(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 215 249 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
26.07.2023 Bulletin 2023/30

(21) Application number: **23152496.8**

(22) Date of filing: **19.01.2023**

(51) International Patent Classification (IPC):
A62B 35/00 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
A62B 35/0037

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(30) Priority: **24.01.2022 GB 202200877**

(71) Applicant: **Excalibur (Wales) Ltd**
Llanberis, Gwynedd LL55 4EL (GB)

(72) Inventors:
- **Phillips, Tom Benjamin**
  2612SZ Delft (NL)
- **Swanson-Low, Dougie**
  Caernarfon LL55 4EL (GB)
- **Cowell, Christopher Sidney**
  Pitlochry PH18 5TP (GB)

(74) Representative: **Hamilton, Alistair**
AHIP
17 Castle Street
Kirkcudbright DG6 4JA (GB)

(54) ATTACHMENT ASSEMBLY

(57) An attachment assembly is disclosed comprising an attachment plate (14) that has one or more attachment apertures (48) and a connecting arrangement (10) that is connected to the attachment plate and is suitable for connection with an external component (2). The connecting arrangement (10) has a loading axis, along which axis (A_{Sw}) load from the attachment plate and the external component is preferentially directed. The connection between the attachment plate (14) and the connecting arrangement (10) is configured such that the attachment plate (14) can pivot with respect to the connecting arrangement (10) about an attachment plate axis (A_P) that is normal to the loading axis (A_{Sw}).

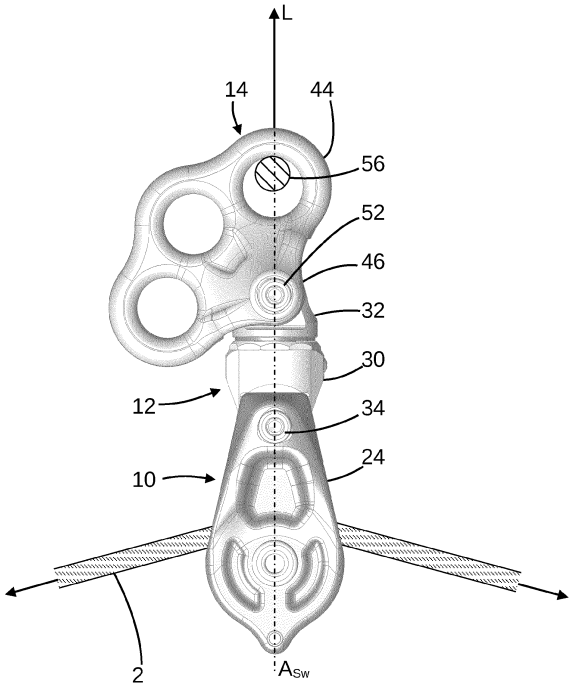

Fig 5

EP 4 215 249 A1

Description

[0001] This invention relates to an attachment assembly. In particular, it relates to an attachment assembly that includes a connecting device or connecting sub-assembly and an attachment plate, which attachment plate can be connected to multiple load-bearing components. It has particular application where the connecting device or sub-assembly has a preferred axis of loading.

[0002] The invention will be described with reference to an embodiment that is used to make connections to a harness for use in climbing or working at height. A widely-used type of harness used by arborists (an example being shown in Figure 1) incorporates a flexible load-bearing member 2 commonly referred to as a "rope bridge" that extends between two forward connection arrangements 4. The rope bridge serves as a primary component that transfers load from the harness into a rigging system through one or more connecting lines. It is usual to provide a metal connecting component on the rope bridge that can be connected to the rigging system for example through a carabiner. At its simplest, the connecting component can be a metal ring 6, which is advantageous because it can rotate on the rope bridge, so distributing wear evenly around the ring. However, when a user wishes to make more than one connection to the connecting component, use of a ring can be problematic since connected components and lines can become entangled during use of the harness. To address this, there have been various proposals to provide a connection assembly that includes a connecting plate having multiple through holes to which connections can be made. However, all of these have known assemblies have various disadvantages that can result in uneven wear, twisting of the connection assembly as a result of asymmetric loading, and difficulty in connecting to the harness.

[0003] An aim of this invention is to provide an improved connection assembly that allows multiple connections to be made through a functional component or sub-assembly to an external anchorage such as the rope bridge of a harness.

[0004] To this end, the present invention provides an attachment assembly comprising:

an attachment plate that has one or more attachment apertures; and

a connecting arrangement that is connected to the attachment plate and is suitable for connection with an external component; wherein:

the connecting arrangement has a loading axis, along which axis load from the attachment plate and the external component is preferentially directed; and

the connection between the attachment plate and the connecting arrangement is configured such that the attachment plate can pivot with respect to the connecting arrangement about an attachment plate axis that is normal to the loading axis.

[0005] Allowing the attachment plate to pivot with respect to the connecting arrangement in this way allows the attachment plate to adapt its alignment to compensate for asymmetric loads connected to the attachment plate to ensure that the connecting arrangement is loaded, as nearly as possible, along its loading axis and that loading off the loading axis is minimised. The connecting arrangement is capable of withstanding loads that are off-axis from the loading axis, but it is strongest when loads are applied to it as close as possible to the loading axis.

[0006] Typically, the attachment plate axis intersects the loading axis.

[0007] The connecting arrangement may include a swivel that comprises first and second bosses interconnected for rotation about a swivel axis, the swivel axis being the loading axis of the connection arrangement, and the attachment plate being connected to the second boss such that the attachment plate can pivot with respect to the second boss about the attachment plate axis. It is preferable to avoid off-axis loading of the swivel since this can cause increased wear and friction in the swivel.

[0008] The connecting assembly may be rigidly attached to the first boss of the swivel or, alternatively, the connecting assembly can pivot with respect to the first boss of the swivel, typically about an axis that is normal to the swivel axis.

[0009] Alternatively or additionally, the connecting arrangement may include a continuous loop or an openable loop which may be in the form of a carabiner body, the loading axis extending through a rope basket of the carabiner body. Off-axis loading of the carabiner body is preferably to be avoided because the carabiner achieves its maximum strength only when loaded on the loading axis.

[0010] The connecting assembly is typically suitable for connection with a rope bridge of a harness whereby load can be transferred from the harness through the attachment assembly to one or more external components connected to the attachment plate.

[0011] For example, the connecting assembly may include a pulley block that has a sheave carried for rotation about a sheave axis within a pulley body. Such a connecting assembly can travel along the rope bridge with minimal friction and even distribution of wear. In embodiments in which the connecting assembly includes a continuous loop or an openable loop, the loop may be suitable for surrounding the rope bridge of a harness.

