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(54) Title: FALL PROTECTION ASSEMBLY

(57) Abstract: Fall protection assemblies including a connector and an energy absorbing assembly. The energy absorbing assembly includes a pouch forming a cavity and opposing first and second openings. A webbing assembly is positioned within the pouch. The webbing assembly includes first and second layers, each layer having an intermediate portion positioned within the cavity. The first layer extends from the first opening a first distance and the second layer extends from the second opening a second distance. The layers are connected with connecting fibers and the first layer is interconnected to the connector. The first and second distances are variable when a load is applied to the layers. The connecting fibers can be configured such that the webbing assembly includes areas having different tear strengths. The fall protection assembly further includes a first strap connected to the second layer.

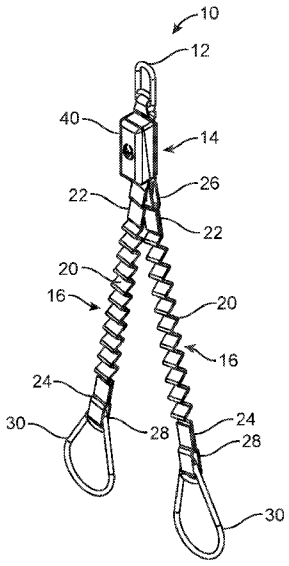

FIG. 1C

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— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

FALL PROTECTION ASSEMBLY

BACKGROUND

[0001] Fall protection equipment is commonly used to reduce a likelihood of a fall and/or injuries associated with a fall, particularly by users who perform tasks at heights or are at risk of falling. Generally, lifelines or lanyards typically interconnect anchorage structures and safety harnesses donned by users. The lifelines or lanyards allow the users to move and perform tasks while being connected to the anchorage structures. Should a user fall, the lifeline or lanyard limits the distance the user falls and reduces the force transferred to the user during a fall.

[0002] The present disclosure addresses problems and limitations associated with the related art.

BRIEF SUMMARY

[0003] Problems associated with prior devices are addressed by embodiments of the disclosure and will be understood by reading and understanding the present specification. The following summary is made by way of example and not by way of limitation.

[0004] In one example embodiment, a fall protection assembly includes a connector and an energy absorbing assembly. The energy absorbing assembly includes a pouch forming a cavity and having opposing first and second openings providing access to the cavity as well as a webbing assembly at least partially positioned within the pouch. The webbing assembly includes a first layer and a second layer, each layer having an intermediate portion interconnecting a first end and a second end. At least a portion of the intermediate portion is positioned within the cavity. The first end of the first layer extends out of the first opening a first distance and the first end of the second layer extends out of the second opening a second distance. The first and second layers are connected with a plurality of connecting fibers. The first end of the first layer is interconnected to the connector. The first and second distances are variable when a

predetermined load is applied to the energy absorbing assembly. The fall protection assembly further includes a first strap including a strap connector and the first strap being connected to the first end of the second layer.

[0005] In yet another example embodiment, a fall protection assembly includes a connector and an energy absorbing assembly. The energy absorbing assembly includes a pouch forming a cavity and having opposing first and second openings providing access to the cavity as well as a webbing assembly including a first layer and a second layer. Each layer has an intermediate portion interconnecting a first end and a second end. The first and second layers are connected with a plurality of connecting fibers that are configured such that the webbing assembly has a first area with a first tear strength and a second area with a second tear strength. In some embodiments, the first tear strength being less than the second tear strength. The first end of the first layer is interconnected to the connector. The fall protection assembly further includes a first strap including a strap connector and the first strap being connected to the first end of the second layer.

[0006] Various embodiments of the disclosure reduce energy exerted to the user as a result of the fall protection assembly arresting a fall.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The present disclosure can be more easily understood, and further advantages and uses thereof can be more readily apparent, when considered in view of the detailed description and the following Figures in which:

[0008] Figure 1A is a front view of a fall protection assembly having an energy absorbing assembly at least partially secured within a pouch;

[0009] Figure 1B is a side view of the fall protection assembly of FIG. 1A;

[0010] Figure 1C is a perspective view of the fall protection assembly of FIGS. 1A-1B;

[0011] Figure 2 is a front view of the fall protection assembly of FIGS. 1A-1C (having the pouch removed for clarity);

[0012] Figure 2B is a side view of the fall protection assembly of FIG. 2A;

[0013] Figure 2C is a perspective view of the fall protection assembly of FIGS. 2A-2B;

[0014] Figure 3 is a front view of one example of a webbing assembly of the energy absorbing assembly of FIGS. 1A-2C;

[0015] Figure 4 is a front view of the webbing assembly of FIG. 3 folded upon itself prior to insertion within a pouch such as that shown in FIGS. 1A-1C;

[0016] Figure 5A is a bottom view of the webbing assembly of FIG. 4 positioned within the pouch of FIGS. 1A-1C;

[0017] Figure 5B is a bottom perspective view of the webbing assembly of FIGS. 4-5A positioned within the pouch of FIGS. 1A-1C;

[0018] Figure 6 is a side view illustrating one way in which the webbing assembly of FIGS. 1A-5 can be secured to respective connectors;

[0019] Figure 7 is a perspective view illustrating how layers of the webbing assembly of FIGS. 1A-6 can be secured together at one end;

[0020] Figure 8 is a bottom view illustrating the webbing assembly of FIGS. 1A-7 in a fully deployed configuration in which first and second layers of the webbing assembly have been separated and pulled out of the pouch due to the application of a load on the webbing assembly;

[0021] Figure 9 is a side view of one example of how two straps can be secured to the energy absorbing assembly;

[0022] Figure 10 is a side view of one example of how one strap can be secured to the energy absorbing assembly; and

[0023] Figure 11 is a graph illustrating the forces recorded when an example energy absorbing assembly constructed in accordance with the fall protection assembly of FIGS. 1A-9 is subjected to a 12 foot free fall using a 282 pound test mass.

[0024] In accordance with common practice, the various described features are not drawn to scale but are drawn to emphasize specific features relevant to the present disclosure. Reference characters denote like elements throughout the Figures and the text.

DETAILED DESCRIPTION

[0025] In the following detailed description, reference is made to the accompanying drawings, which form a part hereof, and in which is shown by way of illustration embodiments in which the disclosure may be practiced. It is to be understood that other embodiments may be utilized and mechanical changes may be made without departing from the spirit and scope of the present disclosure. The following detailed description is, therefore, not to be taken in a limiting sense.

[0026] An embodiment is collectively illustrated in Figures 1A-9. Generally, one example of a fall protection assembly 10 of the disclosure includes a connector 12, an energy absorbing assembly 14 and at least one strap 16 (e.g., one, two or more). In one example, the connector 12 can be a D-ring, a carabiner, a snap hook, or the like configured to be secured to a user's harness (not shown). Each strap 16 can optionally be identically configured and includes a body 20 and first and second ends 22, 24. The first end 22 can optionally include a loop 26 or the like to secure the strap 16 to the energy absorbing assembly 14 and the second end 24 can include a loop 28 or the like to receive a connector 30, such as a hook, a rebar hook, or carabiner. In one example, one or both of the first and second ends 22, 24 can be folded over itself to form its respective loop 26, 28. The body 20 can be of any type known in the art. For example, the body 20 can be made of rope, cable or webbing material and can optionally include elastic, as desired. It is further envisioned that, in some embodiments, each loop 26, 28 can be formed of a separate material that is secured (e.g., sewn) to the respective end 22, 24. If different types of straps are used, it is recognized that each strap may be connected to the energy absorbing assembly 14 in any suitable manner, and each strap may be connected differently.

