(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
16 February 2006 (16.02.2006)

PCT

(10) International Publication Number
WO 2006/017521 A1

(51) International Patent Classification[7]: A45F 3/04

(21) International Application Number:
PCT/US2005/027454

(22) International Filing Date: 2 August 2005 (02.08.2005)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/598,155 2 August 2004 (02.08.2004) US

(71) Applicant *(for all designated States except US)*: **MOUNTAIN HARDWEAR, INC.** [US/US]; 4911 Central Avenue, Richmond, CA 94804 (US).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **MOSLEY, Charles** [US/US]; P.O. Box 8131, Truckee, CA 94162 (US).

(74) Agent: **HENDRICKSON, Jay, P.**; 1010 B Street, Suite 319, San Rafael, CA 94901 (US).

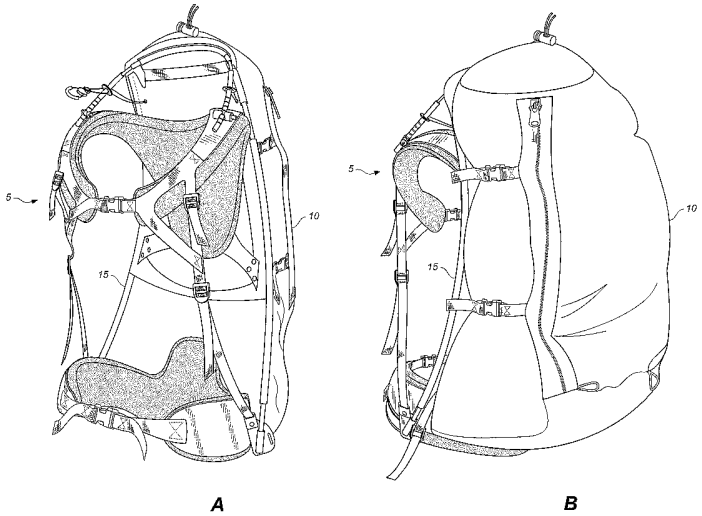
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: LOAD CARRYING SYSTEM



(57) Abstract: An apparatus for carrying a load on a wearer's body includes a shoulder harness assembly and a waist belt assembly, which are attached to a frame for supporting a load. Each assembly has a flexible panel and a pad consisting of three layers: an outer and inner layer made of closed cell foam and a middle layer made of polyethylene. A plurality of elongate grooves is disposed within the outside surfaces of each pad. Each pad is formed into a preferred curved shape, causing the grooves to widen, and the each panel is coupled with its respective pad, causing each pad to substantially maintain its shape. In one embodiment, each panel is coupled to its respective pad by attaching hook and loop material to the inside surface of each panel and to the outside surface of each pad, disposed between the grooves. In another embodiment, the middle layer is omitted.

WO 2006/017521 A1

LOAD CARRYING SYSTEM

Related Applications

[0001] This patent application relates to U.S. Provisional Application No. US60/598,155 filed on August 2, 2004 and claims the benefit of the earlier filing date under 35 U.S.C. 119(e).

Technical Field

[0002] The present invention generally relates to load carrying systems and more specifically to backpacks, daypacks, mountaineering packs and other types of load carrying devices for carrying a load on a wearer's shoulders and hips, while engaging in various activities such as walking, hiking, mountaineering, skiing and the like.

Background

[0003] A conventional load carrying system that is designed to carry a relatively heavy load distributes the weight of the load primarily between the wearer's shoulders and hips. This weight distribution is accomplished, in part, by providing an external or internal support frame structure, which carries the load within a pack or compartment attached to the outside surface of the frame. Typically, the weight of the load is supported on the wearer's shoulders by providing a pair of flexible and compressible shoulder straps, with an end of each strap attached respectively to opposite sides of the inside surface of the frame, usually at or below the top of the shoulders. The straps are designed to drape over the wearer's shoulders, and the other end of each strap is attached respectively to opposite, bottom portions of the frame. The weight of some of the load is also transferred to the wearer's hips by connecting opposite sides of the bottom of the frame to a flexible and compressible hip belt, fastened tightly around the wearer's hips and waist. Normally, the opposite sides of the bottom of the frame are attached to opposite sides of the hip belt such that the points of attachment are adjacent to the hipbone's iliac crest. The wearer is then able to adjust the load's weight distribution between the shoulders and hips by either lengthening or shortening the length of the shoulder straps. Shortening the straps transfers more of the load's weight to the wearer's shoulders, and lengthening the straps places more weight on the hips. In the conventional design, the weight of the load is primarily concentrated at the top of the shoulders and on the iliac crests due to the fact that the flexible and compressible

shoulder straps and hip belt do not have any substantial stiffness or rigidity and, thus, readily deform under the weight of the load.

[0004] Although the ability to distribute the weight of the load between the wearer's shoulders and hips provides a load carrying system design that is potentially more comfortable than a design that only carries the weight on the wearer's shoulders, stability of the load can become a problem if the load is particularly heavy and too much weight is distributed to the hips. In this instance, the load has a tendency to tip forward or backward and to sway from side-to-side, or to tip and sway simultaneously. Conventional systems attempt to address this stability problem by utilizing a pair of flexible tension straps, which are intended to partially stabilize the load. Typically, each tension strap is attached at one end to its respective shoulder strap, generally adjacent to the wearer's upper chest, at or just below the top of the wearer's shoulder, and the other end of each strap is attached to its respective portion of the backpack frame, at or just above the top of the shoulders. The tension straps are provided with an adjustable mechanism, which allows the wearer to adjust each strap's tension by either lengthening or shortening the strap. Shortening the tension strap increases the tension in the strap, while lengthening the strap decreases the tension. In order to maintain control over the movement of the load, however, the tension straps must be sufficiently tensioned in order to exert a tensile force equal to or greater than the forces that arise due to the tipping and swaying movements. Naturally, the heavier the load and/or the more violent the wearer's activities, the greater the tension must be on the tension straps to counter the forces which result from the tipping and swaying movements.

[0005] Although the tension straps can be used by a wearer to partially control unwanted movements of the load, the amount of control is limited because the straps do not have any stiffness or rigidity and, as a result, have no strength in compression or resistance to bending. Thus, the tension straps are not able to control forward tipping motion and the straps are only partially able to control side-to-side swaying motion. In an attempt to gain more control over the swaying motion, the wearer will typically over-tension the tension straps, which increases the pressure of the shoulder straps on the wearer's chest and forces the wearer's middle back to press tightly against the inside surface of the support frame. As a result, the wearer experiences a general loss of

comfort and a loss of mobility in his or her spine, which is extremely detrimental when trying to maintain one's balance, especially when performing more challenging moves like jumping or skiing.

[0006] Another limitation in the ability of the tension straps to control the load exists due to the fact that the back portion of each shoulder strap is pulled away from the wearer's back when the tension straps are fully tensioned. This condition prevents any portion of the weight of the load to be transferred to the back of the shoulders and upper back. As a result, the back portion of each shoulder strap is rendered incapable of contributing to the desired control of unwanted movements of the load because this portion of each shoulder strap is no longer in contact with the wearer's body.

[0007] Conventional systems, as noted above, also attempt to transfer a substantial portion of the load's weight to the wearer's hips. This is typically accomplished by connecting the frame and its load to the hip belt. The hip belt, which is typically made of a soft, padded material, is cinched tightly around the wearer's waist and hips in order to accept the weight of the load. However, due to hip belt's lack of rigidity, most of the load's weight is concentrated at the points where the frame is connected to the belt, and is transferred to corresponding points on the wearer's hips. Due to the concentration of the load at only two points on the wearer's hips, these points are prone to become tender and sore. In order to alleviate the soreness, a backpacker will typically take some of the weight of the load off of the hips by redistributing the weight to the shoulders by shortening the shoulder straps. Unfortunately, transferring some of the weight of the load to the shoulders causes the top of the shoulders to become more susceptible to becoming tender and sore because the shoulder straps' lack of stiffness or rigidity causes them to deform under the weight of the load, concentrating the weight on the top of the shoulders. The backpacker finds himself or herself in a never-ending struggle of redistributing the weight of the load between the hips and shoulders in an attempt to establish a comfortable position.

[0008] What is needed is a load carrying system that overcomes the limitations of the conventional systems by providing a more stable system which eliminates the need to increase the pressure on the wearer's chest and back in order to stabilize the load, and providing a more comfortable load carrying system which distributes the weight of the

load more uniformly on the wearer's shoulders, back and chest, rather than concentrating the weight primarily at the top of the shoulders, and by similarly distributing the weight of the load around the wearer's hips and waist, rather than primarily on the hipbone's iliac crest.

Summary

[0009] A load carrying system for carrying a load on a wearer's body includes providing a frame configured to support the load, and a shoulder harness assembly having a harness panel and a harness pad. The harness panel is flexible and has inside and outside surfaces, with the outside surface attached to the frame. In one embodiment, the harness pad consists of three (3) integral layers: an outer layer and an inner layer, which are flexible, resilient, compressible and stretchable, and a middle layer which is flexible and resilient, with the outer layer having an outside surface. A plurality of elongate grooves is disposed within the outside surface of the harness pad's outer layer. The harness pad and the outside surface of the harness pad's outer layer are formed into a preferred curved shape, causing the width of the grooves to widen, and the inside surface of the harness panel is coupled to the outside surface of the harness pad's outer layer, whereby the coupling of the two surfaces substantially retains the curved shape of the harness pad. In one embodiment the inside surface of the harness panel and the outside surface of the harness pad's outer layer are releasably coupled by providing a hook and loop system in which a first coupling material is attached to the inside surface of the harness panel and a second coupling material is attached to the outside surface of the harness pad's outer layer and disposed between the grooves.

[0010] A waist belt assembly includes belt panel and a harness pad. The belt panel is flexible and has inside and outside surfaces, with the outside surface attached to the frame. In one embodiment, the belt pad consists of three (3) integral layers: an outer layer and an inner layer, which are flexible, resilient, compressible and stretchable, and a middle layer which is flexible, with the outer layer having an outside surface. A plurality of elongate grooves is disposed within the outside surface of the belt pad's outer layer. The belt pad and the outside surface of the belt pad's outer layer are formed into a preferred curved shape, causing the width of the grooves to widen, and

the inside surface of the belt panel is coupled to the outside surface of the belt pad's outer layer, whereby the coupling of the two surfaces substantially retains the curved shape of the belt pad. In one embodiment the inside surface of the belt panel and the outside surface of the belt pad's outer layer are releasably coupled by providing a hook and loop system in which a first coupling material is attached to the inside surface of the belt panel and a second coupling material is attached to the outside surface of the belt pad's outer layer and disposed between the grooves. Preferably, the outer and inner layers of both the harness pad and belt pad are made of closed cell foam and the middle layers are made of polyethylene and the elongate grooves have a cross-section that is v-shaped.

[0011] In another embodiment the shoulder harness assembly is modified by omitting its middle layer and utilizing a harness pad which has only two (2) layers: an outer layer and an inner layer which are flexible, resilient, compressible and stretchable. The waist belt assembly is similarly modified by omitting its middle layer and utilizing a belt pad which has only two (2) layers: an outer layer and an inner layer which are flexible, resilient, compressible and stretchable.

[0012] In another embodiment, the frame has an elongate, semi-rigid stabilizing member attached to the top of the end of the frame. The stabilizing member has a pair of left and right stabilizing member arms, extending outwardly and downwardly away from the frame and attached to the outside surface of the shoulder harness assembly's harness panel. In yet another embodiment the left and right stabilizing member arms are slideably connected to left and right friction sockets, respectively, with the friction sockets attached to the outside surface of the harness panel.

[0013] In another embodiment the outside surface of the shoulder harness assembly's harness panel is slideably attached to the frame so that the shoulder harness can be raised or lowered in relation to the frame, and in another embodiment the shoulder harness assembly is releasably attached to the frame so that the harness panel can be removed from the frame. In yet another embodiment the waist belt assembly's belt panel is pivotally attached to a bottom portion of the frame so that the frame can tilt forward or rearward in relation to the waist belt assembly. The amount the frame's tilt is controlled by an adjustable strap attached to opposite sides of the belt panel and

adjacent to the outside surface of the panel, shortening the strap limits the amount of the frame's potential rearward tilt and lengthening the strap increases the amount of the frame's potential rearward tilt.

Brief Description of the Drawings

[0014] **FIG. 1A** is a front perspective view of the preferred embodiment of the load carrying system.

[0015] **FIG. 1B** is a back perspective view of the preferred embodiment of the load carrying system.

[0016] **FIG. 2A** is a front perspective view of the preferred embodiment of the load carrying system with the pack removed from the frame.

[0017] **FIG. 2B** is a front perspective view of the shoulder harness assembly of the preferred embodiment, which has been removed from the frame.

[0018] **FIG. 2C** is a front perspective view of the shoulder harness assembly of the preferred embodiment separated into its two components: a harness panel and a harness pad.

[0019] **FIG. 2D** is a back perspective view of the shoulder harness assembly of the preferred embodiment separated into its two component parts: a harness panel and a harness pad.

[0020] **FIG. 2E** is an exploded view of the harness pad of the preferred embodiment illustrating the pad's three layers.

[0021] **FIG.'S 3A** through **3C** are cross-sectional views of the harness panel and harness pad of the preferred embodiment.

[0022] **FIG.'S 3D** through **3F** are cross-sectional views of the harness panel and harness pad in another embodiment.

[0023] **FIG. 4A** is a back perspective view of the preferred embodiment of the load carrying system illustrating the shoulder harness assembly in a raised position relative to the frame.

[0024] **FIG. 4A-1** is detail illustration of a sliding frame assembly.

[0025] **FIG. 4B** is a back perspective view of the preferred embodiment of the load carrying system illustrating the shoulder harness assembly in a lowered position relative to the frame.

[0026] **FIG. 4C** is a pictorial diagram illustrating the shoulder harness assembly of the preferred embodiment in a low position relative to the frame (solid line), and further illustrating (in dashed lines) the shoulder harness assembly being raised to a higher position relative to the frame to the position illustrated in **FIG. 4D**.

[0027] **FIG. 5A** is a front perspective view of the preferred embodiment of the load carrying system illustrating a curved stabilizing member attached to the frame.

[0028] **FIG. 5B** is a front perspective view of the preferred embodiment of the load carrying system illustrating the curved stabilizing member in a position having increased curvature.

[0029] **FIG. 6A** is a plan view of the top of the preferred embodiment of the load carrying system illustrating the curved stabilizing member of **FIG. 5A**.

[0030] **FIG. 6B** is a plan view of the top of the preferred embodiment of the load carrying system illustrating the curved stabilizing member of **FIG. 5B**.

[0031] **FIG. 7A** is a front perspective view of the belt assembly of the preferred embodiment, which has been removed from the frame.

[0032] **FIG. 7B** is a front perspective view of the belt assembly of the preferred embodiment separated into its two component parts: a belt panel and a belt pad.

[0033] **FIG. 7C** is a back perspective view of the belt assembly of the preferred embodiment separated into its two component parts: a belt panel and a belt pad.

[0034] **FIG. 7D** is an exploded view of the belt pad of the preferred embodiment illustrating the pad's three layers.

[0035] **FIG.'S 8A** through **8C** are cross-sectional views of the belt panel and belt pad of the preferred embodiment.

[0036] **FIG.'S 8D** through **8F** are cross-sectional views of the belt panel and belt pad in another embodiment.

[0037] **FIG. 9A** is a back perspective view of the preferred embodiment of the load carrying system illustrating the position of the frame relative to the belt assembly in which the frame has the least amount of rearward tilt.

[0038] **FIG. 9B** is a back perspective view of the preferred embodiment of the load carrying system illustrating the position of the frame relative to the belt assembly in which the frame has the most amount of rearward lilt.

[0039] **FIG. 10** is a pictorial diagram presenting a left side view of the frame, illustrating in a solid line the frame in a position having the least amount of rearward tilt and illustrating in a dashed line the frame in position having the most amount of rearward tilt.