[0012] The attachment plate typically includes a planar region through with the or each attachment aperture is formed and a yoke region by which it is connected to the second boss of the swivel. The attachment plate may include several planar regions each having one or more attachment aperture.

[0013] From a second aspect, this invention provides a harness that includes a flexible load-bearing member that extends between two forward connection arrangements and an attachment assembly that embodies the first aspect of the invention carried on the flexible connecting member.

[0014] From a third aspect, this invention provides safety apparatus comprising a harness embodying the second aspect of the invention and a rigging system, in which one or more components of the rigging system are connected to the attachment plate.

[0015] Safety apparatus embodying this aspect of the invention may include a main working line which is under tension during normal use, and a backup safety line that is under significant tension only upon failure of the main working line. These lines could both be connected to the attachment plate. In the event that the main working line fails there will be a sudden shock load as the tension transfers across to the safety backup line. The benefits of the attachment plate will pivot to dynamically adjusting its position to re-align with the preferred loading axis. This is particularly important where high peak loads occur.

[0016] Safety apparatus embodying this aspect of the invention may include two separate and spaced anchors connected to the attachment plate. These anchors enable an arborist to position themselves accurately beneath or between the anchors when it is not possible to find a suitable anchor directly above. This requires the arborist to continuously adjust the tension in both positioning systems as they move. There is a benefit to eliminate bending fatigue on the components by allowing the attachment plate (which the positioning systems are attached to) to dynamically adjust to equalise the load vectors from both anchors.

[0017] An embodiment of the invention will now be described in detail, by way of example, and with reference to the accompanying drawings, in which:

Figure 1 shows a known harness with which embodiments of the invention might typically be used;

Figures 2 and 3 are front and side views of an attachment assembly embodying the invention;

Figure 4 is a rear view of the embodiment of Figures 2 and 3 in an alternative configuration;

Figures 5 and 6 show the embodiment of Figures 2 and 3 in further alternative configurations of the embodiment of Figures 2 and 3;

Figure 7 shows an alternative embodiment of the invention;

Figure 8 shows a second alternative embodiment of the invention;

Figures 9 and 10 show a first alternative attachment plate for use with embodiments of the invention; and

Figures 11 and 12 show a second alternative attachment plate for use with embodiments of the invention.

[0018] With reference to the drawings, a connection assembly embodying the invention comprises three subassemblies: a pulley block 10, a swivel 12 and an attachment plate 14.

[0019] The pulley block 10, which constitutes a connecting assembly in this embodiment includes a sheave 20 carried on an axle 22 between two plates 24, 26 that constitute a pulley body. The sheave 20 is free to rotate on the axle 22 about a sheave axis A_{Sh}.

[0020] The swivel 12 in this embodiment is constructed in accordance with the disclosure of EP-A-3 088 769, the content of which is incorporated herein by reference. This is advantageous because such swivels have an advantageously compact structure, but other forms of swivel could be used instead.

[0021] The swivel 12 includes interconnected first and second bosses 30, 32. The bosses 30, 32 are mechanically interconnected such that they are free to rotate with respect to one another about a swivel axis A_{Sw}. which constitutes a loading axis of the connection assembly.

[0022] The first boss 30 is connected to the pulley block 10, a portion of the first boss 30 extending between the plates 24, 26 where it is retained by a retaining bolt that is held in place by a machine screw. The retaining bolt has a head 34 that is not round in cross-section (rounded triangular in this example) and is received within a correspondingly shaped, close-fitting recess in the second plate 26 whereby its rotation is prevented. The machine screw has a shaft that is threaded into a tapped axial bore of the retaining bolt and a head 36 that is received into a recess in the first plate 24. In this embodiment, it is intended that the pulley block 10 and the swivel 12 can be separated by the user, so the head 36 of the retaining bolt is formed with a recess for cooperation with a standard tool, such as an Allen key.

[0023] In this embodiment, the plates 24, 26 and the first boss 30 are shaped with co-operating formations, shown generally at 28 that prevent rotation of the plates 24, 26 with respect to the first boss 30 about the retaining bolt. In this embodiment, the co-operating formations are flats that extend perpendicular to the swivel axis A_{Sw}.

[0024] The second boss 32 has outwardly-directed flat bearing surfaces 40 and an axle bolt hole that extends through the second boss perpendicular to the bearing surfaces 40.

[0025] The attachment plate 14 has a planar region 44 and a yoke region 46. The yoke region 46 has a U-shaped cross-section with two legs that have spaced, mutually-facing, parallel bearing surfaces that are spaced apart by a distance just greater than the spacing of the bearing surfaces 40 of the second boss 32. An axle bolt hole extends through the yoke region 42 perpendicular to the

bearing surfaces. The planar region 44 has a plurality of attachment holes 48 formed through it. In this example, there are three holes disposed symmetrically on the planar region 44 and each hole is circular. However, a lesser or greater number of attachment holes 48 may be provided and they may vary in shape.

[0026] The attachment plate 14 is connected to the second boss by an axle bolt that passes through the axle bolt holes in the second boss and the yoke region 46 such that the bearing surfaces of the second boss and the yoke region 46 lie closely adjacent to one another. The axle bolt has a head 50 that is not round in cross-section (rounded triangular in this example) and is received within a correspondingly shaped, close-fitting recess one leg of the yoke region 46 whereby its rotation with respect to the attachment plate is prevented. The machine screw has a shaft that is threaded into a tapped axial bore of the retaining bolt and a head 52 that is received into a recess in the other leg of the yoke region 46.

[0027] The axle bolt can rotate within the axle bolt hole of the second boss 32 so allowing the attachment plate to rotate on the second boss about an attachment plate axis A_P between limits imposed by parts of the attachment plate 14 making contact with the second boss 32. This combined with the rotation permitted by the swivel 12 about the swivel axis A_{Sw} allows the attachment plate 14 two rotate with respect to the pulley block 10 about two perpendicular axes.

[0028] In Figure 4, the attachment plate 14 has been rotated about the swivel axis A_{Sw} such that its planar region 44 is offset at an angle from the sheave 20. In installations in which multiple lines are connected to the attachment holes 48 this can prevent the lines from becoming twisted or enable them to be untwisted.

