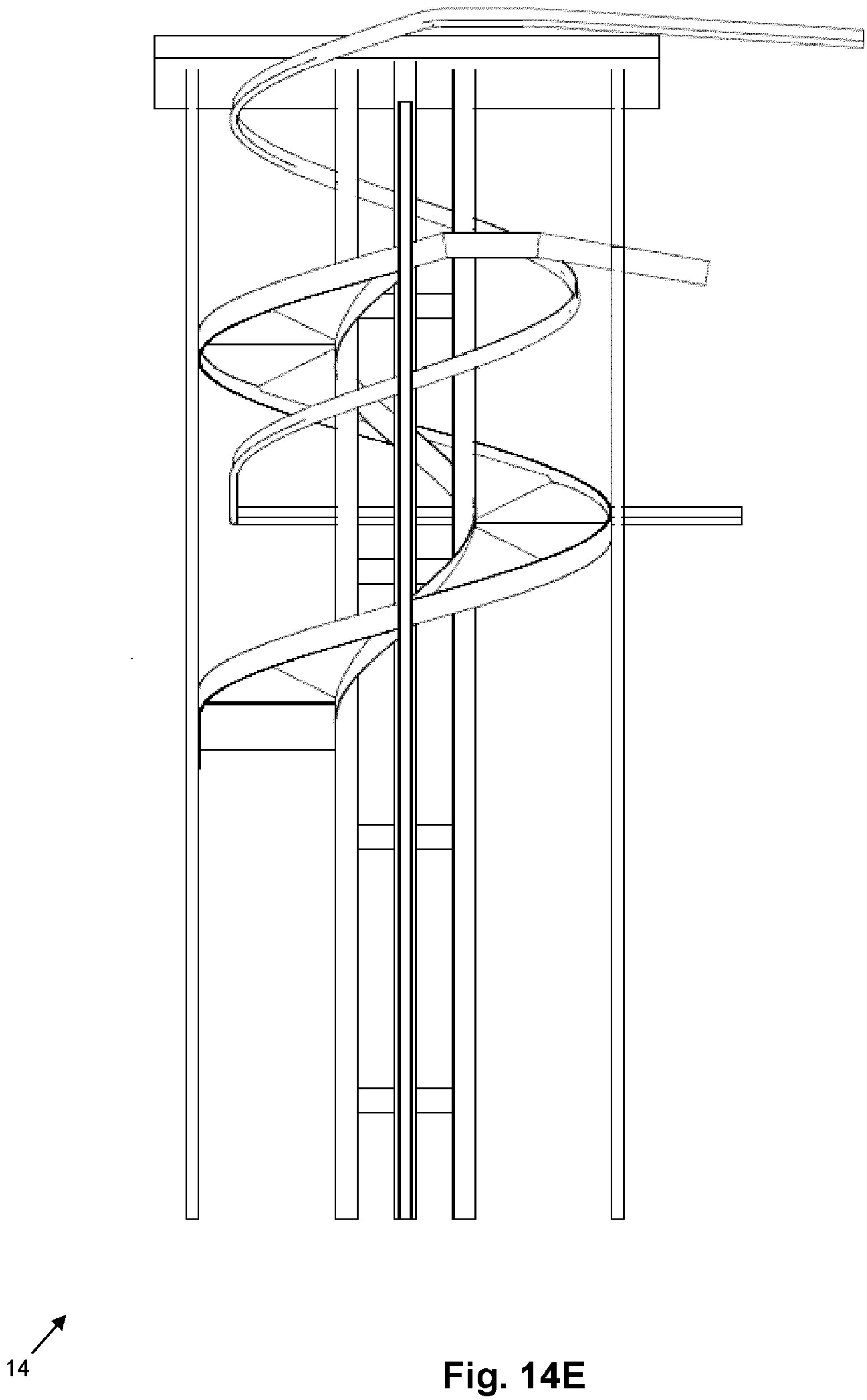

Fig. 14E

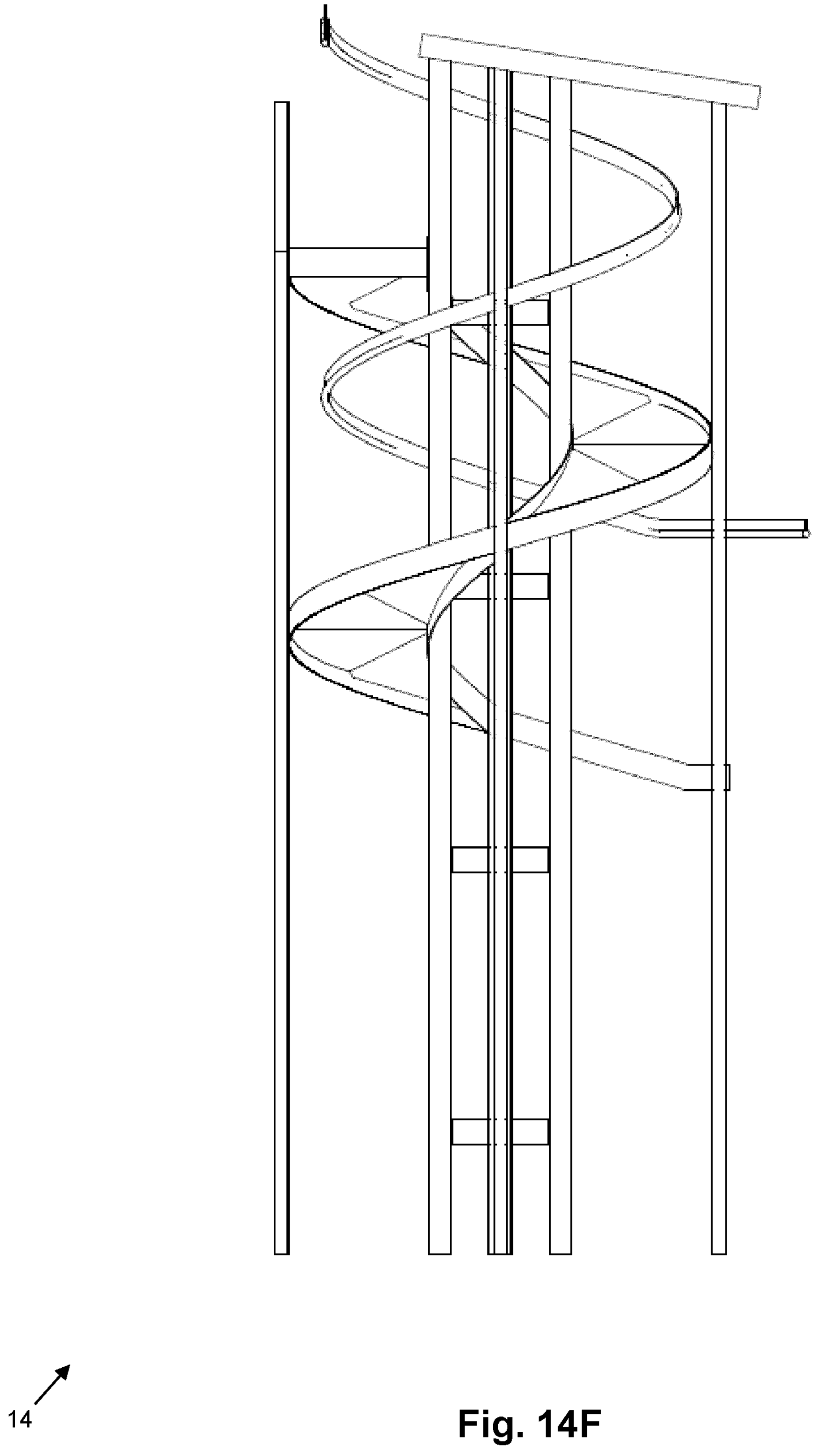

Fig. 14F