Detailed Description of Preferred Embodiments

[0040] **FIG.'s 1A** and **1B** generally illustrate a preferred embodiment of a load carrying system **5,** including a support frame **15** and a pack **10**, with the pack **10** attached to the frame **15** for carrying a load in the pack **10** on a wearer's shoulders and hips. **FIG. 2A** illustrates the load carrying system **5** with the pack **10** removed from the frame **15**. As used herein, the term "load carrying system" includes backpacks, daypacks, mountaineering packs, and other types of load carrying devices for carrying a load on the wearer's shoulders and hips. More specifically, one of the features of the load carrying system **5** includes a shoulder harness assembly **20**, which is illustrated with reference to the following figures: the perspective drawing of **FIG. 2A** showing the shoulder harness assembly **20** attached to the frame **15**; the perspective drawing of **FIG. 2B** illustrating the shoulder harness assembly **20** removed from the frame **15**; the perspective drawings of **FIG.'s 2C** and **2D** illustrating the shoulder harness assembly **20** in a disassembled condition; the exploded view of **FIG. 2E** illustrating the three (3) layers of a harness pad **30**; and the pictorial representations of **FIG.'s 3A** through **3C** presenting a partial cross-sectional view of the shoulder harness assembly **20**. Specifically referring to **FIG.'s 2A through 2D**, the shoulder harness assembly **20** consists of a harness panel **25** and harness pad **30**. The harness panel **25** consists of an integral back panel **35**, having an inside and outside surfaces, **36** and **37**, and pair of, left and right, integral yoke panels, **40** and **41**, with each yoke panel having inside and outside surfaces, **42** and **43**, and the pair of yoke panels, **40** and **41**, disposed on opposite sides of and extending outwardly from the back panel **35** and terminating at a pair of yoke panel distal ends **45.** And, as shown in **FIG.'s 2C** and **2D**, and **3A** through **3C,** a first coupling material **80** of a hook and loop system is attached to the inside surface **36** of the back panel **35** and to the inside surface **42** of the pair of yoke panels **40** and **41**. Preferably, the harness panel **25** has the physical properties of being relatively stiff, but also flexible and resilient. An acceptable material for the panel **25** is

high density polyethylene, having a thickness of approximately 1/16 of an inch or approximately 1.6 mm.

[0041] Referring to **FIG.'s 2A** and **2B**, the harness pad **30** consists of an integral back pad **50** and a pair of left and right integral yoke pads **55** with the pair of yoke pads **55** disposed on opposite sides of and extending outwardly from the back pad **50** and terminating at a pair of yoke pad distal ends **60.** And, as further illustrated in **FIG.'s 2E**, and **3A** through **3C**, the harness pad **30** is a laminated component consisting of three (3) integral and contiguous layers: an outer harness pad layer **65**, having an outside surface **66**, a middle harness pad layer **70**, and an inner harness pad layer **75,** having an inside surface **76**. **FIG. 2E** is an exploded view of the harness pad **30**, separately illustrating each harness pad layer **65**, **70**, and **75**, and the cross sectional views of **FIG.'s 3A** through **3C** further illustrate the harness pad **30** and integral and contiguous layers **65**, **70**, and **75**. Each of the harness pad layers, **65**, **70**, and **75** consists of an integral back pad layer **50a**, **50b**, and **50c**, respectively, and a pair of integral yoke pad layers **55a**, **55b**, and **55c**, respectively, with the pair of yoke pad layers **55a**, **55b**, and **55c** disposed on opposite sides of and extending outwardly from the back pad layers **50a**, **50b**, and **50c**, respectively, and terminating at a pair of yoke pad distal ends **60a**, **60b**, **and 60c,** respectively. Back pad layer **50a** has an outside surface **50d**, and the pair of yoke pad layers **55a** has an outside surface **55d**; and back pad layer **50c** has an inside surface **50e** and the pair of yoke pad layers **55c** has an inside surface **55e**.

[0042] The outer harness pad layer **65** and the inner harness pad layer **75** have the physical properties of exhibiting only minimal stiffness and of being flexible, resilient, compressible, and stretchable. Preferably the harness pad layers, **65** and **75**, consist of closed cell foam made from olefin polymers or blends of olefin polymers. Generally, the preferred compressive strength and thickness of the foam layers are dependent upon the weight of the load being carried by the wearer. For lighter loads, which are typical of the loads carried in a daypack or small backpack, it is preferable to use foam for the inner harness pad layer **75** which has a relatively low compressive strength, because foam which is more compressible is generally more comfortable under load. However, using foam with a low compressive strength requires that the foam be thick enough in

order to ensure that the foam's full range of compression can be utilized. For heavier loads, which are typical of the loads carried in a large mountaineering pack, the compressive strength of the foam for the inner harness pad layer **75** can be approximately the same as that for carrying lighter loads, but the thickness of the foam can be somewhat greater in order to ensure that the heavier loads do not subject the foam to pressure in excess of its compressive limit. With respect to the foam for the outer harness pad layer **65,** its preferred compressive strength and thickness are not as dependent upon the weight of the load, as is the case for the inner layer **75**, because the outer layer **65** is not in contact with the wearer's body. As a result, for most load weights the preferred compressive strength of the foam for the outer layer **65** can generally range from foam having a relatively low compressive strength, similar to the compressive strength of the foam for the inner layer **75,** up to foam having a compressive strength that is characterized as being almost incompressible, because it not necessary that the outer layer compress in order to ensure that the backpack is comfortable on the wearer's shoulders and upper torso. With respect to the thickness of the foam for the outer layer **65,** the thickness for lighter loads can be similar to the thickness of the foam for the inner layer **75**, but for heavier loads the thickness of the outer layer **65** can be less than the thickness of the inner layer **75**, again due to the fact that the outer layer **65** of foam is not in contact with the wearer's body.

[0043] More specifically, it is preferable that for loads of up to approximately five (5) lbs (2.3 kg) the thickness of the inner layer **75** is between approximately 1/8 and 3/4 of an inch, or approximately 3.2 and 19.0 mm, and the foam has a compressive strength of between approximately three (3) psi (0.21 kg/cm^2) and five (5) psi (0.35 kg/cm^2); for loads between approximately five (5) lbs (2.3 kg) and fifty (50) lbs (22.7 kg), the preferred thickness of the inner layer **75** is between approximately 3/16 and 3/4 of an inch, or approximately 4.7 and 19.0 mm, and the preferred compressive strength of the foam is between approximately four (4) psi (0.28 kg/cm^2) and seven (7) psi (0.49 kg/cm^2); and for loads between approximately fifty (50) lbs (22.7 kg) and approximately one-hundred (100) lbs (45.4 kg), the preferred thickness of the inner layer **75** is between approximately 3/16 and 7/8 of an inch, or approximately 4.7 and 22.2 mm, and the preferred compressive strength of the foam is between approximately five (5) psi (0.35

kg/cm²) and seven (7) psi (0.49 kg/cm²), (all compressive strength values determined in accordance with ASTM International, Designation: D 3575-91). Examples of acceptable foams for the inner layer **75** are: Evazote® EV 30 for loads of up to fifty (50) lbs (22.7 kg), and Evazote® EV 50 for loads between fifty (50) lbs (22.7 kg) and one-hundred (100) lbs (45.4 kg). Concerning the outer layer **65**, it is preferable that for loads of up to approximately twenty (20) lbs (9.1 kg) the thickness of the outer layer **65** is between approximately 1/8 and 1/2 of an inch, or approximately 3.2 and 12.7 mm, and the foam has a compressive strength of between seven (7) psi (0.49 kg/cm²) and fifteen (15) psi (1.05 kg/cm²); for loads between approximately twenty (20) lbs (9.1 kg) and fifty (50) lbs (22.7 kg) the preferred thickness of the outer layer **65** is between approximately 3/16 and 5/8 of an inch, or approximately 4.7 and 15.9 mm, and the compressive strength of the foam is between approximately nine (9) psi (0.63 kg/cm²) and seventeen (17) psi (1.19 kg/cm²); and for loads between approximately fifty (50) lbs (22.7 kg) and one-hundred (100) lbs (45.4 kg), the preferred thickness of the outer layer **65** is between approximately 3/16 and 3/4 of an inch, or approximately 4.7and 19.0 mm, and the compressive strength of the foam is between approximately twelve (12) psi (0.84 kg/cm²) and twenty (20) psi (1.40 kg/cm²), (again, all compressive strength values determined in accordance with ASTM International, Designation: D 3575-91). Examples of acceptable foams for the outer layer **65** are: Plastazote® LD 15 for loads of up to five (5) lbs (2.3 kg), Plastazote® LD 45 for loads between five (5) lbs (2.3 kg) and fifty (50) lbs (22.7 kg), and Plastazote® LD 60 for loads between fifty (50) (22.7 kg) and one-hundred (100) lbs (45.4 kg).

[0044] Preferably, the middle harness pad layer **70** has a thickness which is substantially less than the thickness of the inner and outer harness pad layers, **65** and **75**, and although the middle harness pad layer **70** is flexible and resilient, it also has the physical properties of being relatively stiff and non-stretchable as compared to the harness pad layers, **65** and **75**. An acceptable material for the middle harness pad layer **70** is high density polyethylene, having a thickness of approximately 1/16 of an inch or approximately 1.6 mm. This layer provides some stiffness to the harness pad **30** without compromising the flexibility and compressibility of the outer layer **65** and inner layer **75**.

[0045] Although specific types of materials and material thicknesses for the harness panel **25** and harness pad **30** have been described in connection with the preferred embodiment, it will be apparent to those skilled in the art that other types of materials and material thicknesses can also be used.

[0046] As shown in **FIG.'s 2C, 2D, 2E**, and **3A** through **3C** the outer harness pad layer **65** has a plurality of elongate yoke pad grooves **85**, which form a yoke pad groove pattern within the outer layer's outside surface **66,** and more specifically, each of the yoke pad grooves **85** are formed within the outside surface **55d** of the pair of yoke pad layers **55a**. Each of the yoke pad groves **85** extends widthwise across its respective yoke pad layer and is preferably spaced between approximately 1/2 and 1 1/2 inches (approximately 12.7 and 38.1 mm) apart. Preferably, each of the yoke pad grooves **85** has a depth which is between approximately 50% and 95% of the thickness of the pair of yoke pad layers **55a** and each of the grooves **85** has a width at the outside surface **55d** of its respective yoke pad layer which is approximately equal to the depth of the groove. Forming the yoke pad grooves **85** in this manner separates the outside surface **55d** of the pair of yoke pad layers **55a** into a pattern of yoke pad surface segments **90,** disposed between the yoke pad grooves **85**. Similarly, the outer harness pad layer **65** also has a plurality of elongate back pad grooves **86,** which form a back pad groove pattern within the outer layer's outside surface **66,** and more specifically, the back pad grooves **86** are formed within the outside surface **50d** of the back pad layer **50a**. Each of the back pad grooves **86** extends widthwise across the back pad layer and is preferably spaced between approximately 1/2 and 1 1/2 inches (approximately 12.7 and 38.1 mm) apart. Again, it is preferable that each of the back pad grooves **86** has a depth which is between approximately 50% and 95% of the thickness of the back pad layer **50a** and each of the grooves **86** has a width at the outside surface **50d** of the back pad layer **50a** which is approximately equal to the depth of the groove. Similarly, forming the back pad grooves **86** in this manner separates the outside surface **50d** of the back pad layer **50a** into a pattern of back pad surface segments **91**, disposed between the back pad grooves **86**. In a preferred embodiment, the elongate yoke pad grooves and back pad grooves, **85** and **86**, as best illustrated in **Fig. 3A,** are "v-shaped" in that the grooves have a cross-sectional shape in the form of a "V" and each groove has an

approximately uniform width (**w**) as measured across the "V" at the outside surface of its respective pad. In addition to v-shaped grooves, other types of elongate openings having a cross-section in the form of a "U" or slit may be used as well. And, as shown in **FIG.'s 2C** through **2E**, and **3A** through **3C**, a second coupling material **81**of the hook and loop system is attached to the plurality of yoke pad surface segments **90** and to the plurality of back pad surface segments **91**.

[0047] The shoulder harness assembly **20** is assembled into a wearer's desired or predetermined curved shape, draped over the wearer's shoulders, by positioning the inside surface **76** of the inner harness pad layer **75** over the wearer's shoulders and bending the pair of yoke pads **55** down and adjacent to the wearer's chest, and bending the back pad **50** down and adjacent to the wearer's upper back. As illustrated in **FIG. 3B**, bending the yoke pads **55** and back pad **50** in this manner causes the outside surface **66** of the outer harness pad layer **65** to form a concave shape and causes the width (**w**) of the yoke pad grooves **85** and back pad grooves **86** to increase, and the inside surface **76** of the inner harness pad layer **75** forms a concave shape. Further, as illustrated in **FIG. 3C**, the desired curved shape is then substantially held in position by positioning the harness panel **25** adjacent to the harness pad **30** and mating or coupling the first coupling material **80** of the hook and loop fastening system, attached to the inside surface **36** of the back panel **35** and to the inside surface **42** of yoke panels **40** and **41**, to the second coupling material **81** of the hook and loop fastening system, attached to the plurality of yoke pad surface segments **90** and to the plurality of back pad surface segments **91.** Assembling the shoulder harness assembly **20** in this manner creates a semi-rigid shoulder harness, which substantially retains its shape under load. In addition, the inside surface **76** of the inner harness pad layer **75**, which is in contact with the wearer's body, is flexible and compressible, and the outside surface of the assembly, formed by the harness panel **25,** is flexible and substantially incompressible. Once the wearer has assembled the harness panel **25** and harness pad **30** into a desired curved or predetermined shape, the wearer uses a yoke buckle mechanism **95**, attached to the yoke panel distal ends **45** to further fasten the harness assembly **20** against the wearer's chest and upper back, and the wearer uses a pair of left and right frame attachment straps **46** and **47** to pivotally connect the shoulder

harness assembly **20** to left and right pivot plates, **301** and **302**, respectively, which are attached to opposite, left and right sides of a belt assembly **200** (described below).

[0048] The fact that the shoulder harness assembly **20** substantially retains its shape under load is a substantial improvement over conventional shoulder harnesses, because this feature of the harness assembly **20** causes the weight of the load to be substantially distributed over harness assembly's entire outside surface. Distributing the weight of the load **10** in this fashion substantially eliminates the pressure points at the top of the shoulders, which is a characteristic of conventional harnesses, made of soft and compressible pads and fabric. At the same time, the inside surface of the shoulder harness assembly **20**, which is in contact with the wearer, is soft and compressible, ensuring that the shoulder harness **20** is comfortable. In addition to being more comfortable, harness assembly **20** significantly enhances stabilization of the load **10**. When the shoulder harness assembly **20** is subjected to unwanted tipping and swaying forces from the wearer's load, the shoulder harness **20** absorbs the unwanted forces without any substantial deformity. Because the shoulder harness **20** holds its shape under load, the wearer's natural, reactive movements, which are made in attempt to counteract any tipping or swaying forces from the load, are instantly transmitted from the shoulder harness **20** to the frame **15**, and then to the pack **10** containing the load. Another significant advantage of the shoulder harness **20** is that it does not have to be tightly cinched against the wearer's chest and back in order to obtain more control over the load. In conventional load carrying systems the wearer attempts to obtain more control over the load by shortening the shoulder straps, which presses the straps and frame closer to his or her body. Unfortunately, although the wearer may obtain more control over the load in this manner, the backpack is less comfortable due to the added pressure against his or her body. Another drawback arising from tightening the shoulder straps is that the straps tend to roll or slide forward and downward around the shoulders, which places additional stress on the top of the shoulders. The shoulder harness assembly **20** overcomes these limitations by providing the desired load control, thus eliminating the need to tightly cinch the harness **20** against the wearer's body.

[0049] Referring to **FIG.'s 4A** through **4D**, the frame **15** consists of an elongate frame panel **100**, having a central frame panel **101**, with top and bottom edges, **102** and **103**,

left and right side edges, **104** and **105**, and inside and outside surfaces, **106** and **107**. A pair of opposite, left and right, elongate side panels, **110** and **111**, are attached to the central frame panel **101** by attaching the left side panel's top end **112** adjacent to the central panel's top and left side edges, **102** and **104**, respectively, and attaching the left side panel's bottom end **113** adjacent to the central panel's bottom and left side edges, **103** and **104**, respectively, thereby forming a left side panel opening **116**. Similarly, the right side panel's top end **114** is attached adjacent to the central panel's top and right side edges, **102** and **105**, respectively, and the right side panel's bottom end **115** is attached adjacent to the central panel's bottom and right side edges, **103** and **105**, respectively, thereby forming a right side panel opening **117**. Each side panel has a pair of opposite, left and right, integral panel arms, **118** and **119**, which are joined at a pair of, left and right, opposite panel arm distal ends, **120** and **121**, respectively, thereby forming a bottom panel **122**. The bottom panel **122** is positioned below the bottom edge **103** of the central panel **101**, thereby forming a central panel opening **123**. The side panels, **110** and **111**, are attached to the central panel **101**, and the panel arm distal ends, **137** and **121**, are joined such that the frame panel **100** forms a concave shape. An acceptable material for the central frame panel **101** is polycarbonate, having a thickness of approximately 2.0 mm, and an acceptable material for the side panels, **110** and **111**, is compressed polypropylene fiber board, having a thickness of approximately 1.6 mm. A pair of opposite, left and right, elongate tubular side members, **125** and **126**, are attached to the outside surfaces of the left and right side panels, **110** and **111**, respectively, and an elongate pipe bottom member **130**, having a solid core, is attached to the outside surface of the bottom panel **122**. The tubular side members, **125** and **126**, and the pipe bottom member **130** contribute both to maintaining the concave shape of the frame panel **100** and to the overall strength of the panel **100**. An acceptable material for the tubular side members, **125** and **126**, is aluminum alloy tubing having outside and inside diameters of 0.35 inches (8.9 mm) and 0.29 inches (7.4 mm), respectively, and an acceptable material for the pipe bottom member **130** is a thermoplastic material having a diameter of 5/16 of an inch (7.9 mm).