[0029] In Figure 5, the attachment plate 14 has been rotated about the attachment plate axis A_P. In this example, the attachment plate is being loaded asymmetrically by a load L from a connector such as a carabiner 56 that is passed through one of its attachment holes 48, the load L being transferred through the attachment assembly to the rope bridge 2, which is under tension. The attachment plate 15 has been rotated about the attachment plate axis A_P such that the load **L** approaches the alignment of the swivel axis A_{Sw} so reducing the tendency of the connection assembly to become twisted out of alignment.

[0030] When assembled upon a harness, the rope bridge 2 passes through the pulley block 12 between the sheave 20 and the first boss 30. The attachment assembly can be assembled onto the harness in two ways:

- if the rope bridge can be detached from one or other forward connection arrangement so that one of its ends is free, this end can be passed between the plates 24, 26 and then re-fastened to the forward connection arrangement; or

- if the rope bridge cannot be detached from either forward connection arrangement, the retaining screw is unscrewed from the bolt and the connection bolt is then removed to allow the pulley block 12 to be separated from the first boss. The connection arrangement can then be re-assembled with the rope bridge 2 correctly disposed between the sheave 20 and the first boss 30.

[0031] In a modification to the above-described embodiment, the co-operating formations 28 that prevent rotation of the plates 24, 26 with respect to the first boss 30 about the retaining bolt are omitted or modified such that the connecting assembly 10 can pivot with respect to the first boss about the retaining bolt.

[0032] Figure 7 shows an embodiment in which the connecting assembly 10 is constituted by a C-shaped body 60 on which is carried an openable gate 62 - that is to say, it takes the form of a carabiner. A threaded recess is formed in the body 60 into which the first boss 30 of the swivel (which in this embodiment is externally threaded) is received. In this embodiment, the loading axis A_L is coincident with the swivel axis and passes through a rope basket of the carabiner.

[0033] As with the first embodiment, the attachment plate 14 is secured to the second boss 32 of the swivel 12 by an axle bolt about which it can pivot. This helps to reduce any tendency for the carabiner to be incorrectly loaded. For example, when the connecting assembly 10 is attached to a rope bridge 2, the bridge 2 tends to remain in the basket of the carabiner body 60 rather than being displaced sideways towards the gate 62.

[0034] A simplified embodiment is shown in Figure 8. In this embodiment, the attachment plate 14 is secured directly to the connecting assembly 10 without the intermediary of a swivel. As with the preceding embodiment, the connecting assembly 10 is constituted by a C-shaped body 60 on which is carried an openable gate 62 to take the form of a carabiner. As with the preceding embodiment, the attachment plate 14 will pivot in response to forces applied to it to resist any tendency for a rope that is passing through the body to be displaced from the rope basket and to ensure that the body 60 is loaded close to the loading axis A_L. This direct connection can be employed in embodiments that have alternative forms of connecting assembly.

[0035] Modifications to the attachment plate can be used in either embodiment. In the example shown in Figures 9 and 10, the attachment plate includes three planar regions 44', 44", 44‴ each having three circular attachment apertures and connected to a common yoke region 42. In the example shown in Figures 11 and 12, the attachment plate includes one planar region 44^{iv} that has a single attachment aperture 38' in the form of an arcuate slot.

Claims

1. An attachment assembly comprising:

   an attachment plate (14) that has one or more attachment apertures (48); and
   a connecting arrangement (10) that is connected to the attachment plate (14) and is suitable for connection with an external component (2); wherein:
   the connecting arrangement (10) has a loading axis (A_{Sw}), along which loading axis (A_{sw}) load from the attachment plate (14) and the external component (2) is preferentially directed; and **characterised in that**
   the connection between the attachment plate and the connecting arrangement is configured such that the attachment plate can pivot with respect to the connecting arrangement about an attachment plate axis (A_P) that is normal to the loading axis (A_{Sw}).

2. An attachment assembly according to claim 1 in which the attachment plate (14) axis intersects the loading axis (A_{Sw}).

3. An attachment assembly according to claim 1 or claim 2 in which the connecting arrangement (10) may include a swivel that comprises first and second bosses (30, 32) interconnected for rotation about a swivel axis (A_{Sw}), the swivel axis being the loading axis of the connection arrangement, and the attachment plate (14) being connected to the second boss (32) such that the attachment plate can pivot with respect to the second boss about the attachment plate axis (A_P).

4. An attachment assembly according to claim 3 in which the connecting arrangement (10) is rigidly attached to the first boss (30) of the swivel.

5. An attachment assembly according to claim 3 in which the connecting arrangement (10) can pivot with respect to the first boss (30) of the swivel.

6. An attachment assembly according to any preceding claim in which the attachment plate (14) includes a planar region (44) through with the or each attachment aperture (48) is formed and a yoke region (46) by which it is connected to the second boss (32) of the swivel.

7. An attachment assembly according to any preceding claim in which the connecting arrangement (10) is suitable for connection with a rope bridge (2) of a harness whereby load can be transferred from the harness through the attachment assembly to one or more external components (56) connected to the attachment plate.

8. An attachment assembly according to any preceding claim in which the connecting arrangement includes a pulley block that has a sheave (20) carried for rotation about a sheave axis (A_{Sh})within a pulley body.

9. An attachment assembly according to any preceding claim in which the connecting arrangement includes a continuous loop.

10. An attachment assembly according to any preceding claim in which the connecting assembly includes an openable loop in the form of a carabiner body (60).

11. An attachment assembly according to any preceding claim in which the attachment plate includes several planar regions (44', 44", 44‴) through each of which one or more attachment aperture (38) is formed.

12. A harness that includes a flexible load-bearing member (2) that extends between two forward connection arrangements (4) and an attachment assembly according to any preceding claim carried on the flexible connecting member (2).

13. Safety apparatus comprising a harness according to claim 12 and a rigging system, in which one or more components of the rigging system are connected to the attachment plate of the attachment assembly.

14. Safety apparatus according to claim 13 that includes a main working line which is under tension during normal use, and a backup safety line that is under significant tension only upon failure of the main working line, both of the main working line and backup lines being connected to the attachment plate.

15. Safety apparatus according to claim 13 or claim 14 that includes two separate and spaced anchors connected to the attachment plate.