[0027] In one example, the fall protection assembly 10 is used in combination with a user wearing a harness. The connector 12 is secured to the harness (e.g., a dorsal D-ring of a dorsal pad assembly of the harness) to effectively attach the user to the fall protection assembly 10. The connector 30 of one strap 16 can be secured to an attachment point (not shown) so that, if the user should fall, the connector 30 will secure the user to the attachment point. Two straps 16 can be provided so that one connector 30 is secured while the second connector 30 is being advanced and secured as the user moves. If the user should fall, it is desirable to gradually slow the rate at

which the fall protection assembly stops the user from falling to reduce the likelihood of physical shock and injury to the user. The energy absorbing assembly 14 of the fall protection assembly 10 can provide this function, as discussed in greater detail below.

[0028] The energy absorbing assembly 14 is positioned proximate the first end 22 of each strap 16 provided. As is perhaps best shown in FIGS. 5A-5B, the energy absorbing assembly 14 includes a pouch 40 defining a cavity 42 accessible via a side opening 48a that can, for example, be selectively closed or accessed for either installation or inspection of the webbing assembly 44 via a fastener 46 such as a zipper, hook and loop fastener, snap or the like. The cavity 42 is sized to receive at least a portion of a webbing assembly 44 of the energy absorbing assembly 14. The pouch 40 has opposing first and second openings 48b, 48c through which one of first and second layers 50a, 50b of the webbing assembly 44 extend. In this way, the pouch 40 is maintained on the webbing assembly 44 but is not fixedly secured thereto. In one example embodiment, the pouch 40 includes longitudinal sides 41a, 41b; ends 41c, 41d; as well as a top 41e and a bottom 41f. The first and second openings 48b, 48c extend from a respective end 41c, 41d to the bottom 41f of the pouch 40. One opening 48b is shown in FIG. 5B and it is to be understood that the opposing opening 48c is preferably identically configured on the opposing end 41d of the pouch 40. In one example, the openings 48b, 48c can be configured so that the first and second ends 52a, 52b of the webbing assembly 44 extend substantially perpendicular with respect to the bottom 41f of the pouch 40 when tension is applied to the first and second ends 52a, 52b in opposing directions (e.g., during a fall event). In one example embodiment, each opening 48b, 48c is located entirely in a lower half of the respective end 41c, 41d proximate the bottom 41f. In yet another example embodiment, a boundary of at least one of the openings 48b, 48c can be at least partially defined by the bottom 41f and/or the fastener 48. This may be the case when the fastener 48 extends an entire length of the bottom 41f. In some embodiments, the bottom 41f may be configured to have a length that is less than a length of the top 41e to accommodate for the openings 48b, 48c.

[0029] More specifically, as shown in FIG. 3, each layer 50a, 50b of the webbing assembly 44 can be made of webbing material or the like having first ends 52a, 52b and second ends 54a, 54b interconnected by an interconnecting portion 56a, 56b. The first and second layers 50a, 50b

are interconnected with connecting fibers 58 (generally referenced in FIG. 7) such that the first and second layers 50a, 50b, when pulled in opposite directions or when one layer 50a, 50b is pulled away from the other, will peel or separate from the other under a desired predetermined load due to the connecting fibers 58 either separating or breaking. The separation of the layers 50a, 50b allows the energy which would have been transferred to the user to instead be dissipated through the gradual breaking of the connecting fibers 58 along the length of the webbing assembly 44. Depending on input variables (e.g., predominantly user weight, distance and angle of freefall), the amount of severance of the connecting fibers 58 will vary. In one optional example, the webbing assembly 44 can include multiple areas A1, A2 along its length having differing tear strengths as desired or as to otherwise conform to industry standards. The connecting fibers 58 could be stitching, interwoven portions of the webbing, or other suitable severable interconnections. In one example, the first area A1, the area being closest to the first ends 52a, 52b of the layers 50a, 50b can be configured have a tear strength less than a second area A2 proximal to the second ends 54a, 54b of the layers 50a, 50b. In one embodiment, the webbing assembly 44 is configured and arranged to arrest a maximum user free fall of 12 feet or less for a user weight capacity (user weight, clothing, tools, and equipment) of 130 to 420 pounds. In yet another embodiment, the webbing assembly 44 is configured and arranged to arrest a maximum user free fall in the range of 6 feet to 12 feet for a user weight capacity of 130 to 420 pounds. In one example, the area A1 extends a length 42 cm long and the area A2 extends a length 88 cm long.

[0030] Referring now in particular to FIGS. 4-7, the second ends 54a, 54b of the first and second layers 50a, 50b can optionally be secured together and reinforced with a third layer 62, which can be a panel of material, such as a webbing material, to which the second ends 54a, 54b of each layer 50a, 50b are sewn or otherwise secured. In one embodiment, the third layer 62 can merely be the second ends 54a, 54b of the layers 50a, 50b folded over itself and sewn together to provide reinforcement. The first ends 52a, 52b of each layer 50a, 50b are separated at junction 64 so that they can extend in opposing directions (see in particular, FIG. 6). The first end 52a of the first layer 50a is secured to the connector 12 and the first end 52b of the second layer 50b is secured to each strap 16. It is optional to provide a loop of webbing 72a or the like to the first end 52a of the first layer 50a, which can be secured to the connector 12. Similarly, it is optional

to provide a loop of webbing 72b or the like to the first end 52b of the second layer 50b, which can be secured to the one or more straps 16. It will be understood that if the loops of webbing 72a, 72b are not provided, the first ends 52a, 52b can be similarly looped or can be otherwise configured to connect with the connector 12, strap(s) 16, respectively. In this way, a load applied from a user during a fall can be transferred to the energy absorbing assembly 14 in a direction generally parallel to first ends 52a, 52b and along point/junction 64 (see, in particular, FIG. 6) as the first ends 52a, 52b separate. As shown in FIG. 6, the first end 52a of the first layer 50a extends out of the first opening 48b a first distance D1, and the first end 52b of the second layer 50b extends out of the second opening 48c a second distance D2. As a load L is applied that is sufficient for the first and second layers 50a, 50b to at least partially separate at the junction 64, the first and second distances D1, D2 increase (see FIG. 6). In other words, as the load is applied and is being at least partially absorbed, the junction 64 will move in the direction toward the second ends 54a, 54b as the connecting fibers 58 break and the first and second layers 50a, 50b further permanently separate. The third layer 62 acts as a stop to prevent complete separation of the webbing assembly 44.

[0031] As indicated above and partially shown in FIG. 10, it is envisioned that a fall arrest assembly 10' (partially shown in FIG. 10) can include no more than one strap 16. The fall arrest assembly 10' is otherwise identical to and operates in a similar manner as compared to the fall protection assembly 10 illustrated in FIGS. 1A-8 and discussed herein.

[0032] Figure 11 is a graph showing the forces recorded when an example energy absorbing assembly 14 of the fall protection assembly 10 is subjected to a 12 foot free fall using a 282 pound test mass. This graph evidences the change in forces when the separation of the first layer 50a and the second layer 50b progresses through the first tear strength area A1 to a second tear strength area A2.