[0050] Another aspect of the load carrying system **5** is that the frame **15** is slideably attached to the shoulder harness assembly **20** such that the shoulder harness assembly

20 can be raised or lowered in relation to the frame **15,** and the height of the shoulder harness assembly **20** can be adjusted while the shoulder harness assembly **20** is being worn by a wearer. As shown in **FIG.'s 2D**, **4A** and **4B**, the central frame panel **101** is provided with a vertical slot **131** which is positioned at the midline of the panel **101** and recessed within the outside surface of the panel **101**. A pair of, left and right, vertical tabs, **132** and **133**, integral with the central panel **101**, are positioned adjacent to and below the slot **131**, with each tab having a rectangular opening **134** through the tab. The vertical slot **131** contains a frame sliding assembly **135** consisting of a rectangular shaped sliding member **136** which is slideably disposed within the recessed portion of the vertical slot **131**, said sliding member **136** having an elongate opening **137** and an integral horizontal member **138** extending across the elongate opening **137**. The integral horizontal member **138** has a pair of opposite, left and right, ends, **139** and **140**, with each end containing a vertical bore **141** (not shown). A hook-shaped member **143** is attached to the outside surface **37** of the shoulder harness panel's back panel **35** and is located at the midline of the back panel **35**. The shoulder harness assembly **20** is adjustably attached to the frame **15** by attaching the hook-shaped member **143** to the frame sliding assembly **135**, which is accomplished by passing the hook-shaped member **143** successively through the central frame panel's vertical slot **134** and the sliding member's elongate opening **134**, and releasably engaging the hook-shaped member **143** with the sliding member's horizontal member **138**. A looped portion of a shoulder harness adjustment cord **144** is disposed successively through: a clamping mechanism **145**; a right stop member **146** attached to a right stabilizing member arm **156** (described below); and a hole **148** through the central frame panel **101**, located adjacent to the central frame panel's top edge **102** and the right side edge **105**. A non-looped portion of the cord **144** is disposed successively through: the rectangular opening **134** through the right tab **133**; the bore **141** through the right end **140** of the horizontal member **138**; the bore**141** through the left end **139** of the horizontal member **138**; the rectangular opening **134** through the left tab **132**; a hole **149** through the central frame panel **101**, located adjacent to the central frame panel's top edge **102** and left side edge **104**. The end of the looped portion of the adjustment cord **144** extends

out of the clamping mechanism **145** and the end of the non-looped portion of the cord **144** is attached to a left stabilizing member arm **155** (described below).

[0051] A wearer adjusts the height of shoulder harness assembly **20** relative to the frame **15** by depressing a flange **147** extending out of the clasping mechanism **145,** which allows the cord **135** to slide freely through the mechanism **145**, and as a result, allows the shoulder harness assembly to be either raised or lowered. When the desired position is attained, the clasping mechanism **145** is positioned adjacent to the stop mechanism **146** and the flange **147** is released, causing the clamping mechanism **145** to clamp onto the cord **144** and maintain the position of the shoulder mechanism **20** relative to the frame **15. FIG. 4A** shows the shoulder harness assembly **20** in a high position relative to the frame **15**, with the end of the looped portion of the cord **144** adjacent to the left stop member **146**, and **FIG. 4B** shows the shoulder harness assembly **20** in a low position relative to the frame **15**, with the end of the looped portion of the cord **144** pulled away from the left stop member **146** in the direction of the "arrow". The pictorial diagram presented in **FIG. 4C** shows the shoulder harness assembly **20** in the low position relative to the frame **15**, and the "arrow" in **FIG.4C** illustrates the direction the shoulder harness assembly **20** moves when it is raised to the high position, as shown in **FIG. 4D**. Another feature of the frame attachment is that the shoulder harness assembly **20** can be easily removed from the frame **15**, which facilitates the assembly of the shoulder harness assembly **20** into a preferred curved shape. Removing the shoulder harness **20** from the frame **15** is accomplished by simply disengaging the hook-shaped member **143** from the frame sliding assembly **135**, which allow the shoulder harness assembly **20** to be separated from the frame **15.**

[0052] The frame **15** is further provided with a pack attachment strap **124**, which is positioned adjacent to the top edge **102** of the frame's central panel **101**. The strap **124** extends circumferentially around the panel **101** and is fastened tightly against the panel's outside surface **107** by passing one end of the strap through a buckle loop attached to the strap's other end, and a first hook and loop coupling material, attached to the inside surface of the strap **124**, is mated to a second hook and loop coupling material, attached to the outside surface of the strap **124.** The pack **10** is provided with a semi-rigid pack flange (not shown) which is adjacent to the top and back side the pack

10 and extends downwardly from the top of the pack **10**. The pack **10** is attached to frame **15** by passing the pack flange between the outside surface **107** of the central panel and the pack attachment strap **124**.

[0053] Although the shoulder harness assembly **20** provides a load carrying system with enhanced stability and is still comfortable, in some applications where heavier loads are being carried, additional stability might be desired. In those instances, another feature of the load carrying system can be used to further stabilize the load. As illustrated in **FIG.'s 5A**, **5B**, **6A**, and **6B**, an elongate pipe stabilizing member **150**, having a solid core, is attached to the inside surface **106** of the central frame panel **101** and generally adjacent to its top edge **102**, and a pair of opposite, left and right, stabilizing member arms **155** and **156**, respectively, extend outwardly and downwardly from the inside surface of the central frame panel **101**. Due to the slight curvature of the central frame panel's top edge **102**, the stabilizing member **150** is similarly curved when it is attached to the central frame panel **101.** The stabilizing member **150** is a relatively stiff member, but it has sufficient flexibility to flex or bend in response to forces which are to be reasonably expected while carrying loads of up to approximately 100 lbs (45.4 kg). An acceptable material is acetal copolymer solid core pipe having a diameter of 3/8 of an inch (9.5 mm) and a flexural strength of between approximately 85 and 100 MPa.

[0054] The stabilizing member **150** is adjustably attached to the shoulder harness assembly **20** by passing the left stabilizing member arm **155** through a friction socket **160** attached to the outside surface **43** of the left side yoke panel **40** and passing the right stabilizing member arm **156** through another friction socket **161** attached to the outside surface **43** of the right side yoke panel **41**. Each of the stabilizing member arms, **155** and **156**, has a series of circular groves **162**, which extend axially along the length of the respective stabilizing member arm, and each friction socket, **160** and **161**, has an internal engagement mechanism which is activated by the operation of a pin **163** extending out of the socket. When the pins are depressed the stabilizing member ends can freely slide through the sockets, and when the pins are released the engagement mechanisms within each friction socket engage the grooves along the stabilizing member arms, preventing further movement of the stabilizing members. By successively depressing each pin and either pulling or pushing on the respective

stabilizing member arm, the wearer is able to adjust both the distance between the shoulder harness assembly **20** and the frame **15** and the curvature of the stabilizing member **150**. As specifically illustrated in **FIG. 6A**, when stabilizing member arms, **155** and **156**, are pulled in the direction of the "arrow" through friction sockets, **160** and **161**, the distance between the outside surface **37** of shoulder harness assembly's back panel **35** and the frame **15** is reduced, which enhances the stability of the load by bringing the load closer to the wearer's back. At the same time, the distance between the inside surface **50e** of the assembly's back pad layer **50c** and the inside surface **55e** of the pair of yoke pad layers **55c** decreases, which brings the shoulder harness assembly **20** into tighter and closer contact with the wearer's chest, shoulders and back, giving the wearer even more control over the load. In this regard, maximum stability over the load is achieved by pulling the stabilizing member arms, **155** and **156**, through the friction sockets, **160** and **161**, as far as possible. The enhanced stability increases the effectiveness of the wearer's control over the load by further ensuring that the wearer's reactions to unexpected movements of the load are efficiently transferred from the shoulder harness assembly **20** to the frame **15** and then to the load. Although this configuration certainly provides the most stability, some wearer's may find that they would prefer a more comfortable experience. In that case, as shown in **FIG. 6B**, the wearer can adjust the configuration of shoulder harness assembly **20** and its proximity to the frame **15** by pushing the stabilizing member ends through the friction sockets in the direction of the "arrow", which increases the distance between the shoulder harness assembly and the frame and loosens the contact between the shoulder harness assembly 20 and the wearer's body.

[0055] In addition to using the stabilizing member **150** to adjust the configuration and position of the shoulder harness assembly, the fact that the stabilizing member **150** resists bending further contributes to the stability of the load and represents a significant improvement over conventional tension straps. Conventional load carrying systems typically attempt to stabilize the load, in part, by utilizing fabric tension straps, extending between the shoulder straps and the frame. When the straps are tensioned they resist the load's rearward tipping motion and partially resist side-to-side swaying motions. However, since the straps have no intrinsic stiffness, the swaying motions are resisted

only by fully tensing the straps, which pulls the frame closer to the wearer's back. The strap's lack of stiffness also prevents them from resisting any forward tipping motions. The stabilizing member **150** of the load carrying system **5**, on the other hand, resists all of these unwanted motions because the member **150** has sufficient stiffness to substantially retain its shape under load. The stabilizing member **150** instantly and positively transfers the wearer's natural, reactive movements, made in an attempt to counteract tipping or swaying forces caused by the load.

[0056] In another embodiment of the load carrying system **5**, as shown in **FIG.'s 3D** through **3F**, the shoulder harness assembly **20** is modified slightly by omitting the middle layer and utilizing a harness pad **30a** that has only two (2) layers: an outer layer **65a** and an inner layer **75a**. Otherwise the harness pad components of the two (2) layer embodiment utilize the same harness pad components as the three (3) layer embodiment. The outer layer **65a** and inner layer **75a** of the two (2) layer embodiment have the same shape and physical properties as the outer layer **65** and inner layer **75**, respectively, of the preferred three (3) layer embodiment. And, the selection of foam having a specific compressive strength and thickness is generally dictated by the same considerations that were discussed in connection with the three (3) layer embodiment of the harness pad 30. However, due to the fact that there is no middle layer to provide some additional stiffness to the harness pad, the stiffness must be supplied by the two layers themselves. As a result, although the thickness of the foam used in two (2) layer embodiment is generally the same as the thickness of the foam utilized in the three (3) layer embodiment, the preferred compressive strength of the foam used in the two (2) layer embodiment is generally greater than the compressive strength of the foam utilized in the three (3) layer embodiment.

[0057] Specifically, for loads of up to approximately five (5) lbs (2.3 kg) the preferred thickness of the inner layer **75a** for the two (2) layer embodiment is between approximately 1/8 and 3/4 of an inch, or approximately 3.2 and 19.0 mm, and the preferred compressive strength of the foam is between approximately four (4) psi (0.28 kg/cm^2) and seven (7) psi (0.49 kg/cm^2); and for loads between approximately five (5) lbs (2.3 kg) and twenty (20) lbs (9.1 kg) the preferred thickness of the inner layer **75a** is between approximately 3/16 and 3/4 of an inch, or approximately 4.7 and 19.0 mm,

and the preferred compressive strength of the foam is between approximately five (5) psi (0.35 kg/cm²) and eight (8) psi (0.56 kg/cm²). An example of acceptable foam for the inner layer **75a** is Evazote® EV 30 for loads of up to twenty (20) lbs (9.1 kg). With respect to the outer layer **65a** for the two (2) layer embodiment, for loads of up to approximately twenty (20) lbs (9.1 kg) the preferred thickness of the outer layer **65a** is between approximately 1/8 and 1/2 of an inch, or approximately 3.2 and 12.7 mm, and the preferred compressive strength of the foam is between approximately seven (7) psi (0.49 kg/cm²) and eighty-six (86) psi (6.02 kg/cm²). An example of acceptable foam for the outer layer **65a** is Evazote® LD 45.

[0058] The harness pad outer layer **65a** of the two (2) layer embodiment also contains the same v-shaped groove pattern, including the width, depth and spacing of the grooves, the same pattern of pad segments between the grooves, and the same coupling materials of the hook and loop system as in the harness pad **30** of three (3) layer embodiment. The two (2) layer embodiment also uses the same harness panel **25** that is utilized in the three (3) layer embodiment, and the harness pad **30a** and harness panel **25** are assembled and attached to the frame **15** in the same manner as the harness pad **30** and the harness panel **25**. Further, the two (2) layer embodiment has the same advantages over conventional load carrying systems as the three (3) layer embodiment.

[0059] Another feature of the load carrying system **5** includes a waist belt assembly **200**, which is illustrated with reference to the following figures: the perspective drawing of **FIG. 2A** illustrating a waist belt assembly **200** attached to the frame **15**; the perspective drawing of **FIG. 7A** illustrating the belt assembly **200** removed from the frame **15**; the perspective drawings of **FIG.'s 7B** and **7C** illustrating the belt assembly **200** in a disassembled condition; the exploded view of **FIG. 7D** illustrating the three (3) component parts of the belt pad **205**; and the pictorial representations of **FIG.'s 8A** through **8C** presenting a partial cross-sectional view of the belt assembly **200**. Specifically referring to **FIG.'s 7A** through **7D**, the waist belt assembly **200** consists of a belt panel **205** and a belt pad **210**. The belt panel **205** consists of an integral lumbar panel **215**, having inside and outside surfaces, **216** and **217**, and a pair of integral, left and right, hip panels, **220** and **221**, with each hip panel having inside and outside

surfaces, **222** and **223**, and the pair of hip panels, **220** and **221,** disposed on opposite sides of and extending outwardly from the lumbar panel **215**, and terminating at a pair of hip panel distal ends **225**. And, as shown in **FIG.'s 7B, 7C**, and **8A** through **8C**, a first coupling material **275** of a hook and loop system is attached to the inside surface **216** of the lumbar panel **205** and to the inside surface **222** of the pair of hip panels **220** and **221**. Preferably, the belt panel **205** has the physical properties of being relatively stiff, but also flexible and resilient. An acceptable material for the panel **205** is high density polyethylene, having a thickness of approximately one-sixteenth (1/16) of an inch or approximately 1.6 mm.

[0060] The belt pad **210** consists of an integral lumbar pad **230** and a pair of integral hip pads **235**, with the pair of hip pads **235** disposed on opposite sides of and extending outwardly from the lumbar pad **230** and terminating at a pair of hip pad distal ends **240.** And, as further illustrated in **FIG.'s 7D**, and **8A** through **8C**, the belt pad **210** is a laminated component consisting of three (3) integral and contiguous layers: an outer belt pad layer **245** having an outside surface **246**, a middle belt pad layer **250**, and an inner belt pad layer **255**, having an inside surface **256. FIG. 7D** is an exploded view of the belt pad **210**, illustrating the belt pad layers **245**, **250**, and **255**, and the cross sectional views of **FIG.'s 8A** through **8C** further illustrate the belt pad **210** and integral and contiguous layers **245**, **250**, and **255.** Each of the belt pad layers, **245**, **250**, and **255**, consists of an integral lumbar pad layer **230a**, **230b**, and **230c**, respectively, and a pair of integral hip pad layers **235a**, **235b**, and **235c**, respectively, with the pair of hip pad layers **235a**, **235b**, and **235c** disposed on opposite sides of and extending outwardly from the lumbar pad layers **230a**, **230b**, and **230c**, respectively, and terminating at a pair of hip pad distal ends **240a**, **240b**, **and 240c,** respectively. Lumbar pad layer **230a** has an outside surface **230d** and the pair of hip pads layers **235a** has an outside surface **235d**.

[0061] The outer belt pad layer **245** and the inner belt pad layer **255** have the same general physical properties as those of the inner and outer harness pad layers in that the inner and outer hip pad layers, **245** and **255**, have the physical properties of exhibiting only minimal stiffness and of being flexible, resilient and compressible, and preferably consist of closed cell foam made from olefin polymers or blends of olefin

polymers. Further, as in the harness pad foam layers, the preferred compressive strength and thickness of the belt pad foam layers are generally dependent upon the weight of the load being carried by the wearer. For lighter loads, which are typical of the loads carried in a small daypack, it is preferable to use foam for the inner belt pad layer **255** which has a relatively low compressive strength, because foam which is more compressible is generally more comfortable under load. However, using foam with a low compressive strength requires that the foam be thick enough in order to ensure that the foam's full range of compression can be utilized. For heavier loads, which are typical of the loads carried in a large expedition backpack, the compressive strength of the foam for the inner belt pad layer **255** can be approximately the same as that for carrying lighter loads, but the thickness of the foam can be somewhat greater in order to ensure that the heavier loads do not subject the foam to pressure in excess of its compressive limit. Concerning the foam for the outer belt pad layer **245,** its preferred compressive strength and thickness are not as dependent upon the weight of the load, as is the case for the inner belt pad layer **255**, because the outer layer **245** is not in contact with the wearer's body. As a result, for most load weights the preferred compressive strength of the foam for the outer layer **245** can generally range from foam having a relatively low compressive strength, similar to the compressive strength of the foam for the inner layer **255,** up to foam having a compressive strength that is characterized as being almost incompressible, because it not necessary that the outer layer compress in order to ensure that the backpack is comfortable on the wearer's waist and hips. With respect to the thickness of the foam for the outer layer **245,** the thickness for lighter loads can be similar to the thickness of the foam for the inner layer **255**, but for heavier loads the thickness of the outer layer **245** can be less than the thickness of the inner layer **255**, again due to the fact that the outer layer **245** of foam is not in contact with the wearer's body.