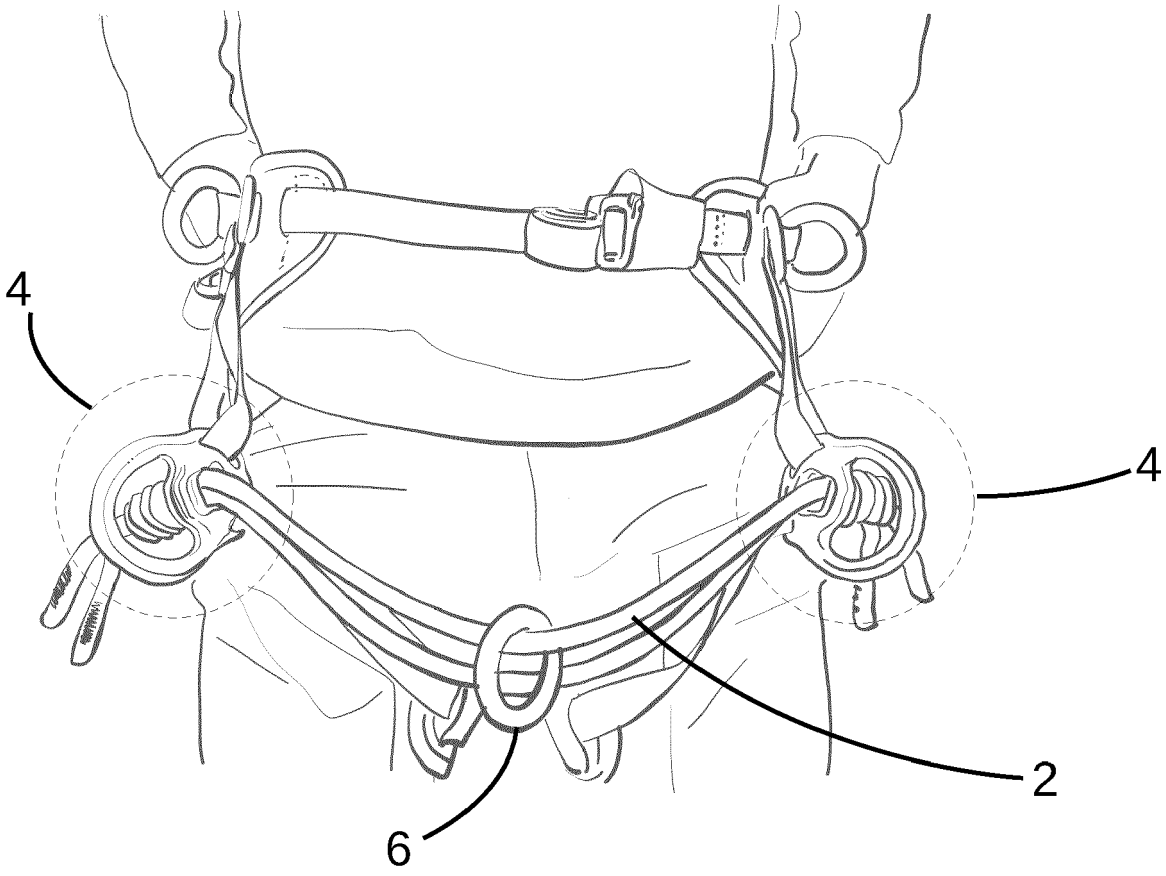

Fig 1

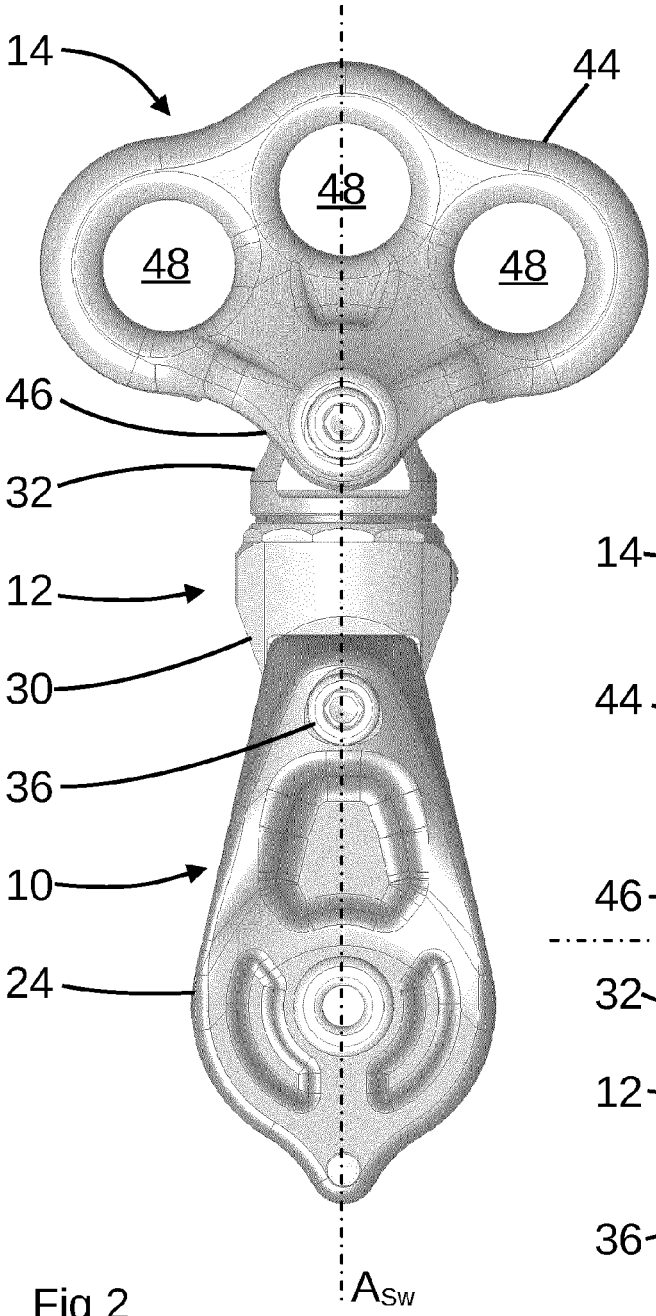
14
44
48
48
48
46
32
12
30
36
10
24
A_{Sw}