EXAMPLES

[0033] The fall protection assembly 10 has an initial 50% of the deployable (separable) length or area that is configured to require an average force of 4105.6723 N for the first and second layers 50a, 50b to separate and the remaining 50% of the deployable length or area requires an average force of 4773.899 N for the first and second layers 50a, 50b to separate. The

webbing assembly 44 (and layers 50a, 50b) has a width of 48 mm (+/- 0.5 mm), a weight of 94.35 g/m (+/- 5%), and has a thickness of 3.0 mm (+/- 0.2mm). The webbing assembly 44 has a HMPE warp, polyester binding and HMPE weft. Tear rates are determined by statically deploying (i.e. tearing) the webbing using a tensile test machine with an unladed cross head speed of 150 mm/minute. Deployment (tear) forces were measured over a 100 mm period of deployment in each stage. Three samples were selected for a total of six measurements to determine average deployment forces.

[0034] In yet another example, the fall protection assembly 10 has 32.31% of the deployable (separable) length or area that is configured to require an average force of 4105.6723 N for the first and second layers 50a, 50b to separate and the remaining 67.69% of the deployable length or area requires an average force of 4773.899 N for the first and second layers 50a, 50b to separate.

[0035] In yet another example, the fall protection assembly 10 has 32-50% of the deployable (separable) length or area that is configured to require an average force of 4105.6723 N for the first and second layers 50a, 50b to separate and the remaining percent of the deployable length or area requires an average force of 4773.899 N for the first and second layers 50a, 50b to separate.

[0036] In yet another example, the fall protection assembly 10 has 32-50% of the deployable (separable) length or area that is configured to require an average force of 3000 N to 5000 N for the first and second layers 50a, 50b to separate and the remaining percent of the deployable length or area requires an average force of 5000 N to 7000 N for the first and second layers 50a, 50b to separate.

[0037] The above specification, embodiments, and data provide a complete description of the manufacture and use of the composition of embodiments of the disclosure. Although embodiments have been illustrated and described herein, it will be appreciated by those of ordinary skill in the art that any arrangement, which is calculated to achieve the same purpose, may be substituted for the embodiments. This application is intended to cover any adaptations or variations of the disclosure.

CLAIMS

1. A fall protection assembly, comprising:

a connector;

an energy absorbing assembly including:

a pouch forming a cavity and having opposing first and second openings providing access to the cavity, and

a webbing assembly at least partially positioned within the pouch, the webbing assembly including a first layer and a second layer, each layer having an intermediate portion interconnecting a first end and a second end; wherein at least a portion of the intermediate portion is positioned within the cavity, the first end of the first layer extends out of the first opening a first distance, and the first end of the second layer extends out of the second opening a second distance; wherein the first and second layers are connected with a plurality of connecting fibers; wherein the first end of the first layer is interconnected to the connector; wherein the first and second distances are variable when a predetermined load is applied to the energy absorbing assembly; and

a first strap including a strap connector and the first strap being connected to the first end of the second layer.

2. The fall protection assembly of claim 1, wherein the first strap is elastic.

3. The fall protection assembly of claim 1, wherein the plurality of connecting fibers are configured such that the webbing assembly has a first tear strength at a first area and a second tear strength at a second area.

4. The fall protection assembly of claim 3, wherein the first tear strength proximate the first ends of the first and second straps is less than the second tear strength proximate the first strap.

5. The fall protection assembly of claim 1, wherein the pouch includes a selectably closeable side opening extending between the first and second openings.

6. The fall protection assembly of claim 5, wherein the selectably closable side opening includes a fastener selected from the group consisting of a zipper, hook and loop fastener, and a snap.

7. The fall protection assembly of claim 1, further including a second strap including a strap connector and the second strap being connected to the first end of the second layer.

8. The fall protection assembly of claim 1, wherein the second end of the first layer is folded over itself and secured; further wherein the second end of the second layer is folded over itself and secured.

9. The fall protection assembly of claim 1, wherein the first ends of the first and second layers are folded back onto themselves and secured to form loops, a first loop extending outward from the first opening and a second loop extending outward from the second opening, and wherein the strap connector is a third loop connected to the second loop.

10. The fall protection assembly of claim 9, further comprising a second strap including a fourth loop connected to the second loop.

11. A fall protection assembly, comprising:

a connector;

an energy absorbing assembly including:

a pouch forming a cavity and having opposing first and second openings providing access to the cavity, and

a webbing assembly including a first layer and a second layer, each layer having an intermediate portion interconnecting a first end and a second end; wherein the first and second layers are connected with a plurality of connecting fibers, the plurality of connecting fibers configured such that the webbing assembly has a first area with a first tear strength and a second area with a second tear strength, the first tear strength being less than the second tear strength; wherein the first end of the first layer is interconnected to the connector; and

a first strap including a strap connector and the first strap being connected to the first end of the second layer.

12. The fall protection assembly of claim 11, wherein the first strap is elastic.

13. The fall protection assembly of claim 11, wherein at least a portion of the intermediate portion is positioned within the cavity, the first layer extends out of the first opening, and the second opening extends out of the second opening.

14. The fall protection assembly of claim 13, wherein the first tear strength proximate the first ends of the first and second straps is less than the second tear strength proximate the second ends of the first and second straps.

15. The fall protection assembly of claim 11, wherein the pouch includes a selectably closeable side opening extending between the first and second openings.

16. The fall protection assembly of claim 15, wherein the selectably closable side opening includes a fastener selected from the group consisting of a zipper, hook and loop fastener, and a snap.

17. The fall protection assembly of claim 11, further including a second strap including a strap connector and the second strap being connected to the first end of the second layer.

18. The fall protection assembly of claim 11, wherein the second end of the first layer is folded over itself and secured; further wherein the second end of the second layer is folded over itself and secured.

19. The fall protection assembly of claim 11, wherein the first ends of the first and second layers are folded back onto themselves and secured to form loops, a first loop extending outward

from the first opening and a second loop extending outward from the second opening, and wherein the strap connector is a third loop connected to the second loop.

20. The fall protection assembly of claim 19, further comprising a second strap including a fourth loop connected to the second loop.

21. The fall protection assembly of claim 11, wherein the first area extends a length 42 cm long and the second area extends a length 88 cm long.