[0062] More specifically, it is preferable that for loads of up to approximately five (5) lbs (2.3 kg) the thickness of the inner belt pad layer **255** is between approximately 1/8 and 3/4 of an inch, or approximately 3.2 and 19.0 mm, and the foam has a compressive strength of between approximately three (3) psi (0.21 kg/cm^2) and five (5) psi (0.35 kg/cm^2); for loads between approximately five (5) lbs (2.3 kg) and fifty (50) lbs (22.7),

the preferred thickness of the inner belt pad layer **255** is between approximately 3/16 of an inch and 1 inch, or approximately 4.7 and 25.4 mm, and the preferred compressive strength of the foam is between approximately four (4) psi (0.28 kg/cm^2) and seven (7) psi (0.49 kg/cm^2); and for loads between approximately fifty (50) lbs (22.7 kg) and approximately one-hundred (100) lbs. (45.4 kg), the preferred thickness of the inner belt pad layer **255** is between approximately 1/4 of and inch and 1 1/2 inches, or approximately 6.4 and 38.1 mm, and the preferred compressive strength of the foam is between approximately five (5) psi (0.35 kg/cm^2) and seven (7) psi (0.49 kg/cm^2), (all compressive strength values determined in accordance with ASTM International, Designation: D 3575-91). Examples of acceptable foams for the inner belt pad layer **255** are: Evazote® EV 30 for loads of up to fifty (50) lbs (22.7 kg), and Evazote® EV 50 for loads between fifty (50) lbs (22.7 kg) and one-hundred (100) lbs (45.4 kg). With respect to the specifications for the outer layer **245**, it is preferable that for loads of up to approximately five (5) lbs (2.3 kg) the thickness of the outer layer **245** is between approximately 1/8 and 1/2 of an inch, or approximately 3.2 and 12.7 mm, and the foam has a compressive strength of between approximately six (6) psi (0.42 kg/cm^2) and twelve (12) psi (0.84 kg/cm^2); for loads between approximately five (5) lbs (2.3 kg) and fifty (50) lbs (22.7 kg) the preferred thickness of the outer layer **245** is between approximately 3/16 and 3/4 of an inch, or approximately 4.7 and 19.0 mm, and the compressive strength of the foam is between approximately seven (7) lbs (0.49 kg/cm^2) and seventeen (17) psi (1.19 kg/cm^2); and for loads between approximately fifty (50) lbs (22.7 kg) and one-hundred (100) lbs (45.4 kg)., the preferred thickness of the outer layer **245** is between approximately 3/16 and 7/8 of an inch, or approximately 4.7 and 22.2 mm, and the compressive strength of the foam is between twelve (12) psi (0.84 kg/cm^2) and twenty (20) psi (1.40 kg/cm^2), (again, all compressive strength values determined in accordance with ASTM International, Designation: D 3575-91). Examples of acceptable foams for the outer layer **245** are: Plastazote® LD 33 for loads of up to twenty (20) lbs (9.1 kg); and Plastazote® LD 45 for loads between twenty (20) lbs (9.1 kg) and one-hundred (100) lbs (45.4 kg).

[0063] Preferably, the middle belt pad layer **250** has a thickness which is substantially less than the thickness of the inner and outer belt pad layers, **245** and **2555**, and

although the middle belt pad layer **250** is flexible and resilient, it also has the physical properties of being relatively stiff and non-stretchable as compared to the belt pad layers, **65** and **75**. An acceptable material for the middle belt pad layer **250** is high density polyethylene, having a thickness of approximately 1/16 of an inch, or approximately 1.6 mm. This layer provides some stiffness to the belt pad **210** without compromising the flexibility and compressibility of the outer layer **245** and inner layer **255**.

[0064] Although specific types of materials and material thicknesses for the belt panel **205** and the belt pad **210** have been described in connection with the preferred embodiment, it will be apparent to those skilled in the art that other types of materials and material thicknesses can also be used.

[0065] Further, as shown in **FIG.'s 7B, 7C**, and **7D**, the outer belt pad layer **245** has a plurality of elongate hip pad grooves **260**, which form a hip pad groove pattern within the outer layer's outside surface **246,** and more specifically, the hip pad grooves **260** are formed within the outside surface **235d** of the pair of hip pad layers **235a**. Each of the hip pad grooves **260** extends widthwise across its respective the hip pad layer and is preferably spaced between approximately 1/2 and 1 1/2 inches, or approximately 12.7 and 38.1 mm, apart. Preferably, each hip pad groove **260** has a depth which is between approximately 50% and 95% of the thickness of the pair of hip pad layers **235a** and each groove **260** has a width at the outside surface of its respective hip pad layer which is approximately equal to the depth of the groove. Forming the hip pad grooves in this manner separates the outside surfaces of the pair of hip pad layers **235a** into a pattern of hip pad surface segments **280**, disposed between the hip pad grooves **260**. Similarly, the outer belt pad layer **245** also has a plurality of elongate lumbar pad grooves **265**, which form a lumbar pad groove pattern within the outer layer's outside surface **246,** and more specifically, the lumbar pad grooves **265** are formed within the outside surface **230d** of the lumbar pad layer **230a**. Each of the lumbar pad grooves **265** extends widthwise across the lumbar pad layer and is preferably spaced between approximately 1/2 and 1 1/2 inches, approximately 12.7 and 38.1 mm, apart. Again, it is preferable that each lumbar pad groove **265** has a depth which is between approximately 50% and 95% of the thickness of the lumbar pad layer **230a** and each

groove **265** has a width at the outside surface of the lumbar pad layer which is approximately equal to the depth of the groove. Forming the lumbar pad grooves **265** in this manner separates the outside surface of the lumbar pad layer **230a** into a pattern of lumbar pad surface segments **281**, disposed between the lumbar pad grooves **265**. In a preferred embodiment, the elongate hip pad grooves and lumbar pad grooves, **260** and **265**, as best illustrated in **Fig. 8A,** are "v-shaped" in that the grooves have a cross-sectional shape in the form of a "V" and each groove has an approximately uniform width (**w**) as measured across the "V" at the outside surface of its respective pad. In addition to v-shaped grooves, other types of elongate openings having a cross-section in the form of a "U" or slit may be used as well. And, as shown in **FIG.'s 7B** through **7D**, and **8A** through **8C**, a second coupling material **276** of a hook and loop system is attached to the plurality of hip pad surface segments **280** and to the plurality of lumbar pad surface segments **281**.

[0066] In the preferred embodiment, as illustrated in **FIG.'s 9A, 9B, 10A,** and **10B**, the belt assembly **200** is pivotally connected to the frame **15**. This pivotal connection is provided by attaching a bottom portion of the frame's left side tubular side member **105** to a left pivot plate **301**, pivotally attached at pivot point **303** to the outside surface **223** of the left side hip panel **220**, and similarly attaching a bottom portion of the right side tubular side member **106** to a right pivot plate **302**, pivotally attached at pivot point **304** to the outside surface **223** of the right side hip panel **221**. Each of the pivot plates, **301** and **302** has an elongate slot, **310** and **320**, respectively, which is positioned within its respective plate such that when the frame is in an approximately vertical position and the waist belt assembly is in an approximately horizontal position, each slot is below its respective pivot point. The frame **15** is also provided with an adjustable pivot control feature, which controls how far the frame **15** can pivot or tilt in a rearward direction in response to a rearward motion of the load. Referring to **FIG. 9A**, this feature is implemented by attaching an adjustable lumbar strap **305** to the frame **15** and to the outside surface **217** of the lumbar panel **215**. More specifically, the lumbar strap **305**, having inside and outside surfaces, **306** and **307**, and left and right ends **308** and **309**, is disposed successively through: the slot **310** within the left pivot plate **301,** a loop **315** attached to the outside surface **217** of the lumbar panel **215**, and another slot **320** within

the right pivot plate **302**. The lumbar strap's left and right ends, **308** and **309**, extend out of slots **310** and **320**, respectively. Left side and right side first coupling materials **325** and **326**, of a hook and loop system are attached to the outside surface **307** of the lumbar strap **305**, with the left coupling material **325** located adjacent to the lumbar strap's left end **308** and the right coupling material **326** adjacent to the lumbar strap's right end **309**. Left side and right side second coupling materials **330** and **331**, of the hook and loop system are also attached to the outside surface **307** of the lumbar strap **305**, with the left coupling material **330** located generally between the slot **310** within the left pivot plate **301** and the loop **315** attached to the lumbar panel's outside surface **217**, and the right coupling material **331** located generally between the slot **320** within the right pivot plate **302** and the loop **315**. In operation a wearer of the load carrying system **5** is able to limit the amount of the frame's reward tilt by mating the hook and loop system's left side first coupling material **325** to the left side second coupling material **330** and similarly mating the right side first coupling material **326** to the right side second coupling material **331**. Mating the hook and loop materials in this manner has the effect of fixing the length of the lumbar strap **305** between pivot plate slots, **310** and **320**, which in turn acts to restrain the rearward tilt of the frame **15**. The amount of rearward tilt is then adjusted simply by adjusting the length of the lumbar strap **305** between the slots, **310** and **320**, lengthening the lumbar strap increases the reward tilt and shortening the lumbar strap reduces it.

[0067] The pictorial diagram presented in **FIG. 10** further illustrates the adjustable, frame tilting feature. The figure presents a left side view of the frame **15** (drawn in a solid line), illustrating the frame **15** pivoting around the pivot points, **303** and **304** and in a position with the least amount of reward tilt, and illustrating the frame **15** (drawn in dashed lines) again pivoting around the pivot points, **303** and **304,** and in a position with the maximum amount of reward tilt. Between these two extreme frame positions, the wearer can control the desired amount frame tilt by using the strap **305** as described above.

[0068] The wearer forms the belt assembly **200** into a desired or preferred curved shape by positioning the inner belt pad layer **255** adjacent to the wearer's hips and waist, and bending the belt pad **210** around the wearer's hips and waist by bringing one

of the hip pad distal ends **240** towards the other distal end **240**. As illustrated in FIG. **8B**, bending the belt pad **210** in this manner causes the hip pad grooves **260** to widen. And, as illustrated in **FIG. 8C**, the belt assembly's preferred shape is then substantially held in position by positioning the belt panel **205** adjacent to the belt pad **210** and mating the first coupling material of the hook and loop system **275** attached to the inside surface of the belt panel **205** to the second coupling material of the hook and loop system **276** attached to the plurality of hip pad surface segments **280** and to the plurality of lumbar pad surface segments **281**. Assembling the belt panel **205** and belt pad **210** in this fashion creates belt assembly **200** having sufficient stiffness to hold its shape under load. Once the wearer has assembled the belt panel **205** and belt pad **210** into a preferred curved shape, the wearer uses a conventional buckle mechanism **270**, attached to the hip panel distal ends **220** and **221**, to further fasten the belt assembly **200** around the wearer's hips and waist. The belt assembly **200** is a substantial improvement over conventional backpack belts because the stiffness of the belt assembly causes the weight of the load to be distributed around the entire outside surface of the belt. Distributing the weight of the load in this fashion eliminates the pressure points, where the frame is connected to the belt, which is a characteristic of conventional load carrying systems made of flexible and compressible pads and fabric. At the same time, the inside surface of the belt assembly **200**, in contact with the wearer, is compressible, ensuring that the belt is comfortable.

[0069] In another embodiment of the load carrying system **5**, as shown in FIG.'s **8D** through **8F**, the waist belt assembly **200** is modified slightly by omitting the middle layer **250** and utilizing a belt pad **210a** that has only two (2) layers: an outer layer **245a** and an inner layer **255a**. Otherwise the belt pad components of the two (2) layer embodiment utilize the same belt pad components as the three (3) layer embodiment. The outer layer **245a** and inner layer **255a**, as in the three (3) layer embodiment, consist of flexible and compressible closed cell foam made from olefin polymers. And, the selection of foam having a specific compressive strength and thickness is generally dictated by the same considerations that were discussed in connection with the three (3) layer embodiment of the belt pad **210**. However, due to the fact that the middle layer has been omitted, the extra stiffness supplied by the middle layer in the three layer

embodiment must be supplied by the two layers themselves. As a result, the preferred compressive strength of the foam used in the two (2) layer embodiment is generally greater than the compressive strength of the foam utilized in the three (3) layer embodiment, and the thickness of the foam used in two (2) layer embodiment is generally greater than the thickness of the foam utilized in the three (3) layer embodiment.

[0070] Specifically, for loads of up to approximately five (5) lbs (2.3 kg) the preferred thickness of the inner layer **255a** for the two (2) layer embodiment is between approximately 1/8 and 3/4 of an inch, or approximately 3.2 and 19.0 mm, and the preferred compressive strength of the foam is between approximately four (4) psi (0.28 kg/cm^2) and seven (7) psi (0.49 kg/cm^2); and for loads between five (5) lbs (2.3 kg) and twenty (20) lbs (9.1 kg) the preferred thickness of the inner layer **255a** is between approximately 3/16 of an inch and 1 inch, or approximately 4.7 and 25.4 mm, and the preferred compressive strength of the foam is between approximately five (5) psi (0.35 kg/cm^2) and eight (8) psi (0.56 kg/cm^2). An Example of acceptable foam for the inner layer 75a is Evazote® EV 30 for loads of up to twenty (20) lbs (9.1 kg). With respect to the outer layer **245a** for the two (2) layer embodiment, for loads of up to approximately five (5) lbs (2.3 kg) the preferred thickness of the outer layer **245a** is between approximately 1/8 and 3/4 of an inch, or approximately 3.2 and 19.0 mm, and the preferred compressive strength of the foam is between approximately seven (7) psi (0.49 kg/cm^2) and eighty-six (86) psi (6.02 kg/cm^2); and for loads of between approximately five (5) lbs (2.3 kg) and twenty (20) lbs (9.1 kg) the preferred thickness of the outer layer **245a** is between approximately 3/16 and 3/4 of an inch, or approximately 4.7 and 19.0 mm, and the preferred compressive strength of the foam is between approximately nine (9) lbs (0.63 kg/cm^2) and eighty-six (86) psi (6.02 kg/cm^2). Examples of acceptable foams for the outer layer **245a** are: Plastazote® LD 24 for loads of up to five (5) lbs (2.3 kg), and Plastazote® LD 45 for loads between five (5) lbs (2.3 kg) and twenty (20) lbs (9.1 kg).

[0071] The belt pad outer layer **245a** of the two (2) layer embodiment contains the same v-shaped groove pattern, including the width, depth and spacing of the grooves, the same pattern of pad segments between the grooves, and the same coupling

materials of the hook and loop system as in the belt pad **210** of three (3) layer embodiment. The two (2) layer embodiment also uses the same belt panel **205** that is utilized in the three (3) layer embodiment, and the belt pad **210a** and belt panel **205** are assembled and attached to the frame **15** in the same manner as the belt pad **210** and the belt panel **215**. Further, the two (2) layer embodiment has the same advantages over convention load carrying systems as the three (3) layer embodiment.

[0072] Although the load carrying system has been described in its preferred embodiment and in certain other embodiments, it will be recognized by those skilled in the art that other embodiments and features may be provided without departing from the underlying principals of those embodiments. The scope of the invention is defined only by the appended claims.

CLAIMS

I claim:

1. A load carrying system for carrying a load on a wearer's body, comprising:

a frame configured to support the load;

a shoulder harness assembly, comprising:

a flexible harness panel having an inside and outside surface, said outside surface attached to the frame;

a harness pad having an outer layer and an inner layer, which are flexible, resilient, compressible, and stretchable and a middle layer, which is flexible and resilient, said outer layer having an outside surface;

a plurality of elongate grooves disposed within the outside surface of the harness pad's outer layer;

forming the harness pad and the outside surface of the harness pad's outer layer into a curved shape; and

coupling the inside surface of the harness panel to outside surface of the curved harness pad's outer layer, whereby the coupling of the two surfaces substantially retains the curved shape of the harness pad;

a waist belt assembly, comprising:

a flexible belt panel having an inside and outside surface, said outside surface attached to the frame;

a belt pad having an outer layer and an inner layer, which are flexible, resilient, compressible and stretchable, and a middle layer, which is flexible and resilient, said outer layer having an outside surface;

a plurality of elongate grooves disposed within the outside surface of the belt pad's outer layer;

forming the belt pad and the outside surface of the belt pad's outer layer into a curved shape; and

coupling the inside surface of the belt panel to outside surface of the curved belt pad's outer layer, whereby the coupling of the two surfaces substantially retains the curved shape of the belt pad.