Fig 2

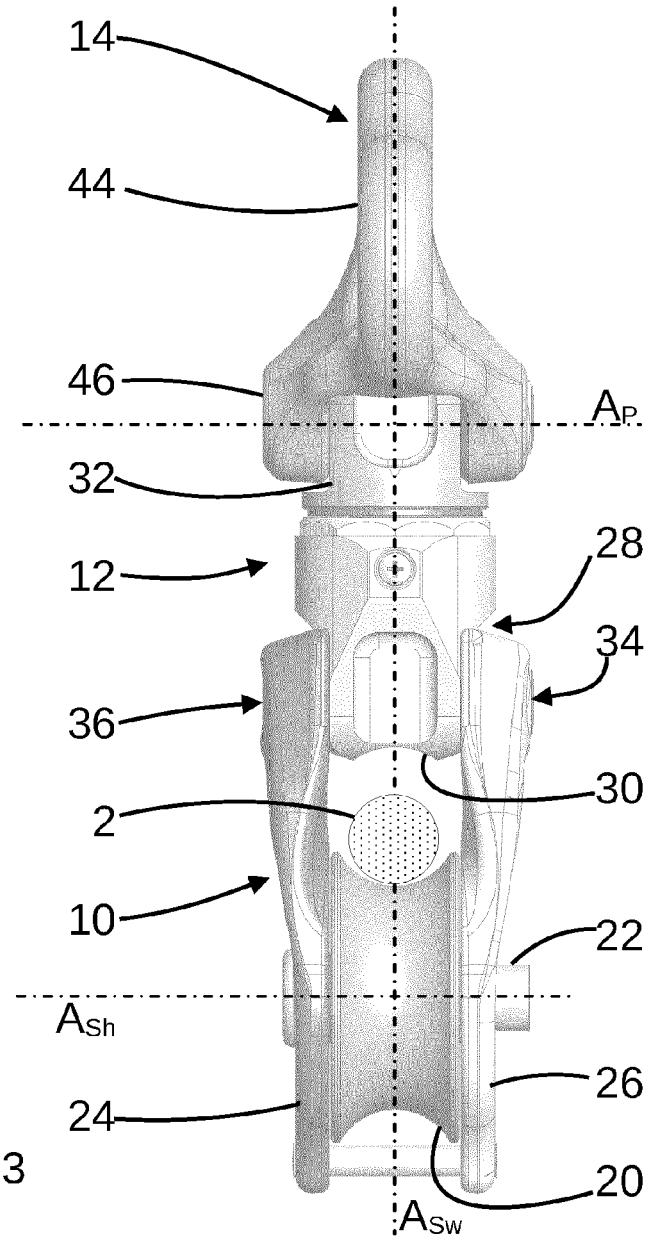
14
44
46
A_P
32
28
12
34
36
30
2
10
22
A_{Sh}
26
24
20
A_{Sw}