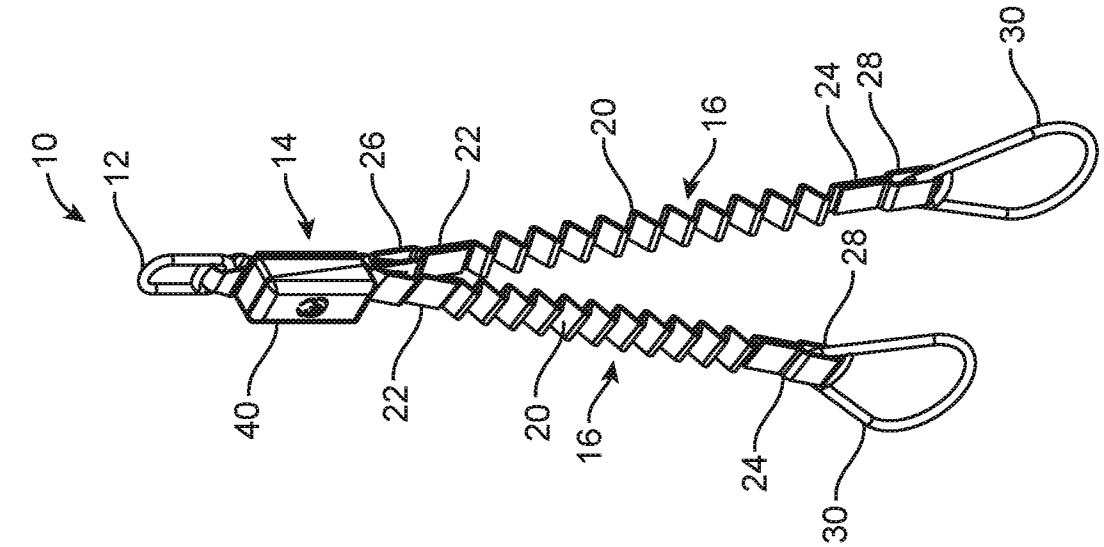

FIG. 1C

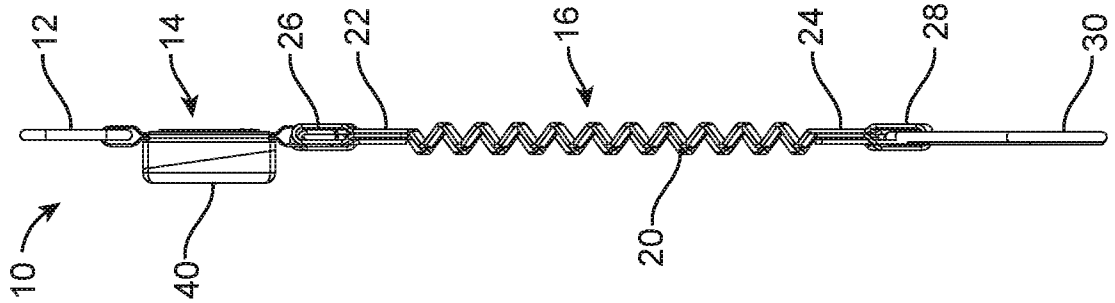

FIG. 1B

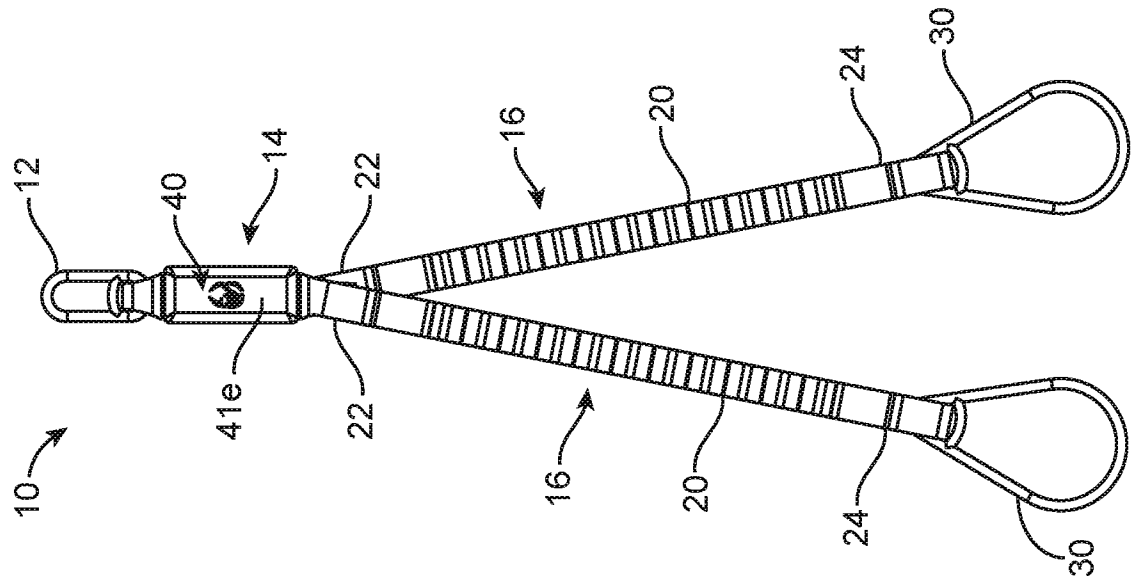

FIG. 1A

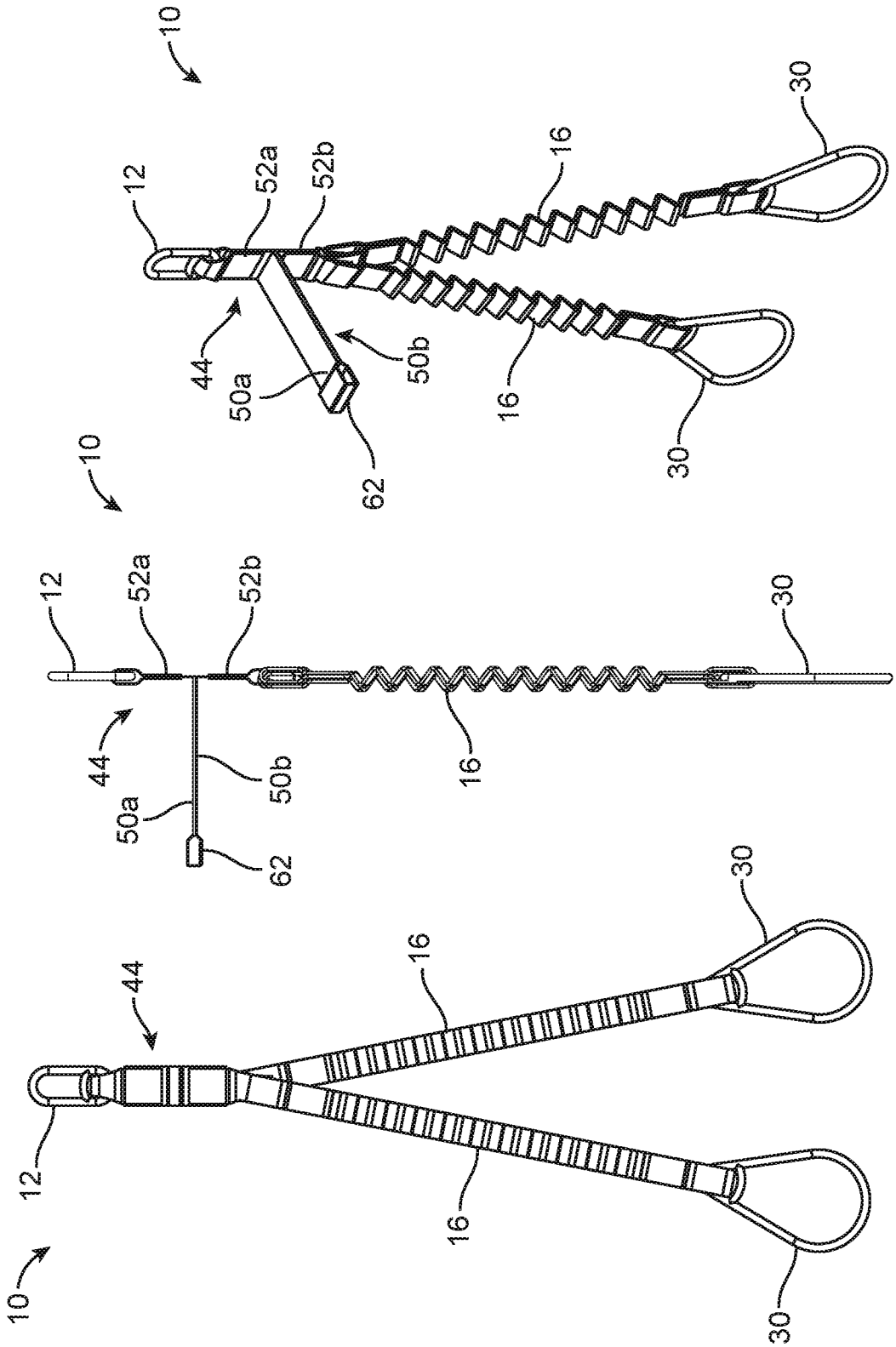