2. The load carrying system of Claim 1 in which inside surface of the harness panel is releasably coupled to the outside surface of the harness pad's outer layer.

3. The load carrying system of Claim 2 in which the inside surface of the harness panel is releasably coupled to the outside surface of the harness pad's outer layer by providing a hook and loop system in which a first coupling material is attached to the inside surface of the harness panel and a second coupling material is attached to the outside surface of the harness pad's outer layer and disposed between the grooves.

4. The load carrying system of Claim 1 in which inside surface of the belt panel is releasably coupled to the outside surface of the belt pad's outer layer.

5. The load carrying system of Claim 4 in which the inside surface of the belt panel is releasably coupled to the outside surface of the belt pad's outer layer by providing a hook and loop system in which a first coupling material is attached to the inside surface of the belt panel and a second coupling material is attached to the outside surface of the belt pad's outer layer and disposed between the grooves.

6. The load carrying system of Claim 1 in which the harness panel and belt panel are made of high density polyethylene.

7. The load carrying system of Claim 1 in which the harness pad's outer layer and inner layer are made of closed cell foam, and harness pad's middle layer is made of high density polyethylene.

8. The load carrying system of Claim 7 in which the in which the harness pad's outer layer has a thickness of between approximately 3.2 mm and 19 mm and a compressive strength of between approximately 0.49 kg/cm^2 and 1.40 kg/cm^2; the harness pad's inner layer has a thickness of between approximately 3.2 mm and 22.2 mm and a compressive strength of between approximately 0.21 kg/cm^2 and 0.49 kg/cm^2; and the harness pad's middle layer has a thickness of approximately 1.6 mm.

9. The load carrying system of Claim 1 in which the belt pad's outer layer and inner layer are made of closed cell foam, and belt pad's middle layer is made of high density polyethylene.

10. The load carrying system of Claim 9 in which the in which the belt pad's outer layer has a thickness of between approximately 3.2 mm and 22.2 mm and a compressive strength of between approximately 0.42 kg/cm^2 and 1.40 kg/cm^2; the belt pad's inner

layer has a thickness of between approximately 3.2 mm and 38.1 mm and a compressive strength of between approximately 0.21 kg/cm² and 0.49 kg/cm²; and the belt pad's middle layer has a thickness of approximately 1.6 mm.

11. The load carrying system of Claim 1 in which the elongate grooves have a cross-section which is v-shaped.

12. The load carrying system of Claim 1 in which the frame has an elongate, semi-rigid stabilizing member attached to a top end of the frame, said stabilizing member having a pair of left and right stabilizing member arms attached to the outside surface of the harness panel.

13. The load carrying system of claim 12 in which the left and right stabilizing member arms are slideably connected to left and right friction sockets, respectively, with the friction sockets attached to the outside surface of the harness panel.

14. The load carrying system of Claim 12 in which the stabilizing member is made of acetal copolymer solid core pipe.

15. The load carrying system of Claim 1 in which the outside surface of the harness panel is slideably attached to the frame, whereby the shoulder harness assembly can be raised or lowered in relation to the frame.

16. The load carrying system of Claim 1 in which the outside surface of the harness panel is releasably attached to the frame, whereby the harness panel can be removed from the frame.

17. The load carrying system of Claim 1 in which the outside surface of the belt panel is pivotally attached to a bottom portion of the frame, whereby the frame can be tilted forward or rearward in relation to the waist belt assembly.

18. The load carrying system of Claim 17 in which the waist belt assembly further comprises an adjustable strap connected to opposite sides of the belt panel and adjacent to the outside surface of the panel, whereby shortening the strap limits the amount of the frame's potential rearward tilt and lengthening the strap increases the amount of the frames potential rearward tilt.

19. A shoulder harness assembly for a load carrying system, including a frame configured to support a load on a wearer's body, the shoulder harness assembly comprising:

a flexible harness panel having an inside and outside surface, said outside surface adapted to be attached to the frame;

a harness pad having an outer layer and an inner layer, which are flexible, resilient, compressible, and stretchable and a middle layer, which is flexible and resilient, said outer layer having an outside surface;

a plurality of elongate grooves disposed within the outside surface of the harness pad's outer layer;

forming the harness pad and the outside surface of the harness pad's outer layer into a curved shape; and

coupling the inside surface of the harness panel to outside surface of the curved harness pad's outer layer, whereby the coupling of the two surfaces substantially retains the curved shape of the harness pad.

20. The shoulder harness assembly of Claim 19 in which inside surface of the harness panel is releasably coupled to the outside surface of the harness pad's outer layer.

21. The shoulder harness assembly of Claim 20 in which the inside surface of the harness panel is releasably coupled to the outside surface of the harness pad's outer layer by providing a hook and loop system in which a first coupling material is attached to the inside surface of the harness panel and a second coupling material is attached to the outside surface of the harness pad's outer layer and disposed between the grooves.

22. The shoulder harness assembly of Claim 19 in which the harness panel is made of high density polyethylene.

23. The shoulder harness assembly of Claim 19 in which the harness pad's outer layer and inner layer are made of closed cell foam, and harness pad's middle layer is made of high density polyethylene.

24 The shoulder harness assembly of Claim 23 in which the in which the harness pad's outer layer has a thickness of between approximately 3.2 mm and 19 mm and a compressive strength of between approximately 0.49 kg/cm^2 and 1.40 kg/cm^2; the harness pad's inner layer has a thickness of between approximately 3.2 mm and 22.2 mm and a compressive strength of between approximately 0.21 kg/cm^2 and 0.49 kg/cm^2; and the harness pad's middle layer has a thickness of approximately 1.6 mm.

25. The shoulder harness assembly of Claim 19 in which the elongate grooves have a cross-section which is v-shaped.

26. A waist belt assembly for a load carrying system, including a frame configured to support a load on a wearer's body, the waist belt assembly comprising:

a flexible belt panel having an inside and outside surface, said outside surface adapted to be attached to the frame;

a belt pad having an outer layer and an inner layer, which are flexible, resilient, compressible and stretchable, and a middle layer, which is flexible and resilient, said outer layer having an outside surface;

a plurality of elongate grooves disposed within the outside surface of the belt pad's outer layer;

forming the belt pad and the outside surface of the belt pad's outer layer into a curved shape; and

coupling the inside surface of the belt panel to outside surface of the curved belt pad's outer layer, whereby the coupling of the two surfaces substantially retains the curved shape of the belt pad.

27. The waist belt assembly of Claim 26 in which inside surface of the belt panel is releasably coupled to the outside surface of the belt pad's outer layer.

28. The waist belt assembly of Claim 27 in which the inside surface of the belt panel is releasably coupled to the outside surface of the belt pad's outer layer by providing a hook and loop system in which a first coupling material is attached to the inside surface of the belt panel and a second coupling material is attached to the outside surface of the belt pad's outer layer and disposed between the grooves.

29. The waist belt assembly of Claim 26 in which the belt panel is made of high density polyethylene.

30. The waist belt assembly of Claim 26 in which the belt pad's outer layer and inner layer are made of closed cell foam, and belt pad's middle layer is made of high density polyethylene.

31. The waist belt assembly of Claim 30 in which the in which the belt pad's outer layer has a thickness of between approximately 3.2 mm and 22.2 mm and a compressive strength of between approximately 0.42 kg/cm^2 and 1.40 kg/cm^2; the belt pad's inner

layer has a thickness of between approximately 3.2 mm and 38.1 mm and a compressive strength of between approximately 0.21 kg/cm^2 and 0.49 kg/cm^2; and the belt pad's middle layer has a thickness of approximately 1.6 mm.

32. The waist belt assembly of Claim 26 in which the elongate grooves have a cross-section which is v-shaped.

33. A load carrying system for carrying a load on a wearer's body, comprising:

a frame configured to support the load; and

a shoulder harness assembly, comprising:

a flexible harness panel having an inside and outside surface, said outside surface attached to the frame;

a harness pad having an outer layer and an inner layer, which are flexible, resilient, compressible and stretchable, said outer layer having an outside surface;

a plurality of elongate grooves disposed within the outside surface of the harness pad's outer layer;

forming the harness pad and the outside surface of the harness pad's outer layer into a curved shape; and

coupling the inside surface of the harness panel to outside surface of the curved harness pad, whereby the coupling of the two surfaces substantially retains the curved shape of the harness pad;

a waist belt assembly, comprising:

a flexible belt panel having an inside and outside surface, said outside surface attached to the frame;

a belt pad having an outer layer and an inner layer, which are flexible, resilient, compressible and stretchable, said outer layer having an outside surface;

a plurality of elongate grooves disposed within the outside surface of the belt pad's outer layer;

forming the belt pad and the outside surface of the belt pad's outer layer into a curved shape; and

coupling the inside surface of the belt panel to outside surface of the curved belt pad's outer layer, whereby the coupling of the two surfaces substantially retains the curved shape of the belt pad.

34. The load carrying system of Claim 33 in which inside surface of the harness panel is releasably coupled to the outside surface of the harness pad's outer layer.
35. The load carrying system of Claim 34 in which the inside surface of the harness panel is releasably coupled to the outside surface of the harness pad's outer layer by providing a hook and loop system in which a first coupling material is attached to the inside surface of the harness panel and a second coupling material is attached to the outside surface of the harness pad's outer layer and disposed between the grooves.
36. The load carrying system of Claim 33 in which inside surface of the belt panel is releasably coupled to the outside surface of the belt pad's outer layer.
37. The load carrying system of Claim 36 in which the inside surface of the belt panel is releasably coupled to the outside surface of the belt pad's outer layer by providing a hook and loop system in which a first coupling material is attached to the inside surface of the belt panel and a second coupling material is attached to the outside surface of the belt pad's outer layer and disposed between the grooves.
38. The load carrying system of Claim 33 in which the harness panel and belt panel are made of high density polyethylene.
39. The load carrying system of Claim 33 in which the harness pad's outer layer and inner layer are made of closed cell foam.
40. The load carrying system of Claim 39 in which the in which the harness pad's outer layer has a thickness of between approximately 3.2 mm and 12.7 mm and a compressive strength of between approximately 0.49 kg/cm^2 and 6.02 kg/cm^2; the harness pad's inner layer has a thickness of between approximately 3.2 mm and 19 mm and a compressive strength of between approximately 0.28 kg/cm^2 and 0.56 kg/cm^2.
41. The load carrying system of Claim 33 in which the belt pad's outer layer and inner layer are made of closed cell foam.
42. The load carrying system of Claim 41 in which the in which the belt pad's outer layer has a thickness of between approximately 3.2 mm and 19 mm and a compressive strength of between approximately 0.49 kg/cm^2 and 6.02 kg/cm^2; the belt pad's inner layer has a thickness of between approximately 3.2 mm and 25.4 mm and a compressive strength of between approximately 0.28 kg/cm^2 and 0.56 kg/cm^2.

43. The load carrying system of Claim 33 in which the elongate grooves have a cross-section which is v-shaped.

44. A shoulder harness assembly for a load carrying system, including a frame configured to support a load on a wearer's body, the shoulder harness assembly comprising:

a flexible harness panel having an inside and outside surface, said outside surface adapted to be attached to the frame;

a harness pad having an outer layer and an inner layer, which are flexible, resilient, compressible and stretchable, said outer layer having an outside surface;

a plurality of elongate grooves disposed within the outside surface of the harness pad's outer layer;

forming the harness pad and the outside surface of the harness pad's outer layer into a curved shape;

coupling the inside surface of the harness panel to outside surface of the curved harness pad's outer layer, whereby the coupling of the two surfaces substantially retains the curved shape of the harness pad.

45. The shoulder harness assembly of Claim 44 in which inside surface of the harness panel is releasably coupled to the outside surface of the harness pad's outer layer.

46. The shoulder harness assembly of Claim 45 in which the inside surface of the harness panel is releasably coupled to the outside surface of the harness pad's outer layer by providing a hook and loop system in which a first coupling material is attached to the inside surface of the harness panel and a second coupling material is attached to the outside surface of the harness pad's outer layer and disposed between the grooves

47. The shoulder harness assembly of Claim 44 in which the harness panel is made of high density polyethylene.

48. The shoulder harness assembly of Claim 44 in which the harness pad's outer layer and inner layer are made of closed cell foam.

49. The shoulder harness assembly of Claim 48 in which the in which the harness pad's outer layer has a thickness of between approximately 3.2 mm and 12.7 mm and a compressive strength of between approximately 0.49 kg/cm^2 and 6.02 kg/cm^2; the

harness pad's inner layer has a thickness of between approximately 3.2 mm and 19 mm and a compressive strength of between approximately 0.28 kg/cm² and 0.56 kg/cm².

50. The shoulder harness assembly of Claim 44 in which the elongate grooves have a cross-section which is v-shaped.

51. A waist belt assembly for a load carrying system, including a frame configured to support a load on a wearer's body, the waist belt assembly comprising:

a flexible belt panel having an inside and outside surface, said outside surface adapted to be attached to the frame;

a belt pad having an outer layer and an inner layer, which are flexible, resilient, compressible and stretchable, said outer layer having an outside surface;

a plurality of elongate grooves disposed within the outside surface of the belt pad's outer layer;

forming the belt pad and the outside surface of the belt pad's outer layer into a curved shape; and

coupling the inside surface of the belt panel to outside surface of the curved belt pad's outer layer, whereby the coupling of the two surfaces substantially retains the curved shape of the belt pad.

52. The waist belt assembly of Claim 51 in which inside surface of the belt panel is releasably coupled to the outside surface of the belt pad's outer layer.

53. The waist belt assembly of Claim 52 in which the inside surface of the belt panel is releasably coupled to the outside surface of the belt pad's outer layer by providing a hook and loop system in which a first coupling material is attached to the inside surface of the belt panel and a second coupling material is attached to the outside surface of the belt pad's outer layer and disposed between the grooves.

54. The waist belt assembly of Claim 51 in which the belt panel is made of high density polyethylene.

55. The waist belt assembly of Claim 51 in which the belt pad's outer layer and inner layer are made of closed cell foam.

56. The waist belt assembly of Claim 55 in which the belt pad's outer layer has a thickness of between approximately 3.2 mm and 19 mm and a compressive strength of between approximately 0.49 kg/cm² and 6.02 kg/cm²; the belt pad's inner layer has a

thickness of between approximately 3.2 mm and 25.4 mm and a compressive strength of between approximately 0.28 kg/cm² and 0.56 kg/cm².

57. The waist belt assembly of Claim 51 in which the elongate grooves have a cross-section which is v-shaped.

58. A load carrying system for carrying a load on a wearer's body, comprising:

a frame configured to support the load;

a shoulder harness assembly comprising:

a flexible harness panel having an inside and outside surface, said outside surface attached to the frame;

a flexible, resilient, compressible and stretchable harness pad having an inside and outside surface;

a plurality of elongate grooves disposed within the outside surface of the harness pad;

forming the harness pad and its outside surface into a curved shape; and

coupling the inside surface of the harness panel to outside surface of the curved harness pad, whereby the coupling of the two surfaces substantially retains the curved shape of the harness pad;

a waist belt assembly, comprising:

a flexible belt panel having an inside and outside surface, said outside surface attached to the frame;

a flexible, resilient, compressible and stretchable belt pad having an inside and outside surface;

a plurality of elongate grooves disposed within the outside surface of the belt pad;

forming the belt pad and its outside surface into a curved shape; and

coupling the inside surface of the belt panel to outside surface of the curved belt pad, whereby the coupling of the two surfaces substantially retains the curved shape of the belt pad.

59. The load carrying system of Claim 58 in which inside surface of the harness panel is releasably coupled to the outside surface of the harness pad.

60. The load carrying system of Claim 59 in which the inside surface of the harness panel is releasably coupled to the outside surface of the harness pad by providing a hook and loop system in which a first coupling material is attached to the inside surface of the harness panel and a second coupling material is attached to the outside surface of the harness pad and disposed between the grooves.

61. The load carrying system of Claim 58 in which inside surface of the belt panel is releasably coupled to the outside surface of the belt pad.

62. The load carrying system of Claim 61 in which the inside surface of the belt panel is releasably coupled to the outside surface of the belt pad by providing a hook and loop system in which a first coupling material is attached to the inside surface of the belt panel and a second coupling material is attached to the outside surface of the belt pad and disposed between the grooves.

63. The load carrying system of Claim 58 in which the harness panel and belt panel are made of high density polyethylene.

64. The load carrying system of Claim 58 in which the harness pad and belt pad are made of closed cell foam.

65. The load carrying system of Claim 58 in which the elongate grooves have a cross-section which is v-shaped.

66. A shoulder harness assembly for a load carrying system, including a frame configured to support a load on a wearer's body, the shoulder harness assembly comprising:

a flexible harness panel having an inside and outside surface, said outside surface adapted to be attached to the frame;

a flexible, resilient, compressible and stretchable harness pad having an inside and outside surface;

a plurality of elongate grooves disposed within the outside surface of the harness pad;

forming the harness pad and its outside surface into a curved shape; and

coupling the inside surface of the harness panel to outside surface of the curved harness pad, whereby the coupling of the two surfaces substantially retains the curved shape of the harness pad.