Fig 3

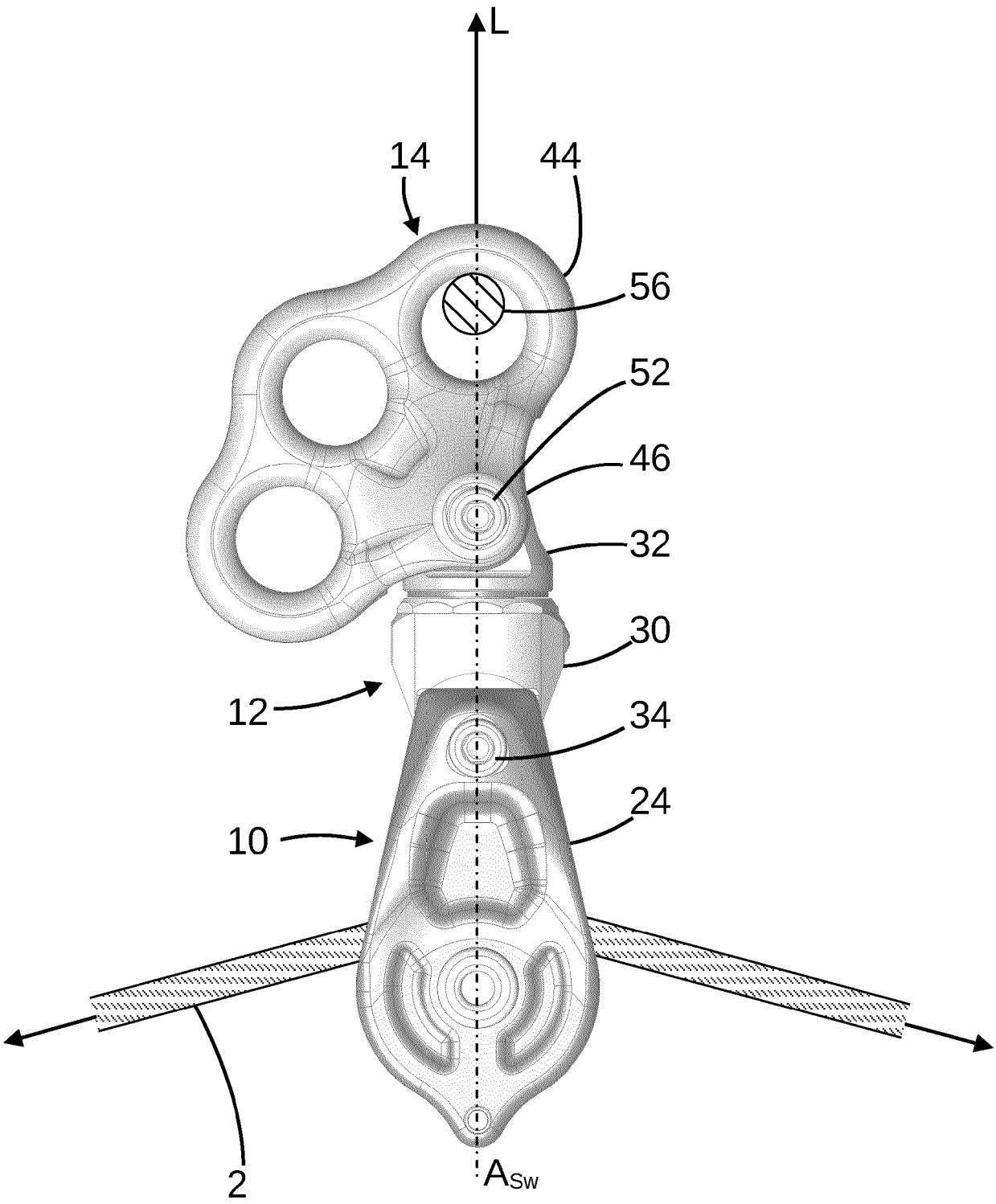

Fig 5

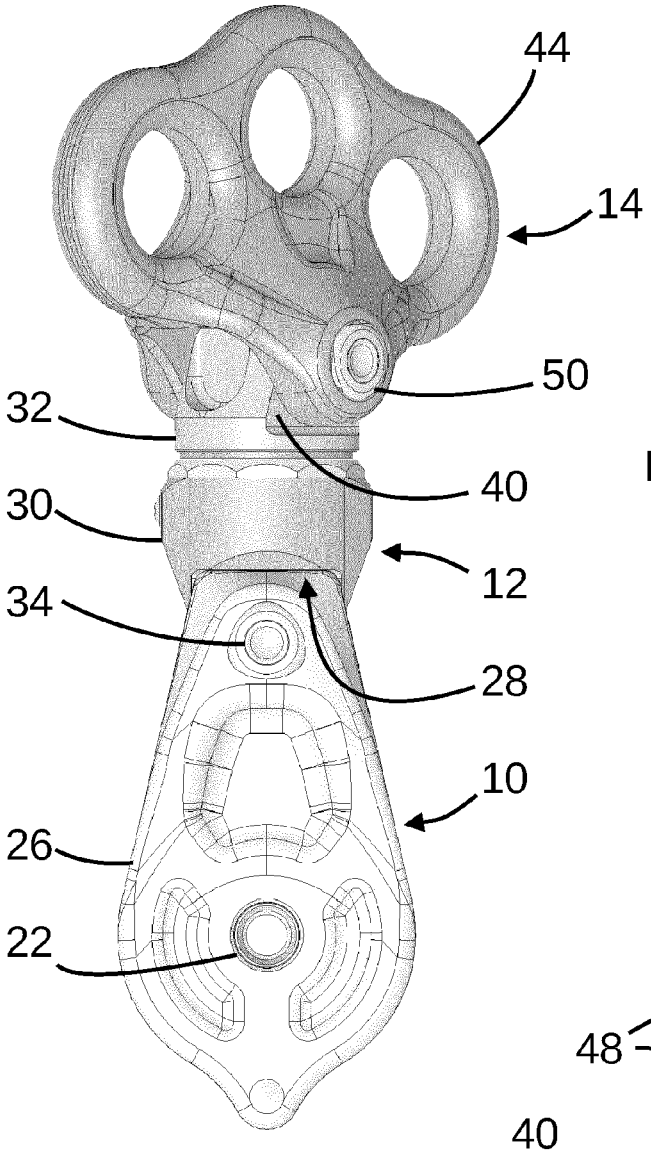

Fig 4

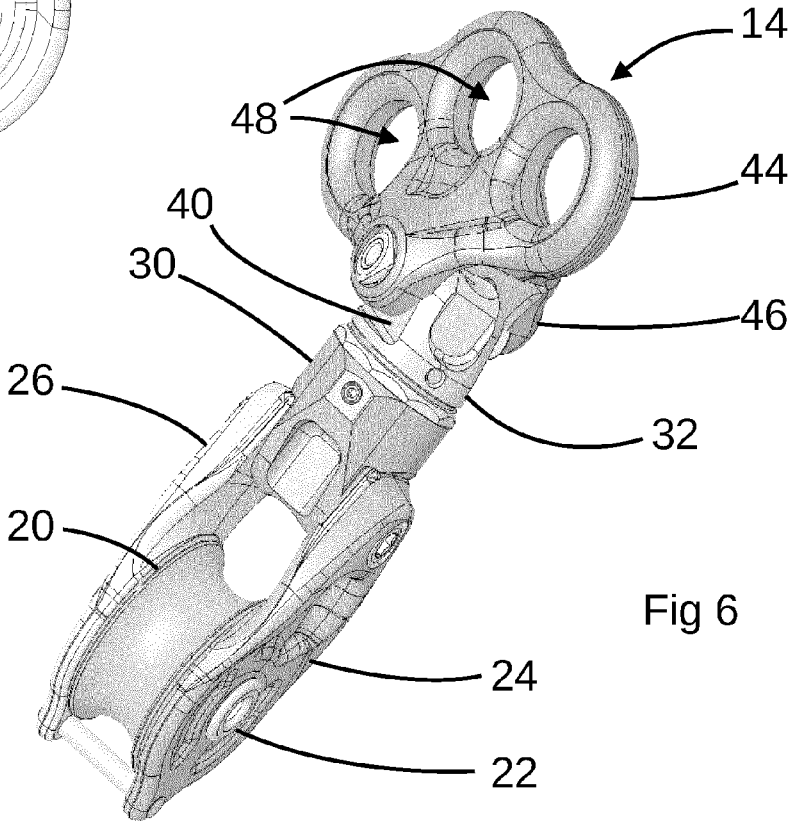

Fig 6

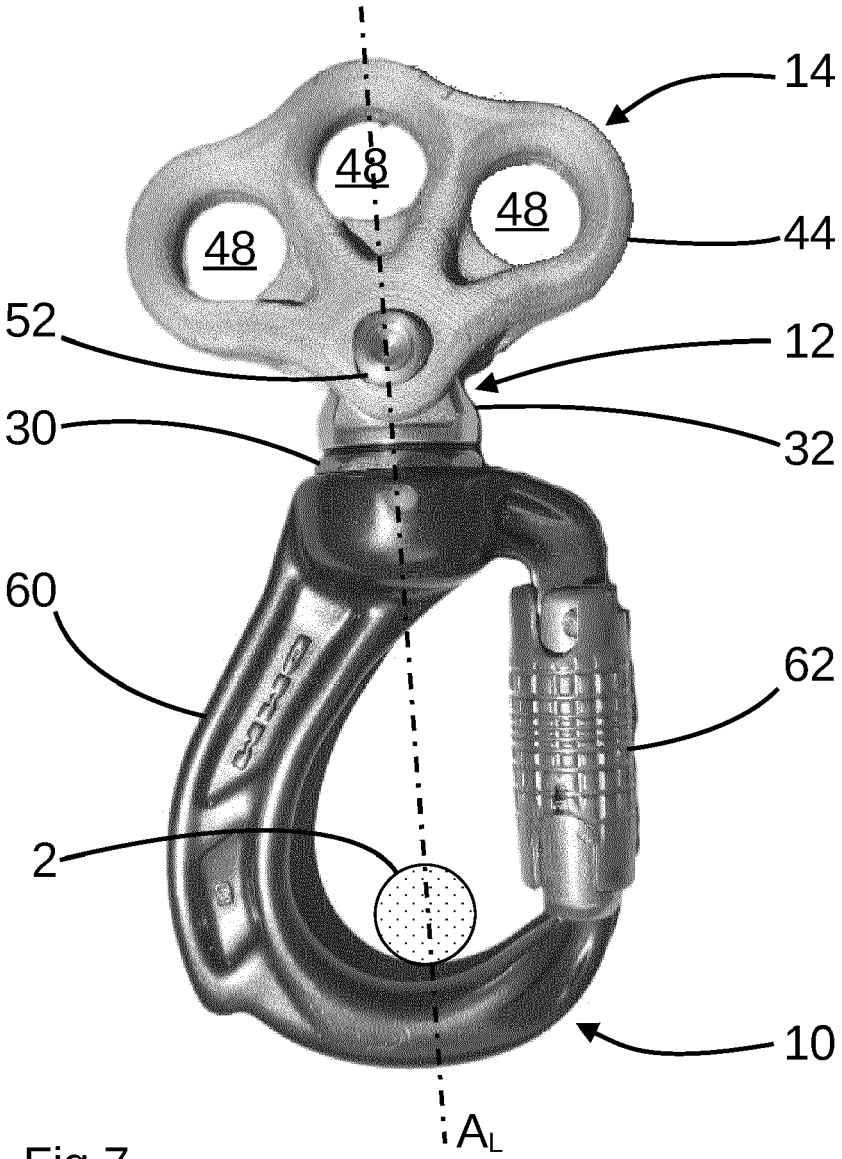

Fig 7

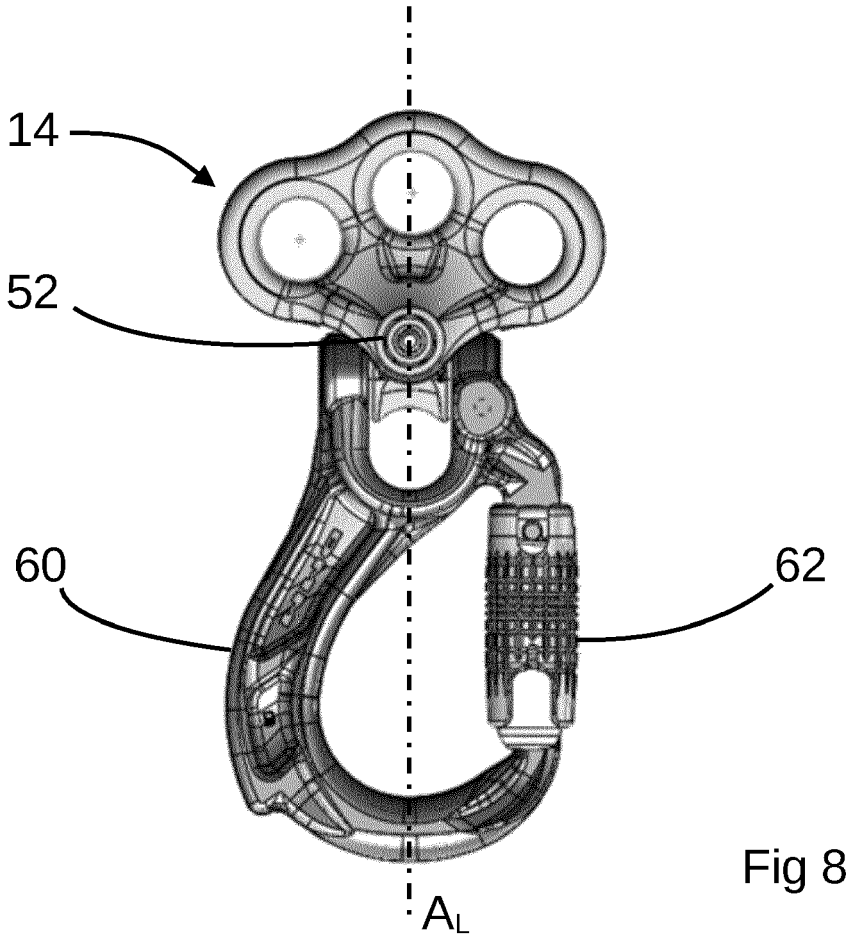

Fig 8

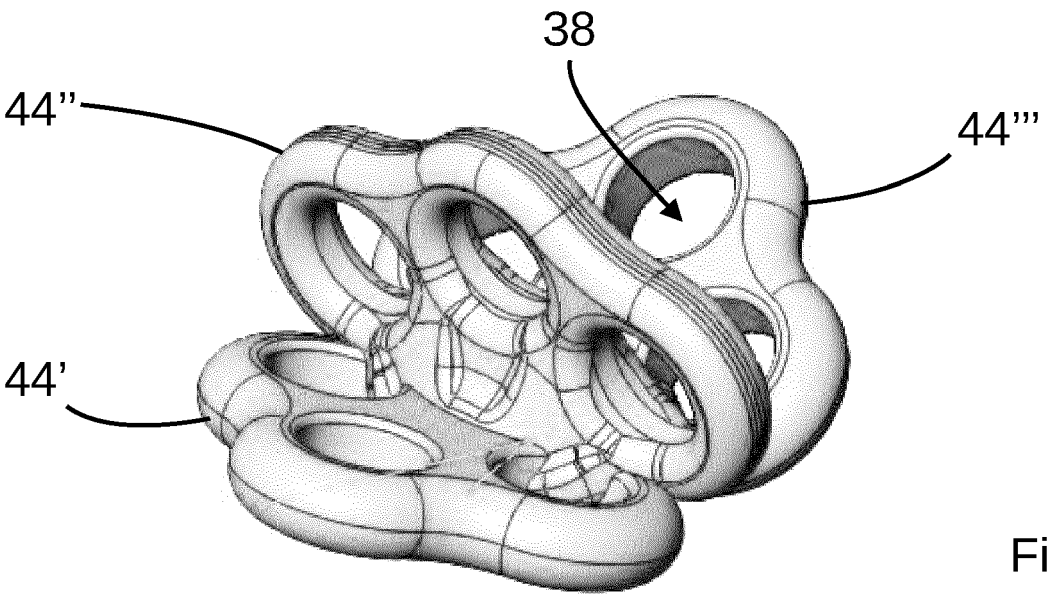

Fig 9

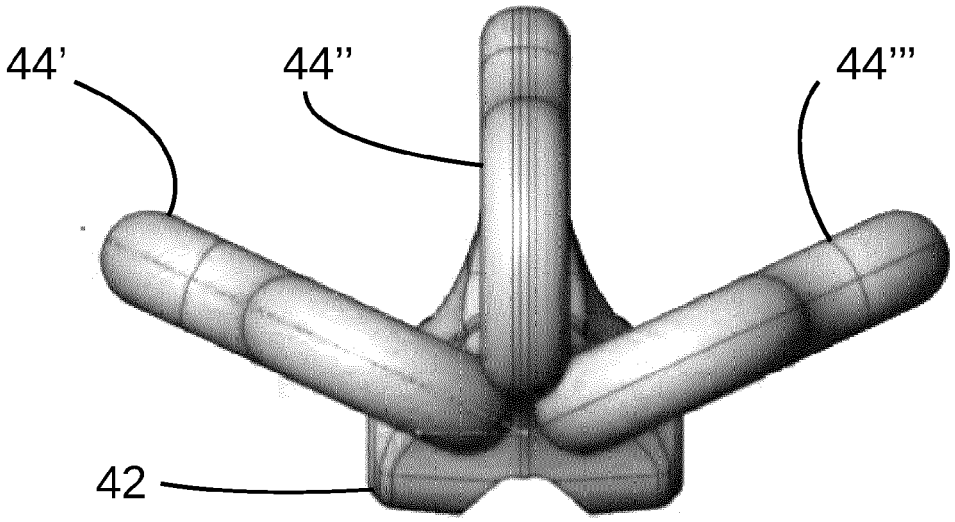

Fig 10

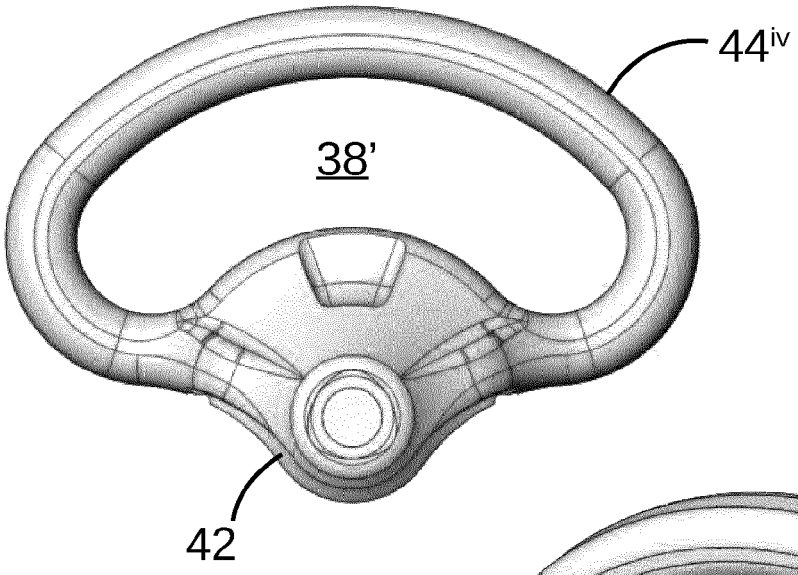

Fig 11

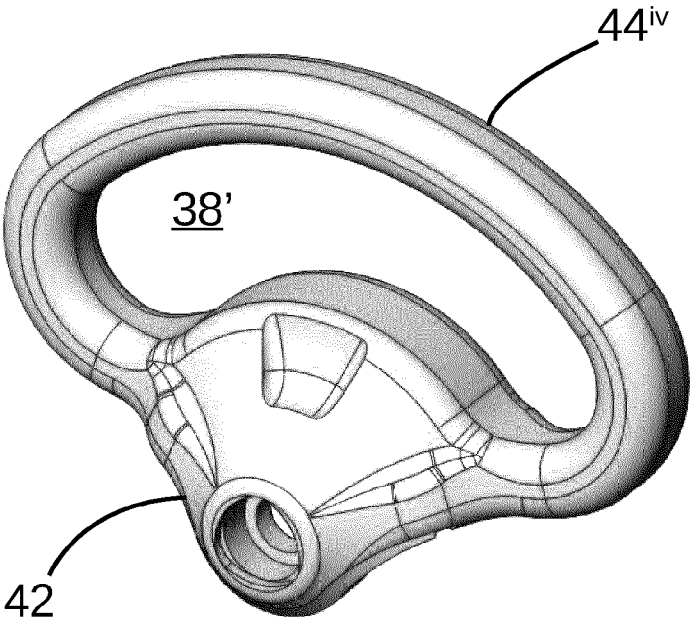

Fig 12

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 23 15 2496

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X,P	EP 4 050 240 A1 (TREEMAGINEERS LTD [GB]) 31 August 2022 (2022-08-31) * paragraphs [0036] - [0040] * * figures 8-11 *	1-11	INV. A62B35/00