FIG. 2C

FIG. 2B

FIG. 2A

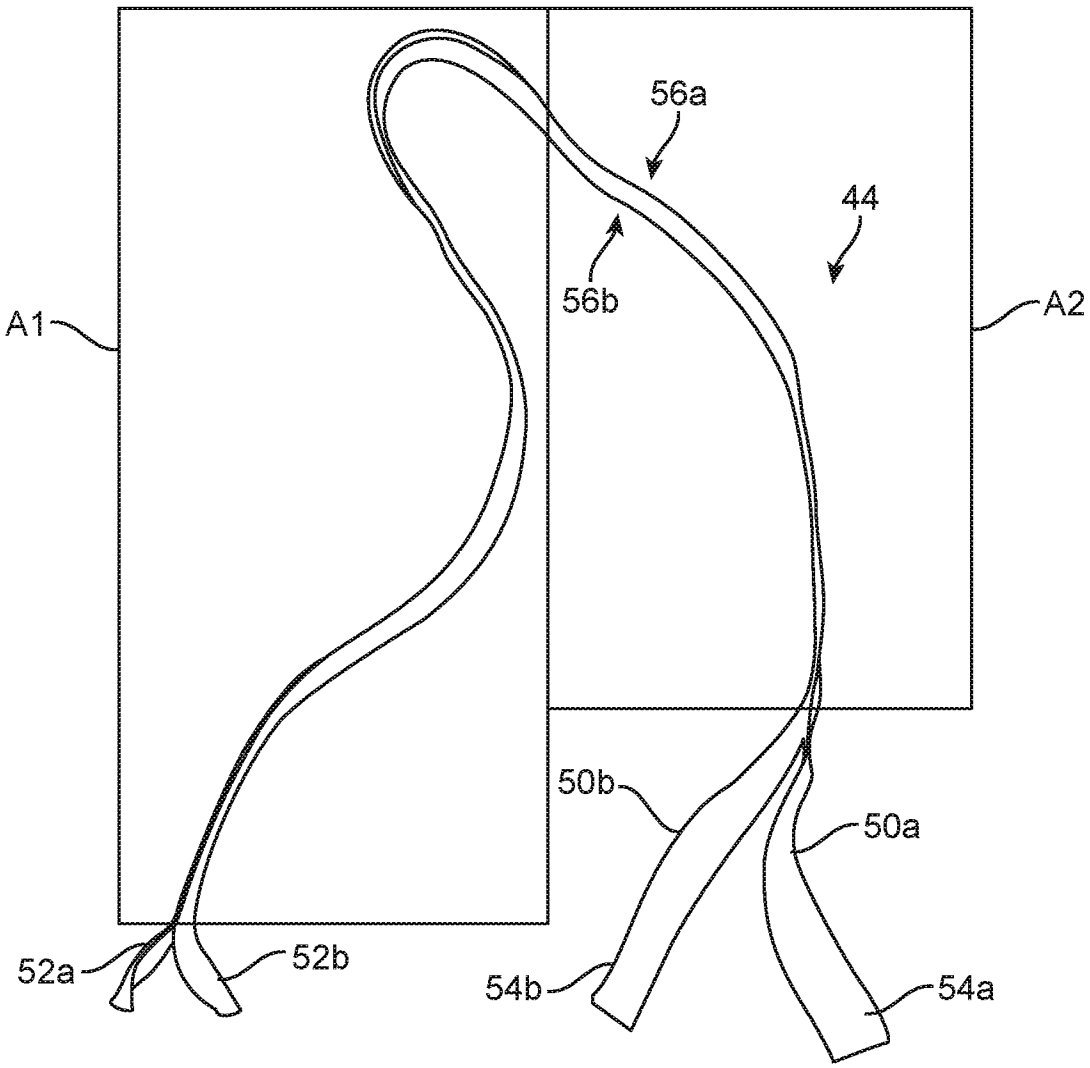

FIG. 3

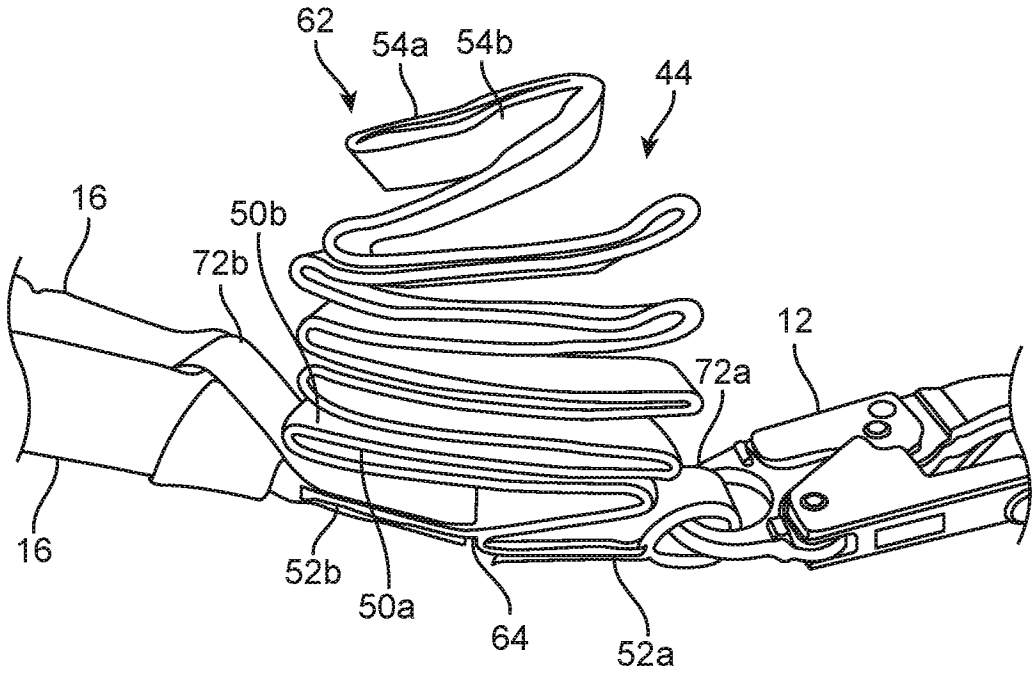
62
54a
54b
44
16
50b
72b
12
72a
16
52b
50a
64
52a