67. The shoulder harness assembly of Claim 66 in which inside surface of the harness panel is releasably coupled to the outside surface of the harness pad.

68. The shoulder harness assembly of Claim 67 in which the inside surface of the harness panel is releasably coupled to the outside surface of the harness pad by providing a hook and loop system in which a first coupling material is attached to the inside surface of the harness panel and a second coupling material is attached to the outside surface of the harness pad and disposed between the grooves.

69. The shoulder harness assembly of Claim 66 in which the harness panel is made of high density polyethylene.

70. The shoulder harness assembly of Claim 66 in which the harness pad is made of closed cell foam.

71. The shoulder harness assembly of Claim 66 in which the elongate grooves have a cross-section which is v-shaped.

72. A waist belt assembly for a load carrying system, including a frame configured to support a load on a wearer's body, the waist belt assembly comprising:

a flexible belt panel having an inside and outside surface, said outside surface adapted to be attached to the frame;

a flexible, resilient, compressible and stretchable belt pad having an inside and outside surface;

a plurality of elongate grooves disposed within the outside surface of the belt pad;

forming the belt pad and its outside surface into a curved shape; and

coupling the inside surface of the belt panel to outside surface of the curved belt pad, whereby the coupling of the two surfaces substantially retains the curved shape of the belt pad.

73. The waist belt assembly of Claim 72 in which inside surface of the belt panel is releasably coupled to the outside surface of the belt pad.

74. The waist belt assembly of Claim 73 in which the inside surface of the belt panel is releasably coupled to the outside surface of the belt pad by providing a hook and loop system in which a first coupling material is attached to the inside surface of the belt

panel and a second coupling material is attached to the outside surface of the belt pad and disposed between the grooves.