X	US 10 781 848 B2 (TREEMAGINEERS LTD [GB]) 22 September 2020 (2020-09-22)	1-7,9-11	
Y	* column 1, line 9 - column 2, line 3 * * column 2, line 47 - column 6, line 15 * * figures 1-17 *	8,12-15	
X	EP 3 088 769 A1 (TREEMAGINEERS LTD [GB]) 2 November 2016 (2016-11-02)	1-7,10	
Y	* paragraph [0031] *	8	
A	* figures 16-18 *	9,11-15	
X	US 4 482 264 A (KODERA YASUJI [JP]) 13 November 1984 (1984-11-13)	1-7,9	
A	* abstract; figures 1-7 *	8,10-15	
Y	EP 3 512 609 B1 (CARRS BILLINGTON AGRICULTURE SALES LTD [GB]) 8 July 2020 (2020-07-08)	12-15	TECHNICAL FIELDS SEARCHED (IPC) A62B
A	* paragraph [0045] * * figure 1 *	1-11	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	8 June 2023	Zupancic, Gregor

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 23 15 2496

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

08-06-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 4050240 A1	31-08-2022	EP 4050240 A1	31-08-2022
		GB 2604177 A	31-08-2022
		US 2022274812 A1	01-09-2022
US 10781848 B2	22-09-2020	EP 3323474 A1	23-05-2018
		GB 2556122 A	23-05-2018
		GB 2558747 A	18-07-2018
		GB 2578811 A	27-05-2020
		US 2018142725 A1	24-05-2018
		US 2020408242 A1	31-12-2020
EP 3088769 A1	02-11-2016	EP 3088769 A1	02-11-2016
		GB 2537937 A	02-11-2016
		US 2016319905 A1	03-11-2016
US 4482264 A	13-11-1984	CA 1197982 A	17-12-1985
		US 4482264 A	13-11-1984
EP 3512609 B1	08-07-2020	EP 3512609 A1	24-07-2019
		WO 2018051068 A1	22-03-2018

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 3088769 A **[0020]**