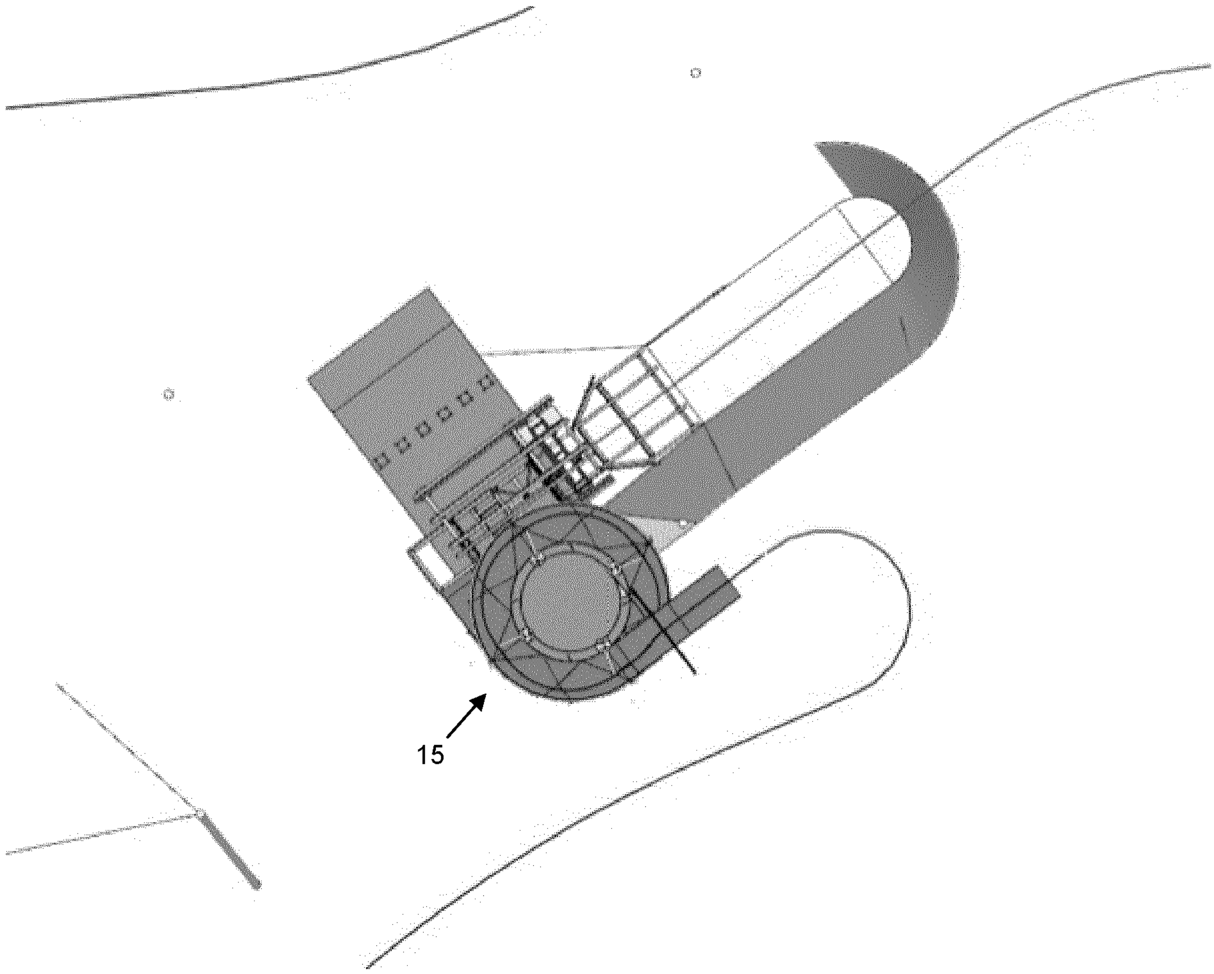

Fig. 15A

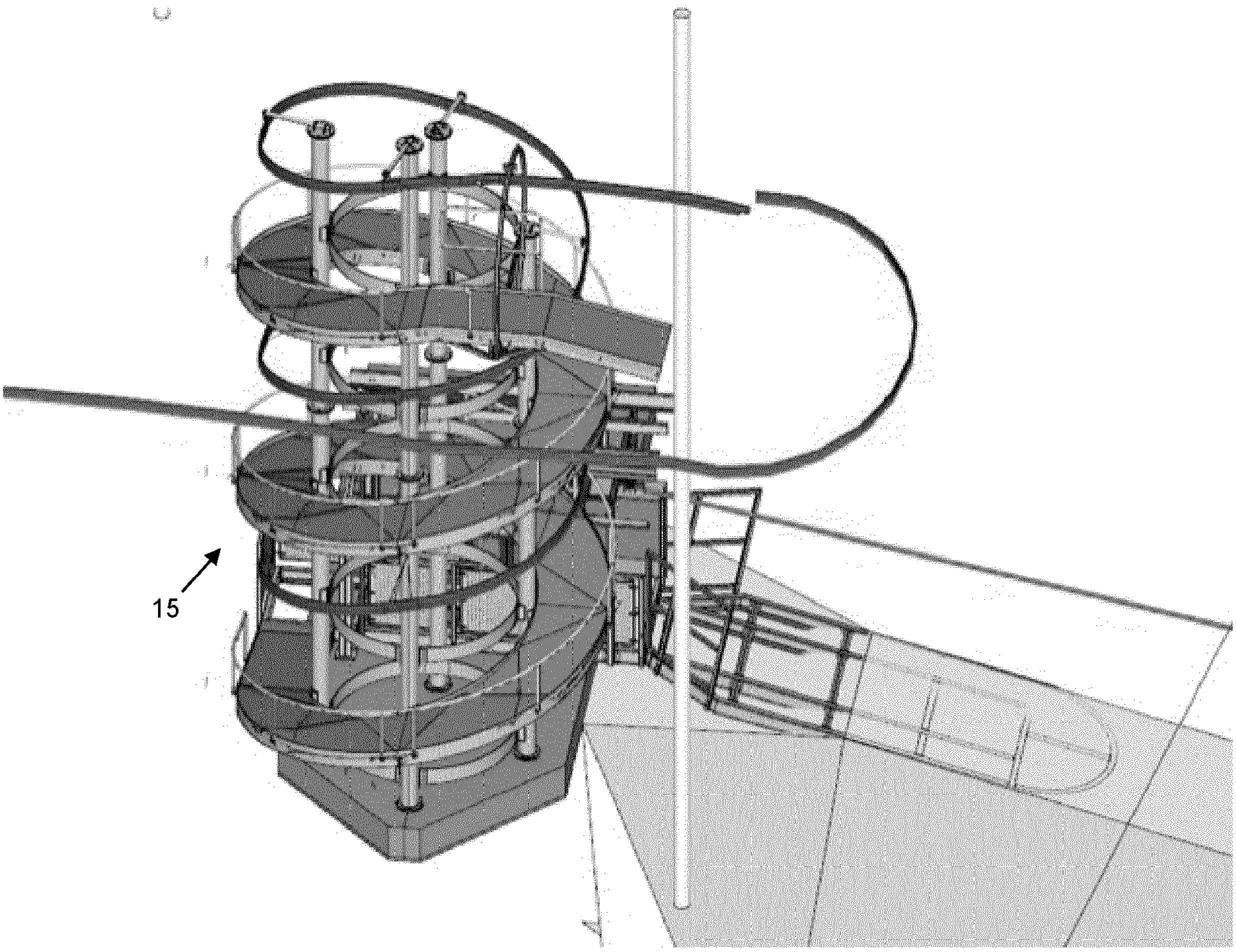

Fig. 15B