75. The waist belt assembly of Claim 72 in which the belt panel is made of high density polyethylene.

76. The waist belt assembly of Claim 72 in which the belt pad is made of closed cell foam.

77. The waist belt assembly of Claim 72 in which the elongate grooves have a cross-section which is v-shaped.

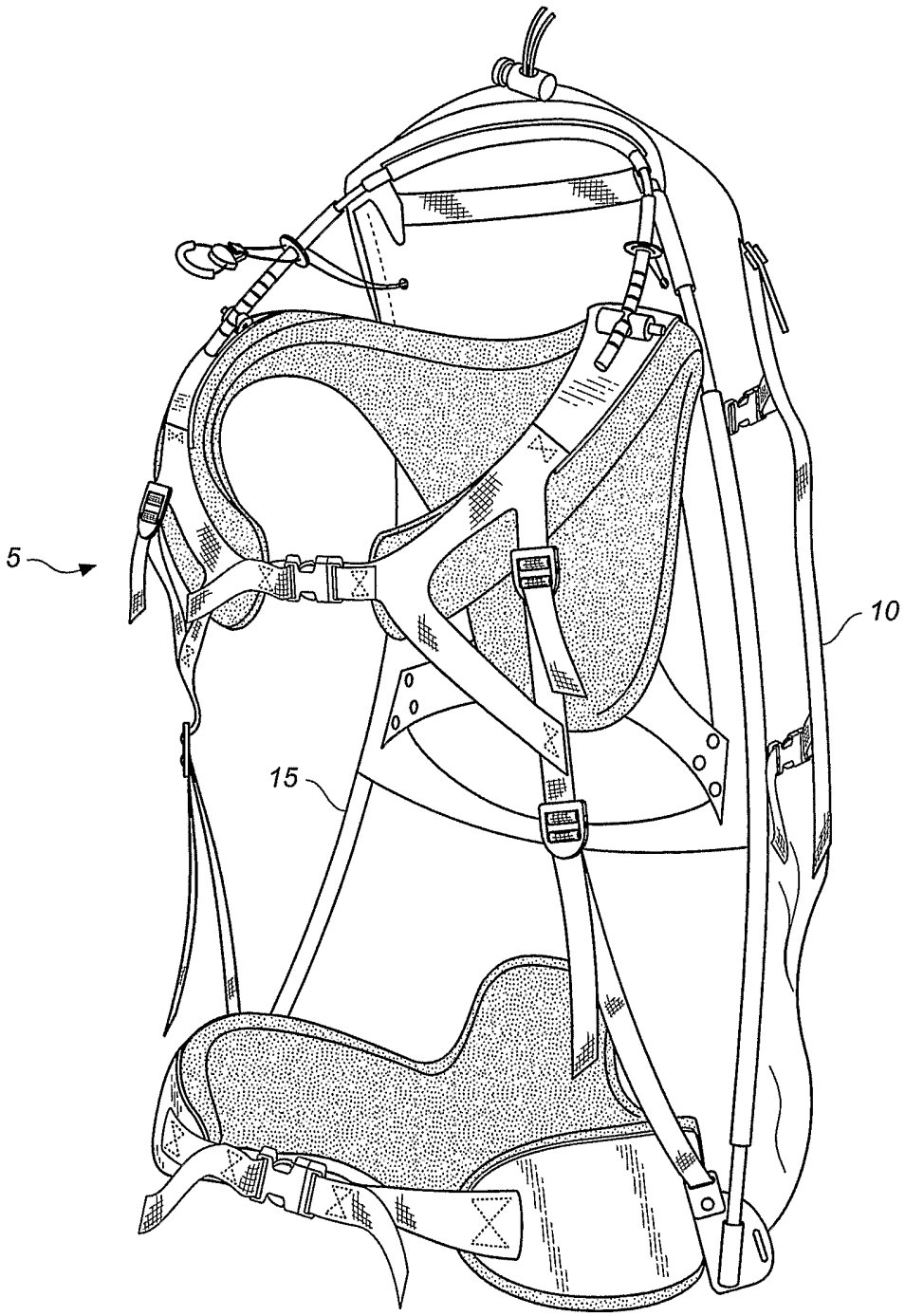


FIG._1A

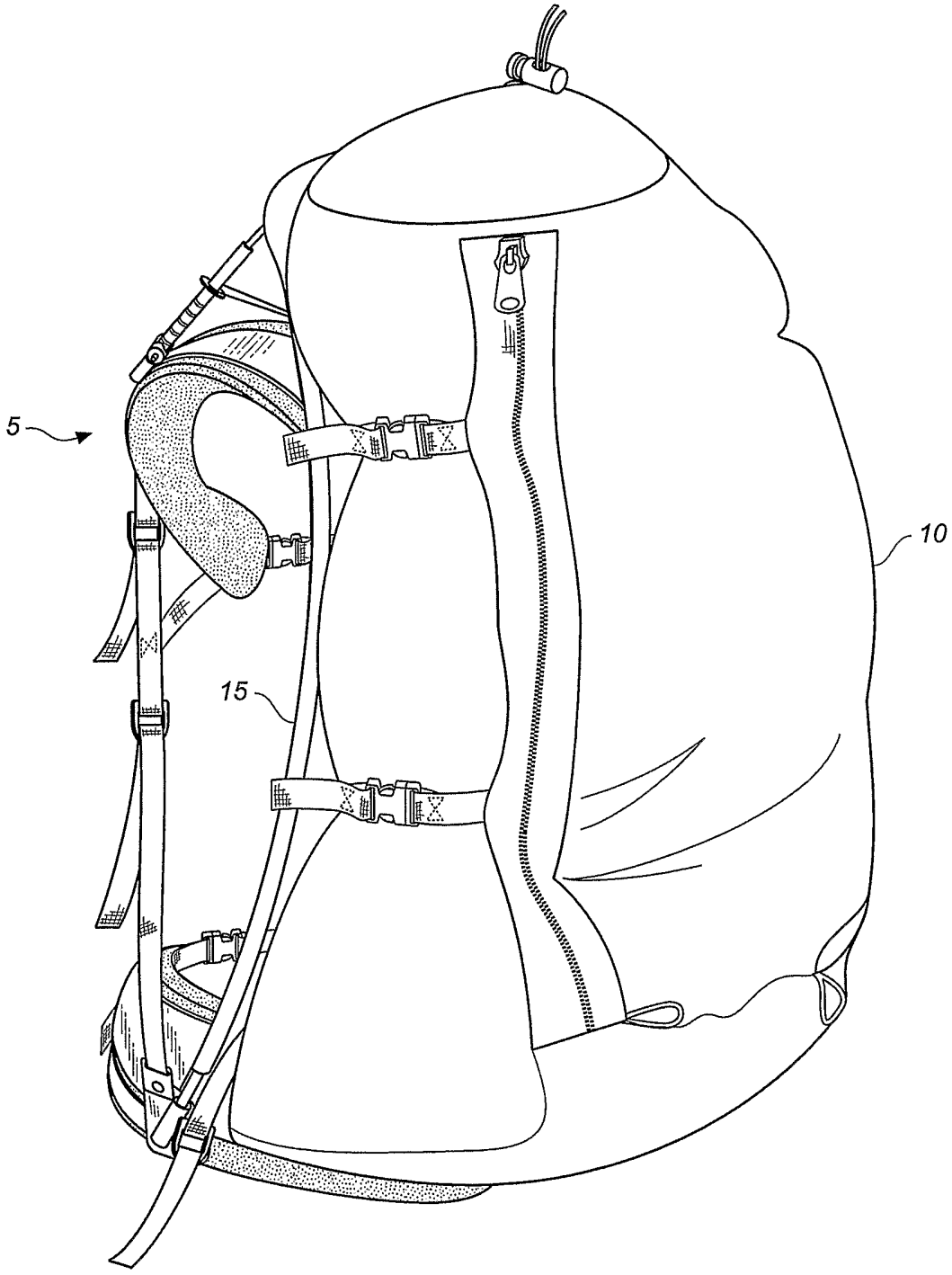


FIG._1B

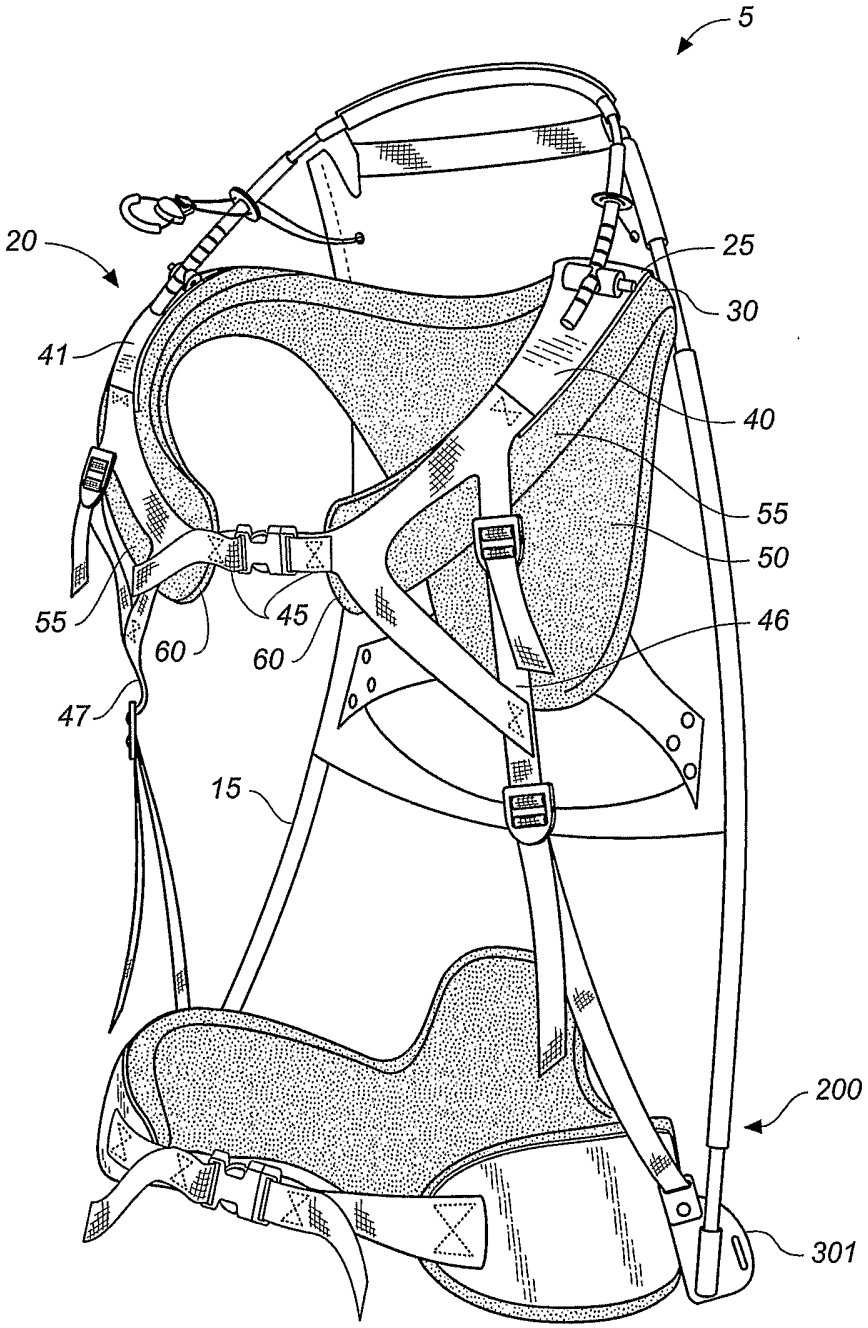


FIG._2A

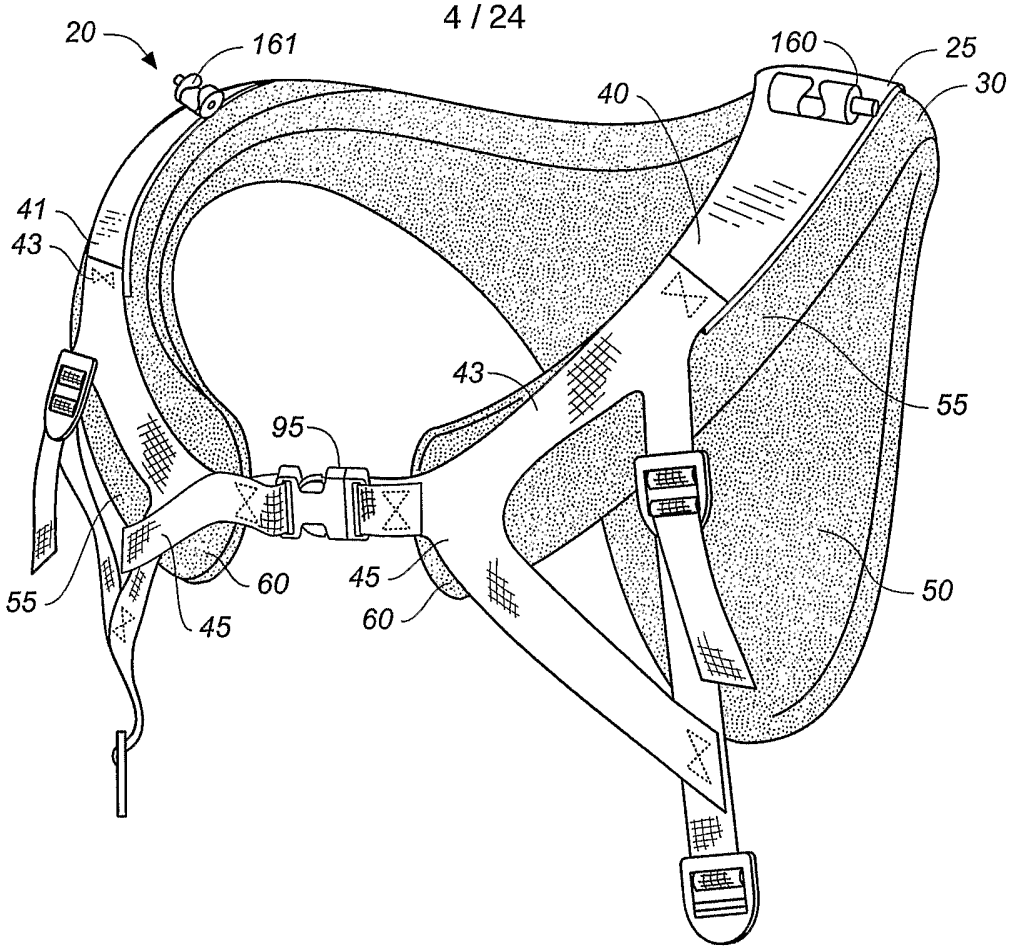


FIG._2B

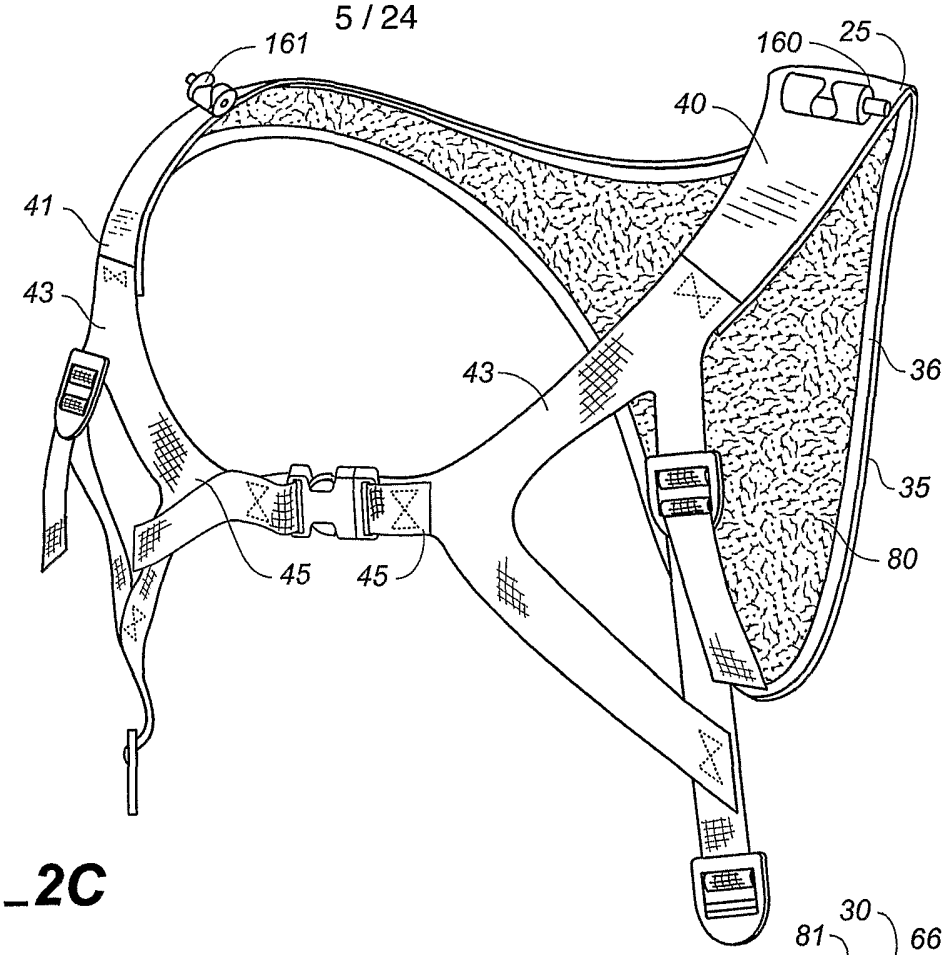
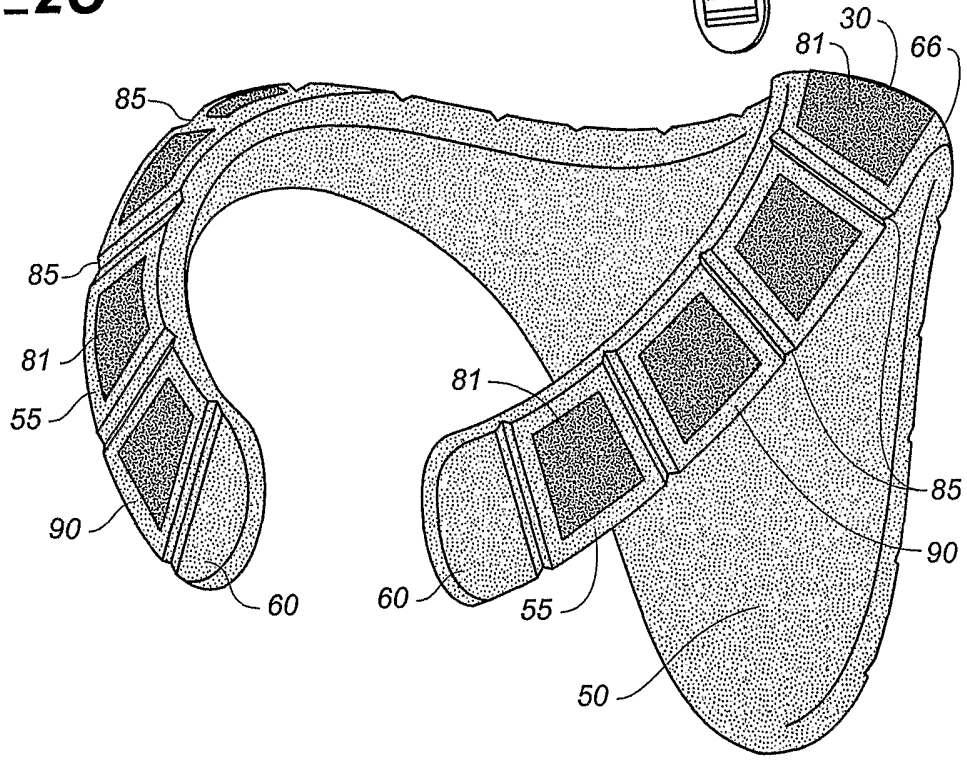

161
160
25
40
41
43
43
36
35
80
45
45

FIG._2C


30
81
66
85
85
81
55
81
85
90
90
60
60
55
50

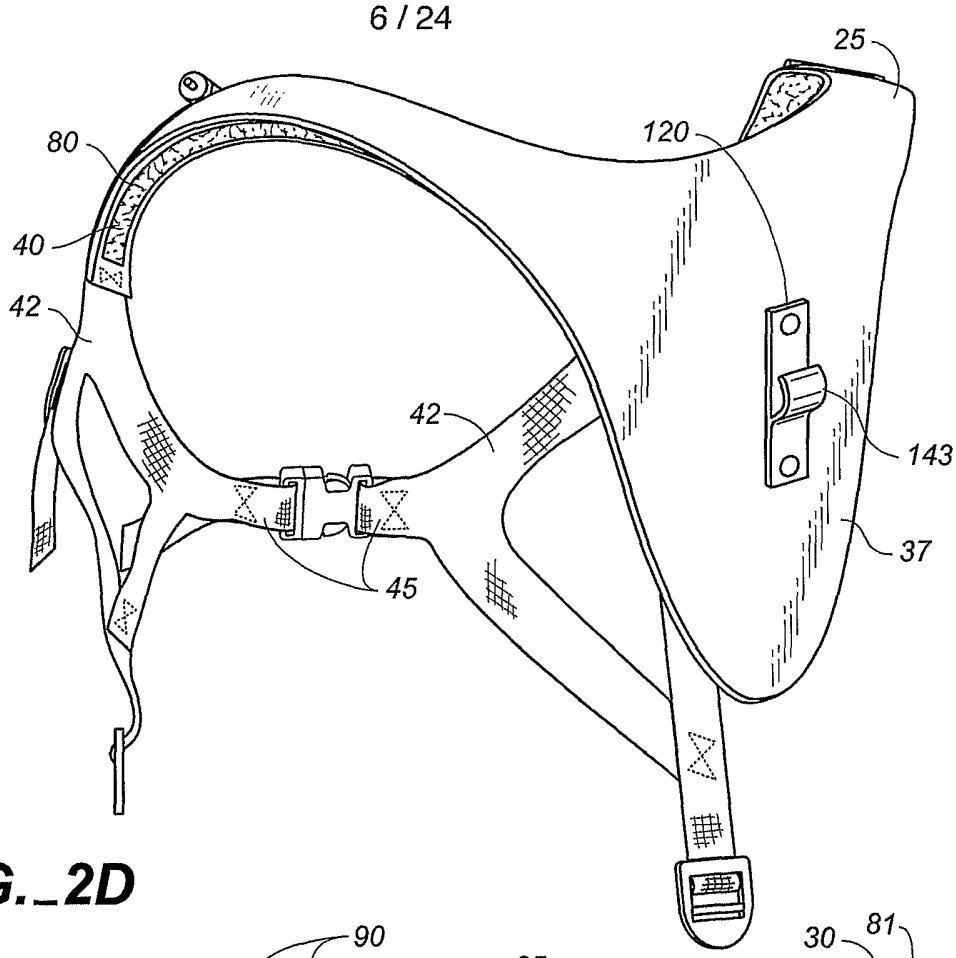
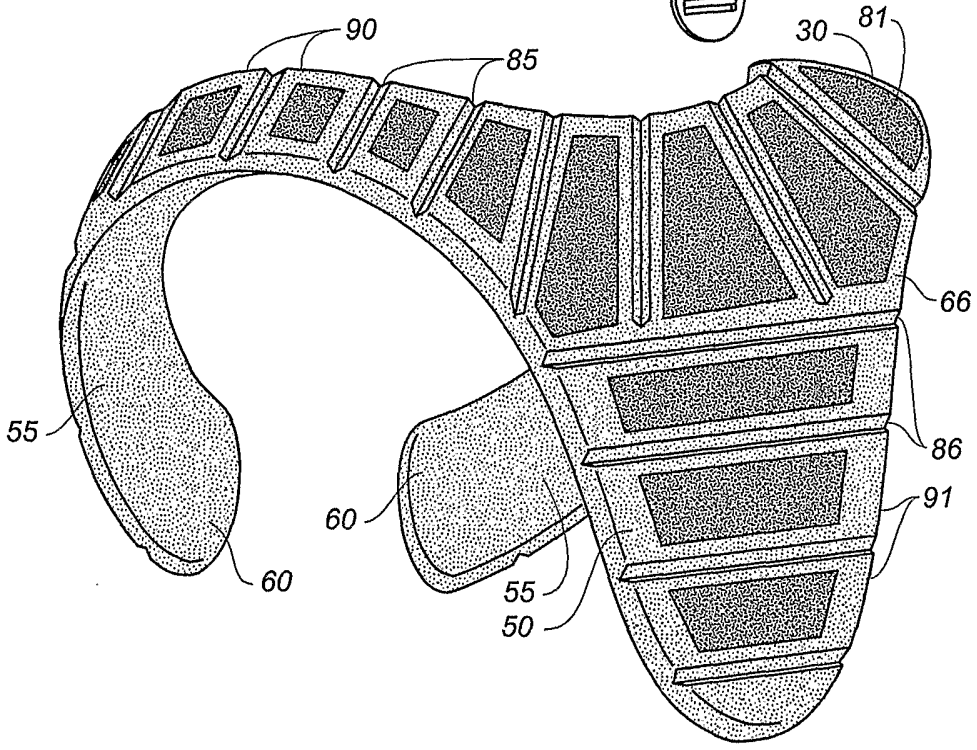


FIG._2D



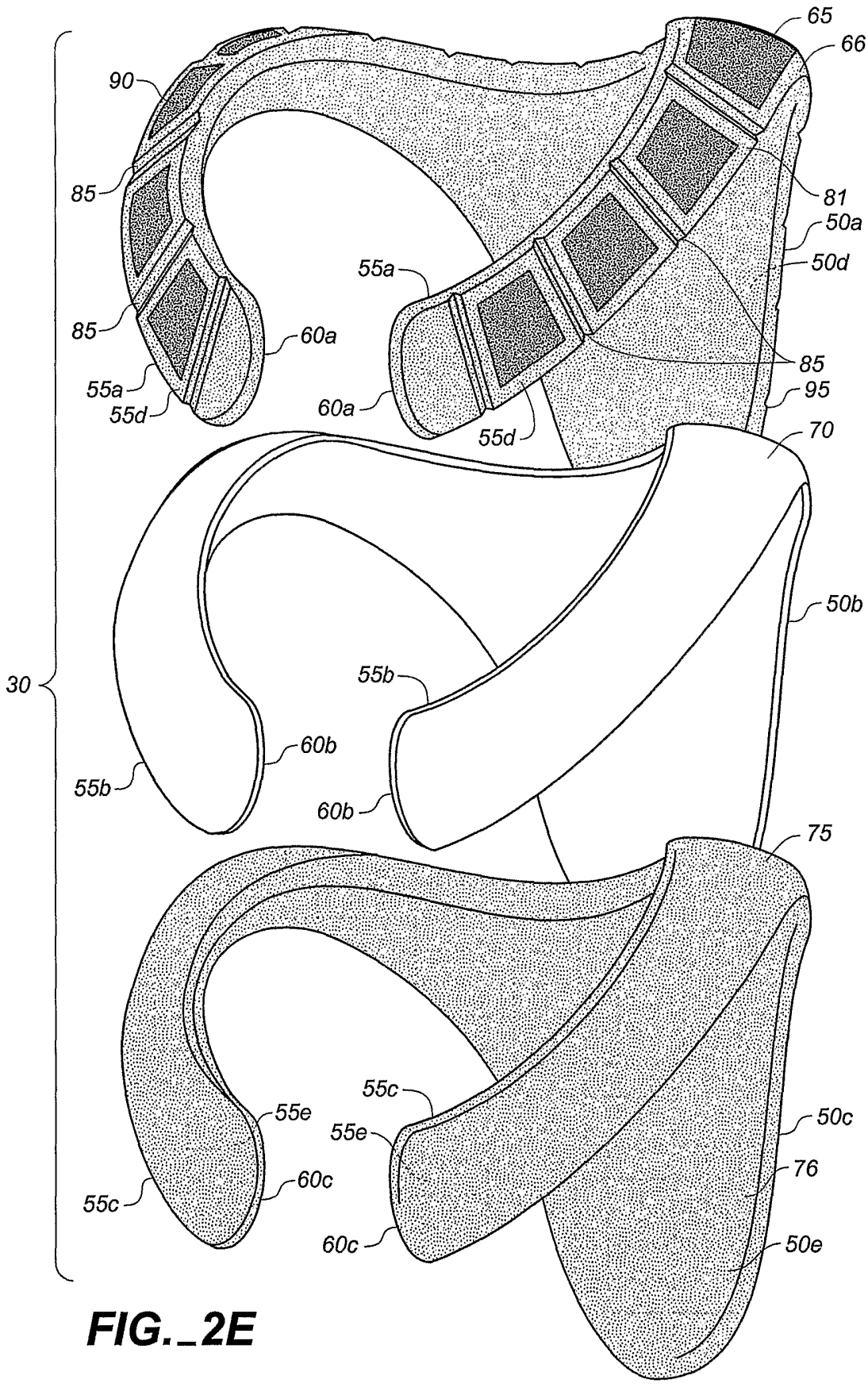

65
66
90
85
81
50a
50d
55a
85
60a
85
55a
55d
60a
55d
95
70
50b
30
55b
60b
55b
60b
75
55c
55e
50c
55e
76
60c
55c
60c
50e