FIG. 4

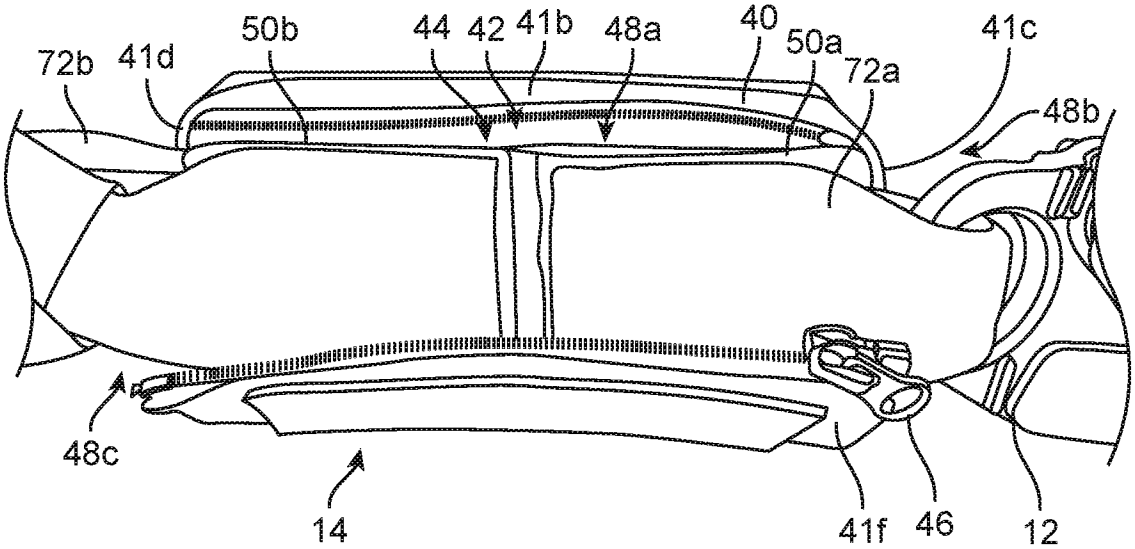
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FIG. 5A