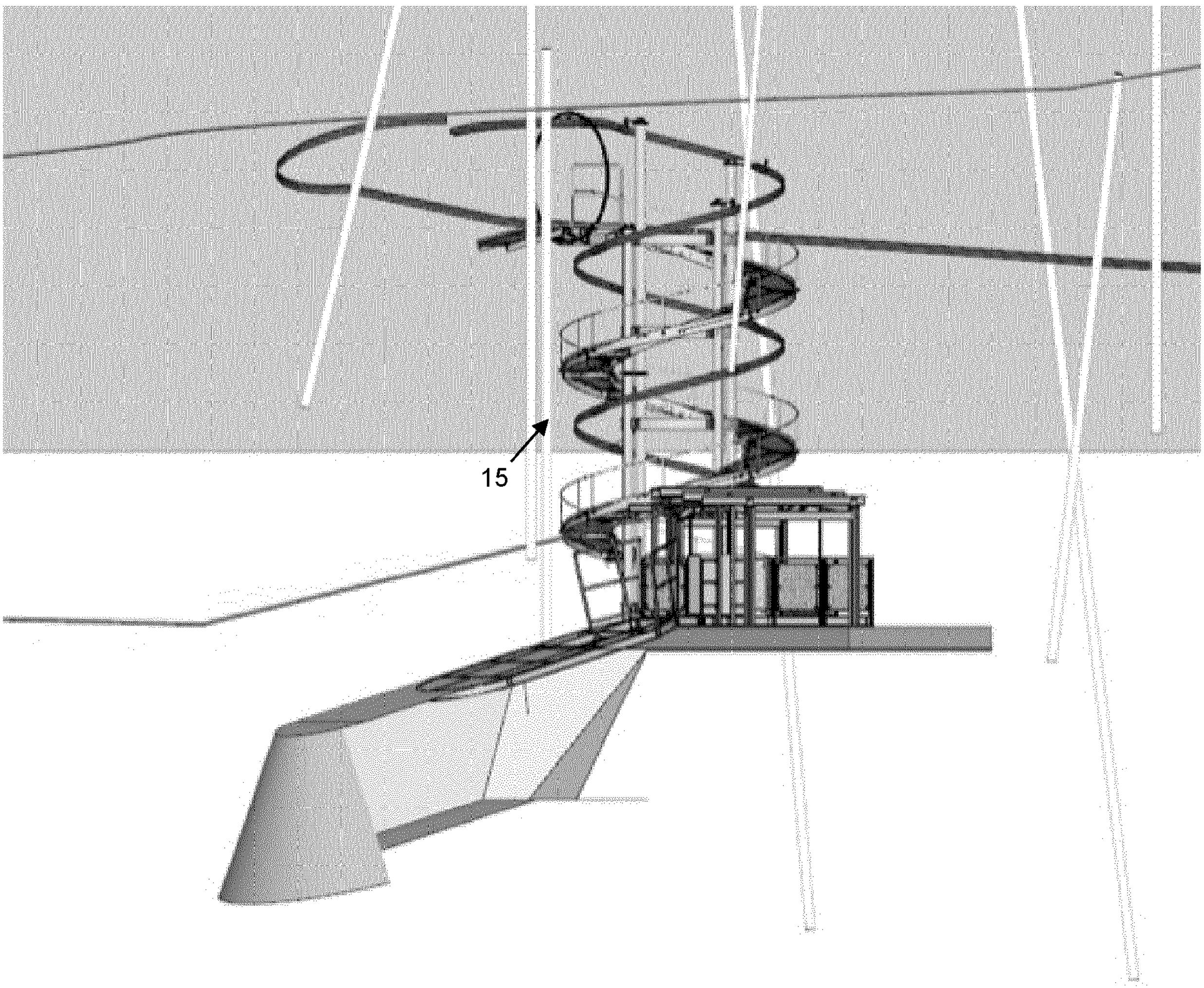

Fig. 15C

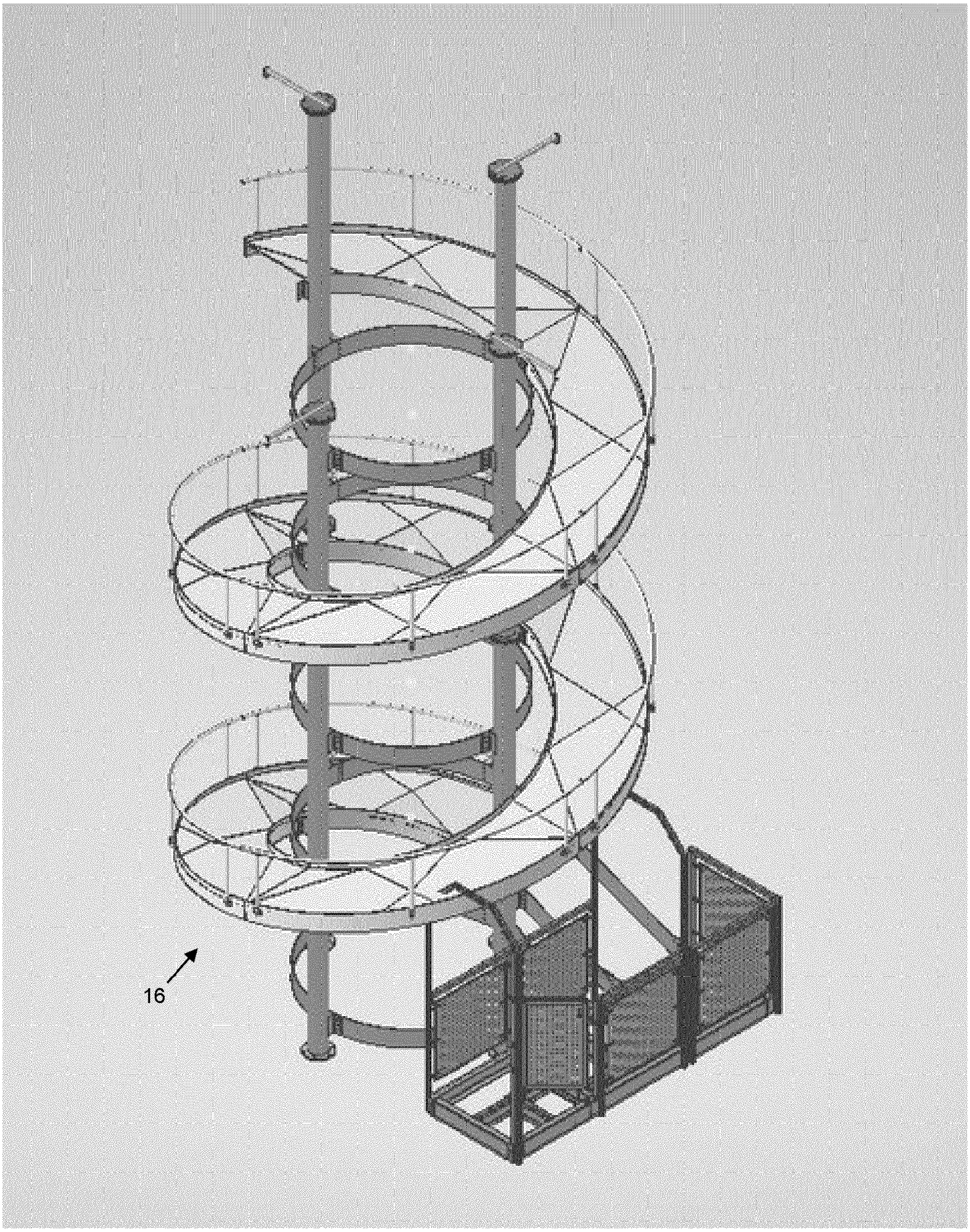

Fig. 16A

Fig. 16B

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EUROPEAN SEARCH REPORT

Application Number
EP 23 17 8197

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	15 November 2023	Brumme, Ion

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15-11-2023

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