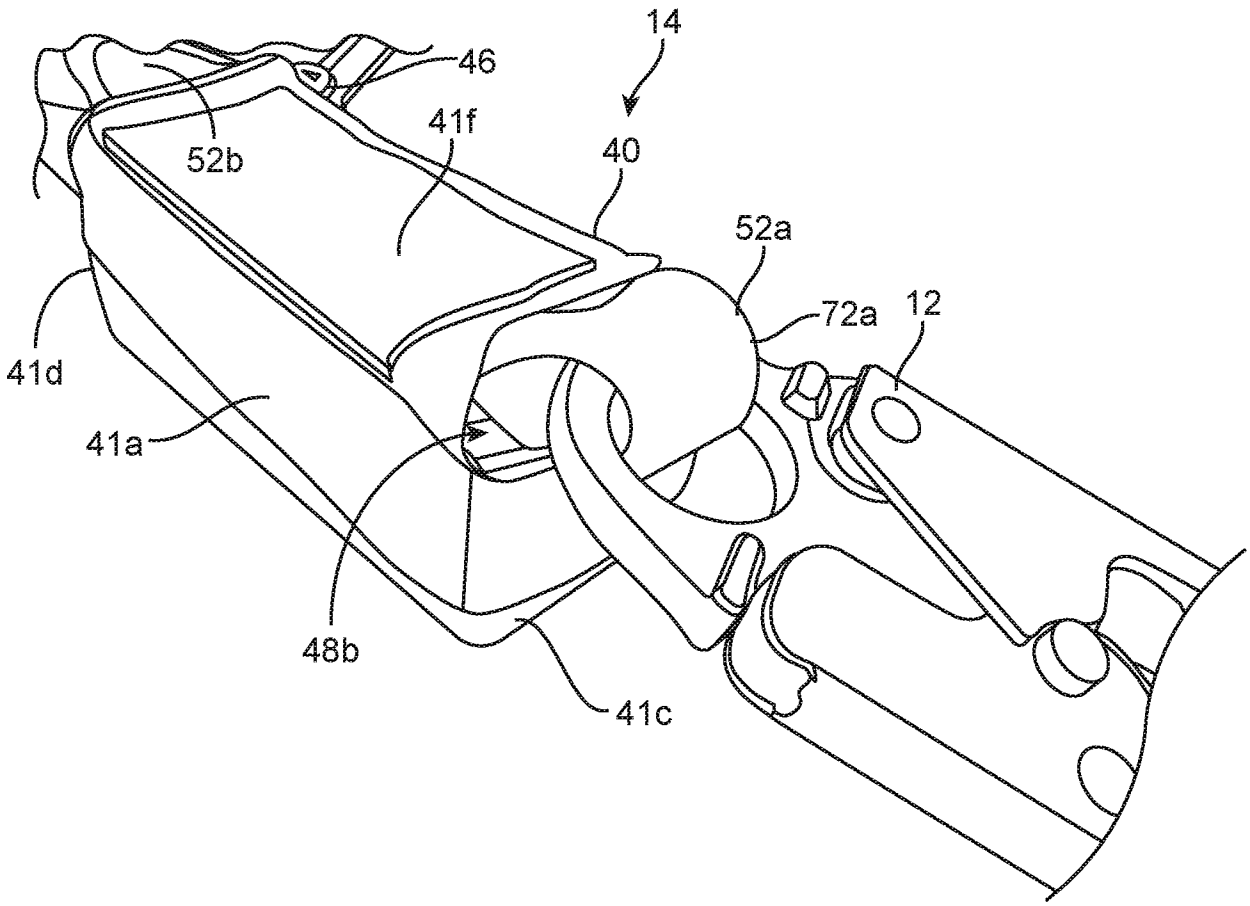

FIG. 5B

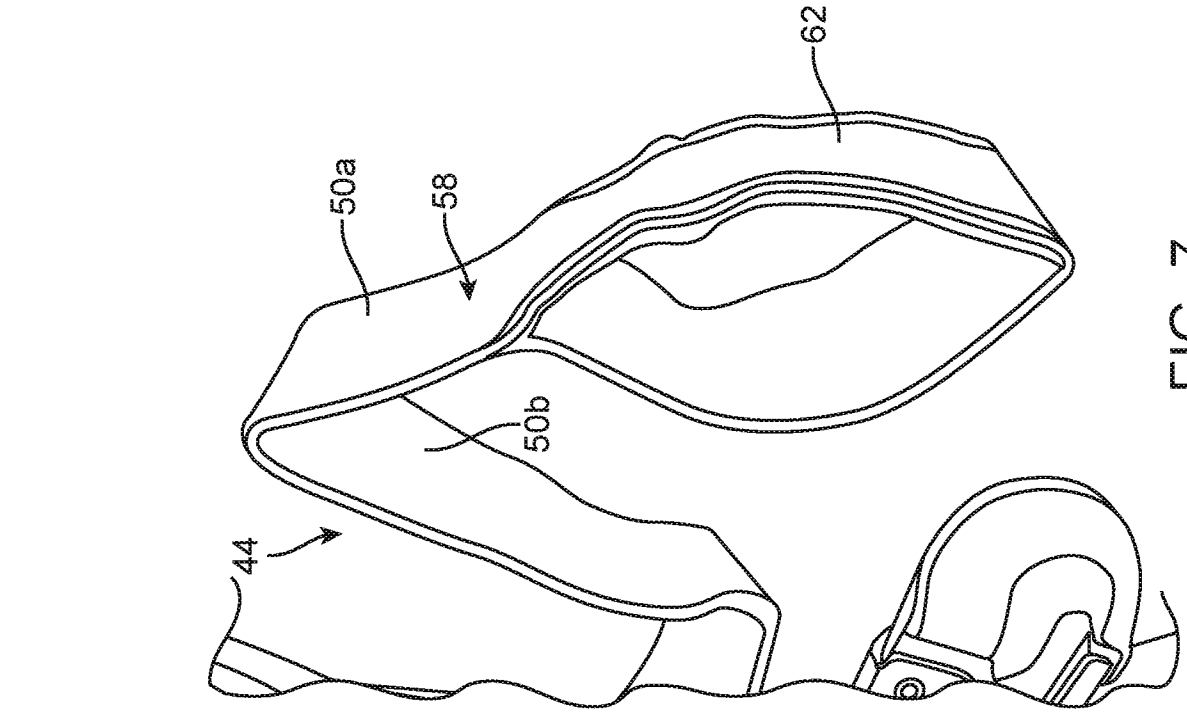

FIG. 7

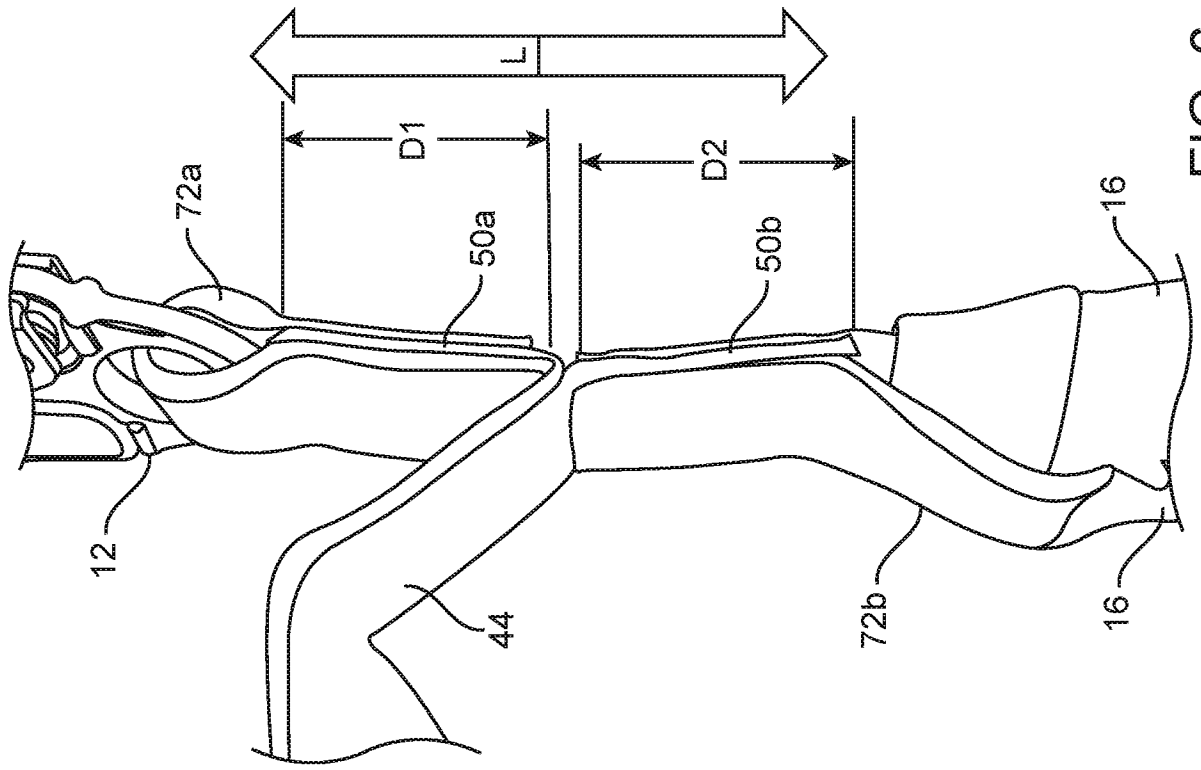

FIG. 6

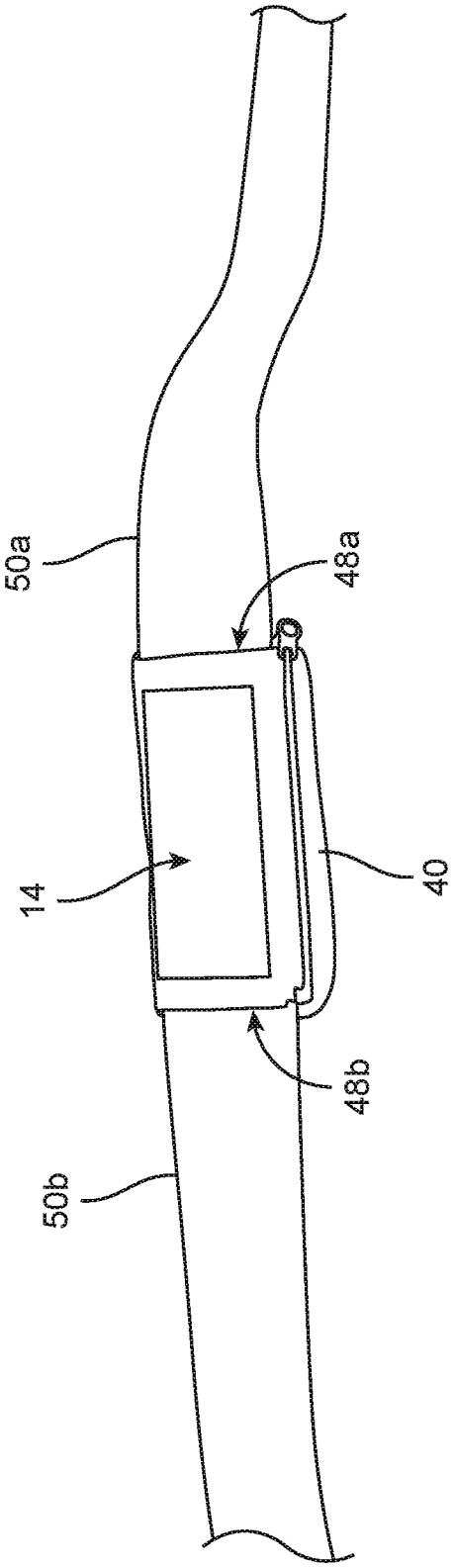

FIG. 8

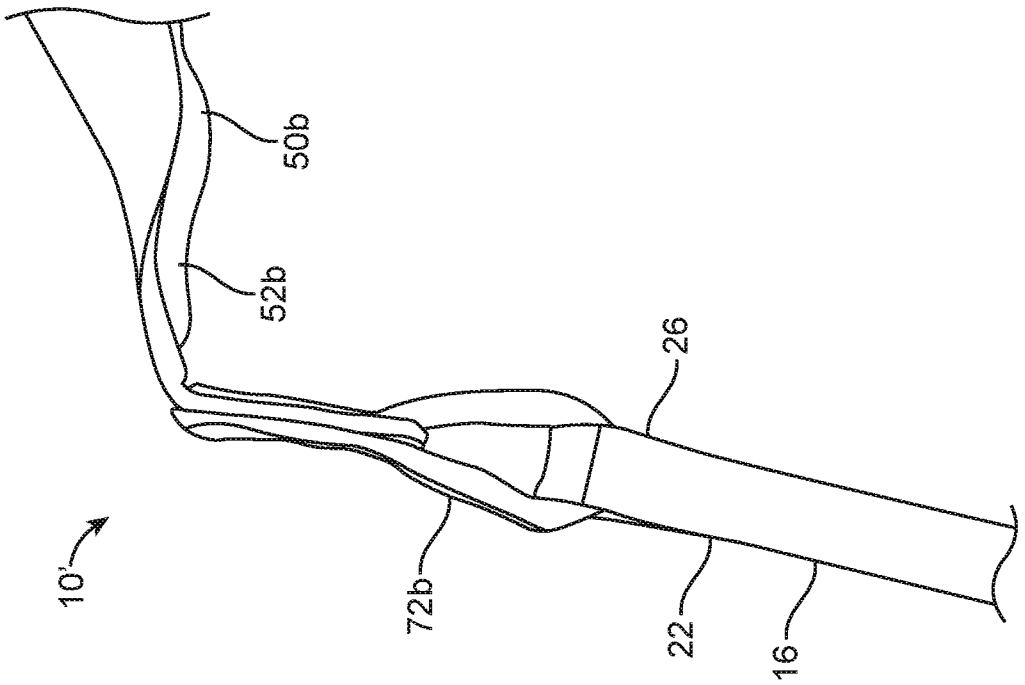

FIG. 10

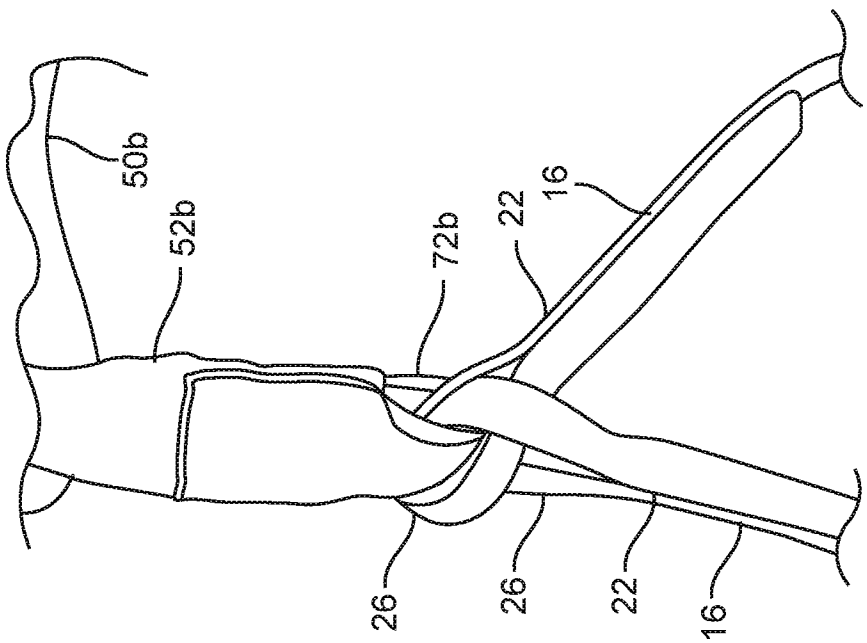

FIG. 9

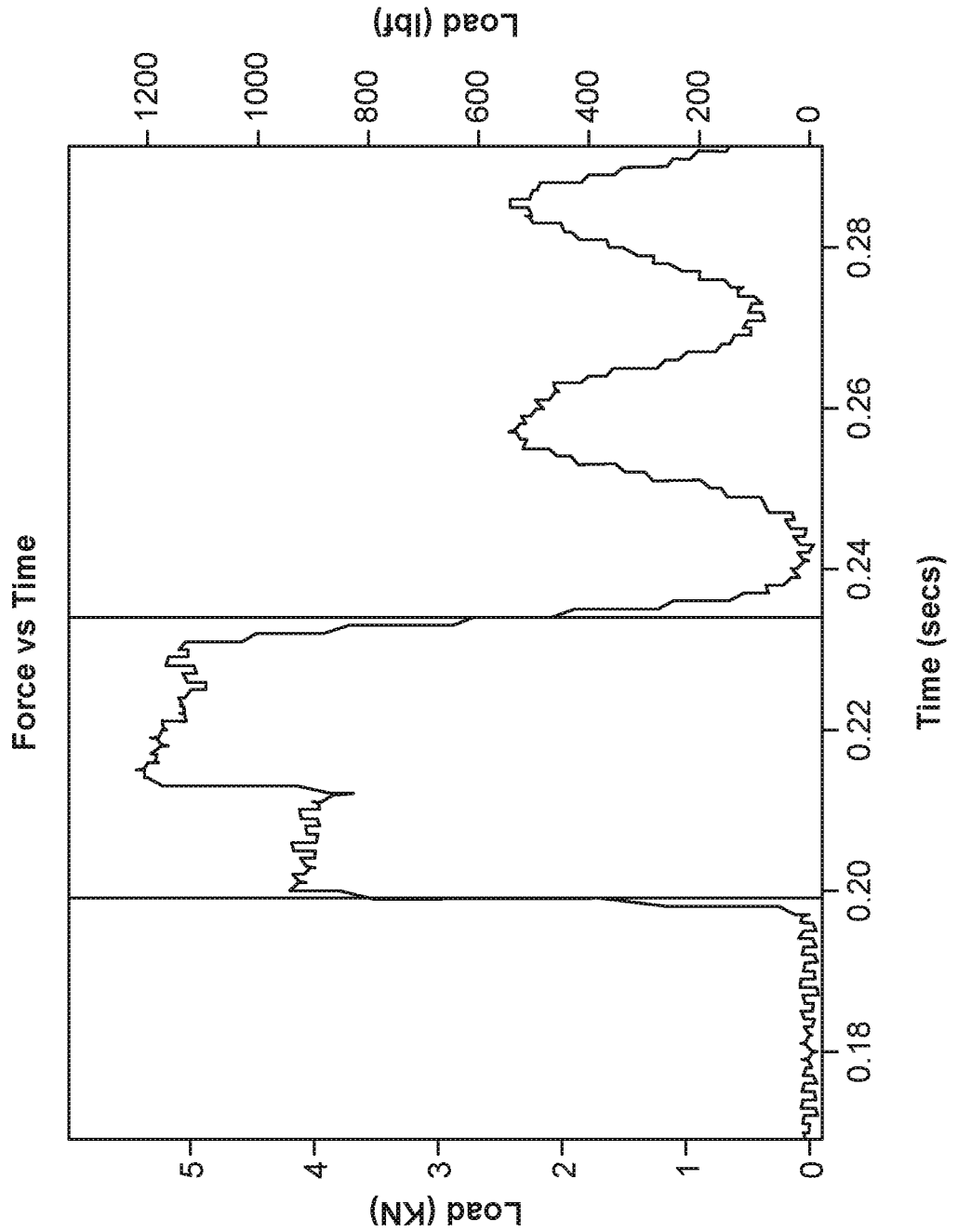
Force vs Time
Load (kN)
0
1
2
3
4
5
Load (lbf)
0
200
400
600
800
1000
1200
0.18
0.20
0.22
0.24
0.26
0.28
Time (secs)

FIG. 11

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2020/052129

A. CLASSIFICATION OF SUBJECT MATTER
INV. A62B35/04
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A62B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2019/217134 A1 (GREEN MULLINS SHERRY [US]) 18 July 2019 (2019-07-18) paragraphs [0038], [0040], [0042]; figures 1,3A-13	1-21
X	FR 2 513 717 A1 (FRANCE ETAT [FR]) 1 April 1983 (1983-04-01) page 4, lines 6-16; figures 1a-6	1-21
X	US 3 444 957 A (ERVIN ROBERT GILPIN JR) 20 May 1969 (1969-05-20) figures 1-6,8,9	1-21

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 January 2021	21/01/2021

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Gkama, Alexandra

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/GB2020/052129

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2019217134 A1	18-07-2019	NONE	
FR 2513717 A1	01-04-1983	NONE	
US 3444957 A	20-05-1969	NONE	