FIG._2E

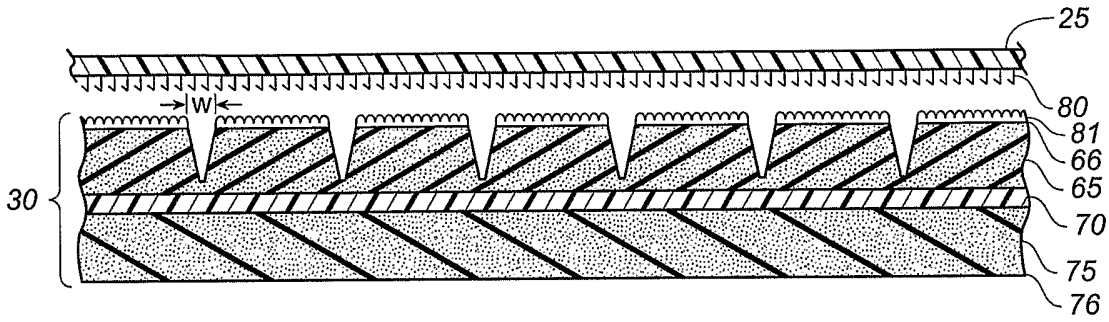


FIG._3A

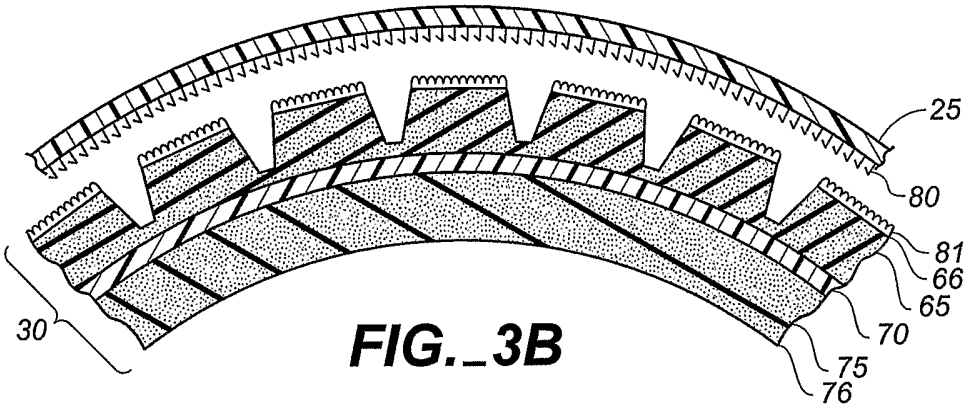


FIG._3B

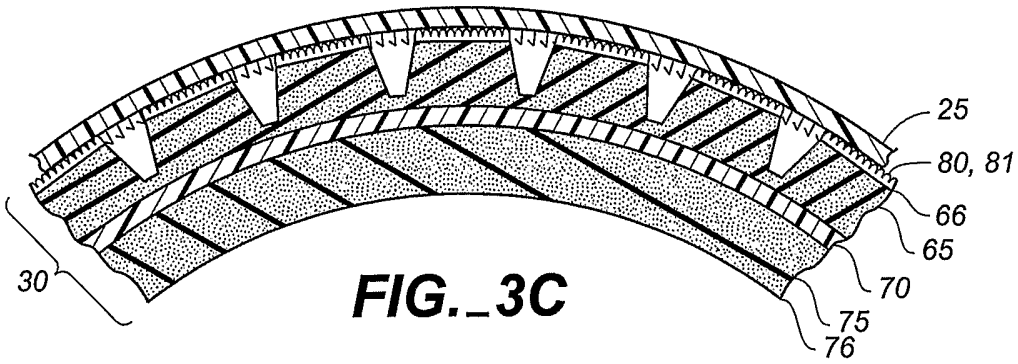


FIG._3C

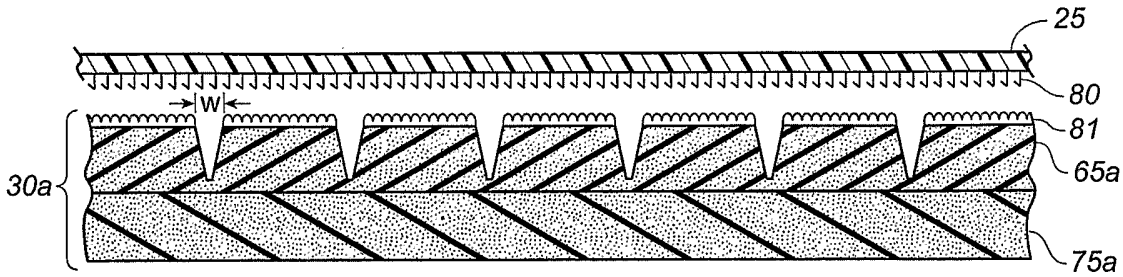


FIG._3D

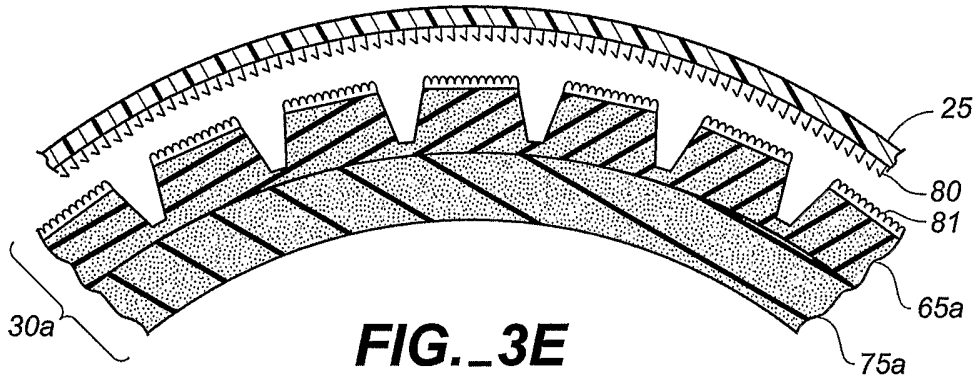


FIG._3E

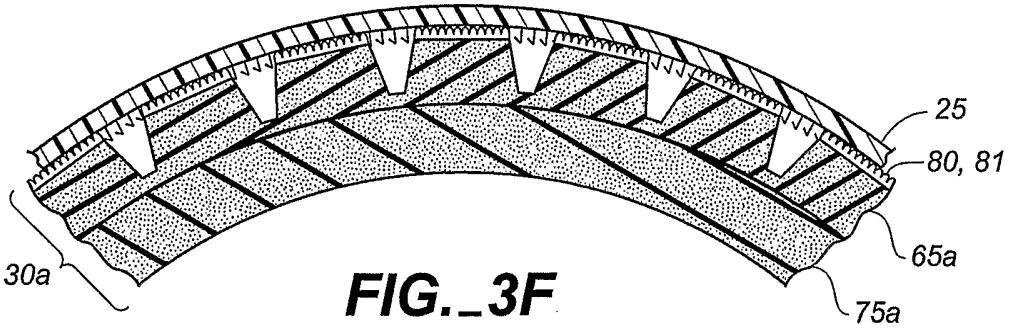


FIG._3F

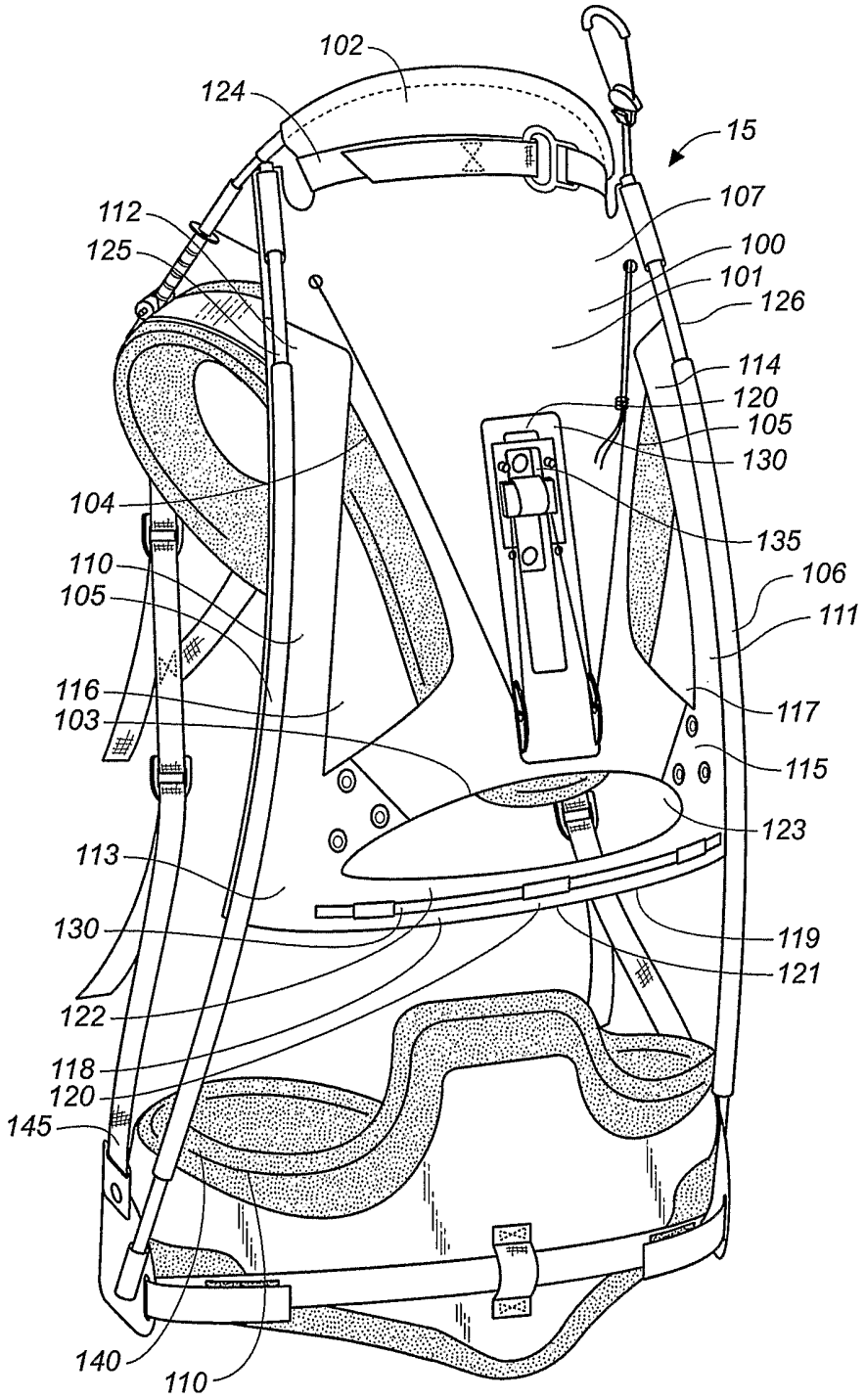

102
124
15
112
125
107
100
101
126
114
120
105
130
104
135
110
105
106
111
116
103
117
115
123
113
130
119
121
122
118
120
145
140
110

FIG._4A

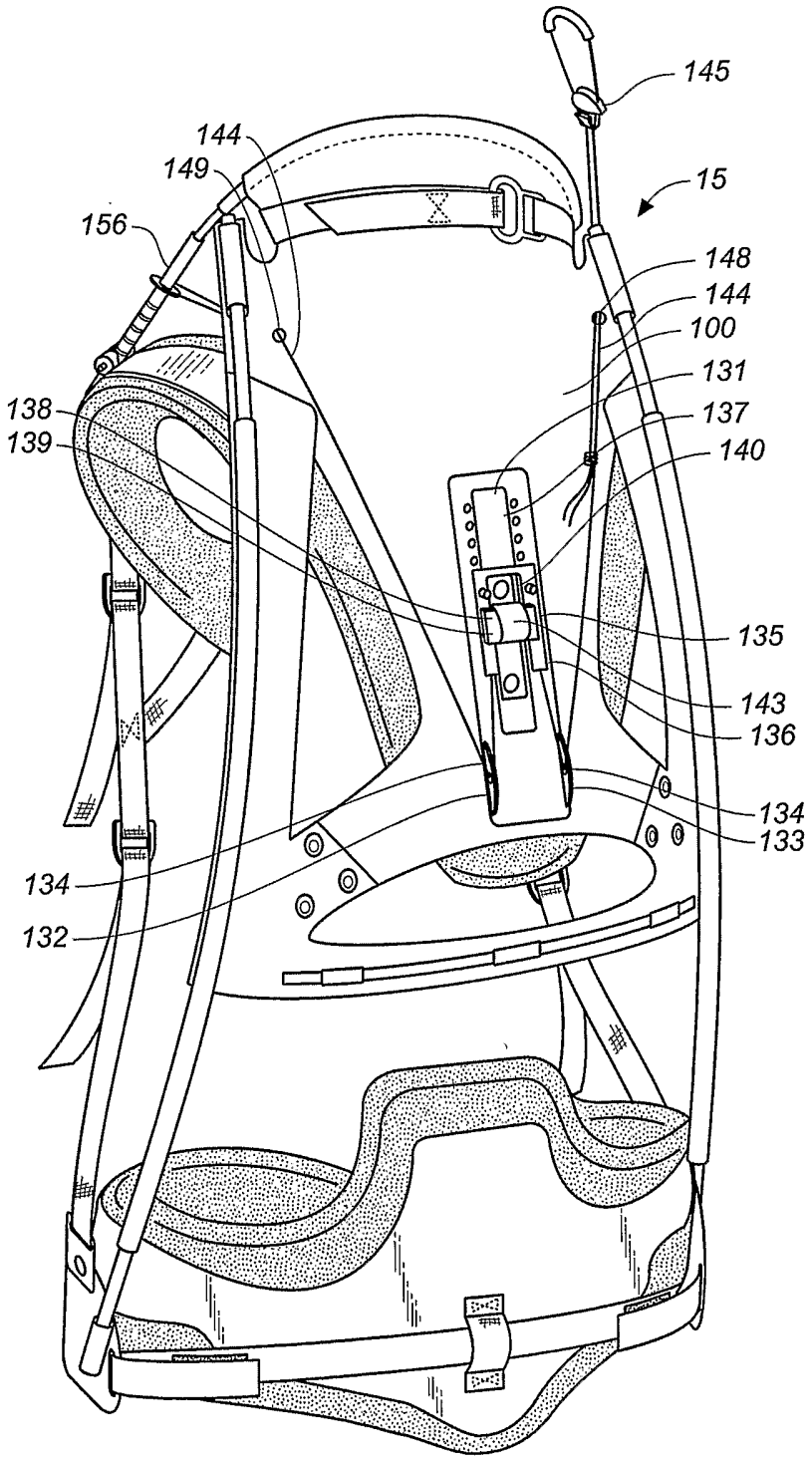

145
144
149
15
156
148
144
100
131
138
137
139
140
135
143
136
134
133
134
132

FIG._4B

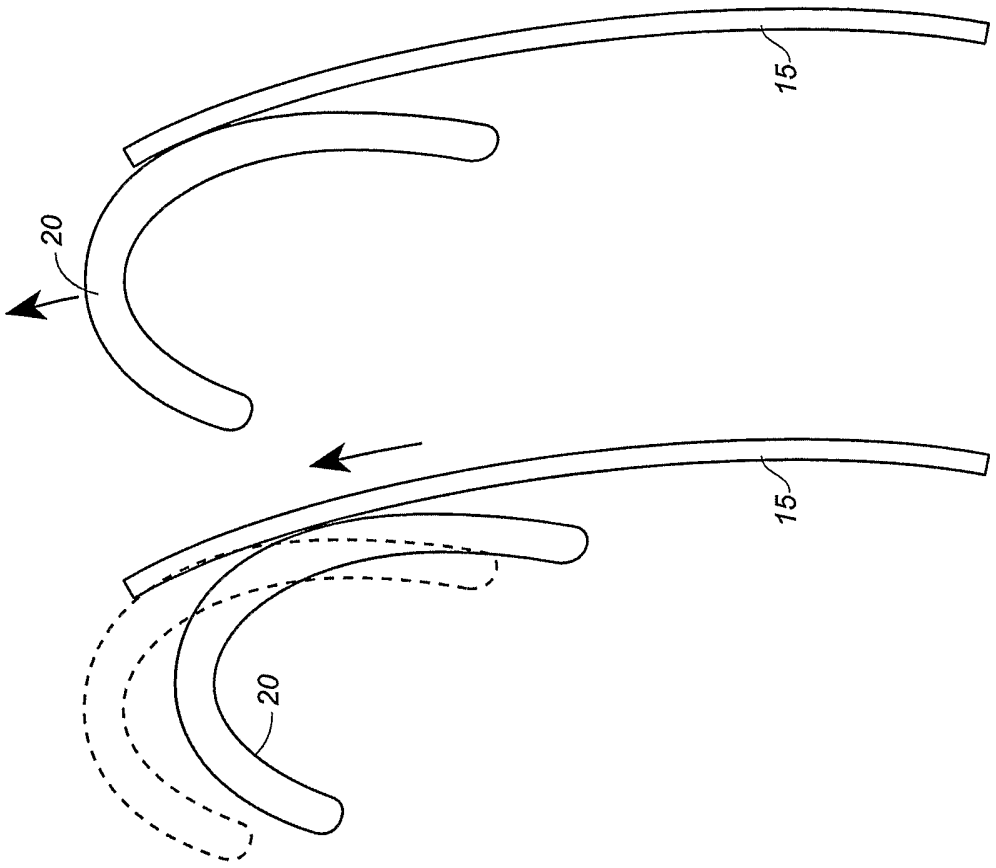


FIG._4D

FIG._4C

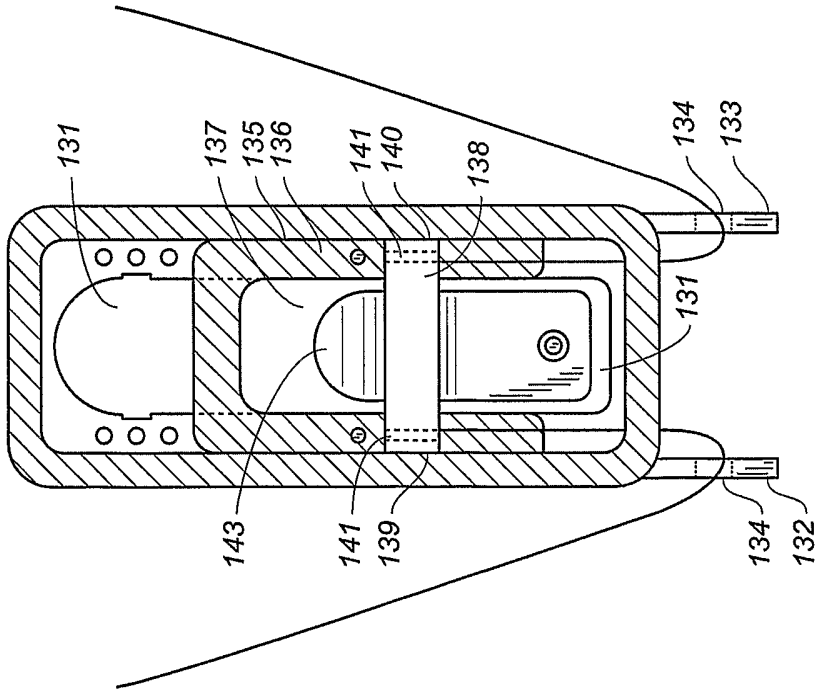


FIG._4A-1

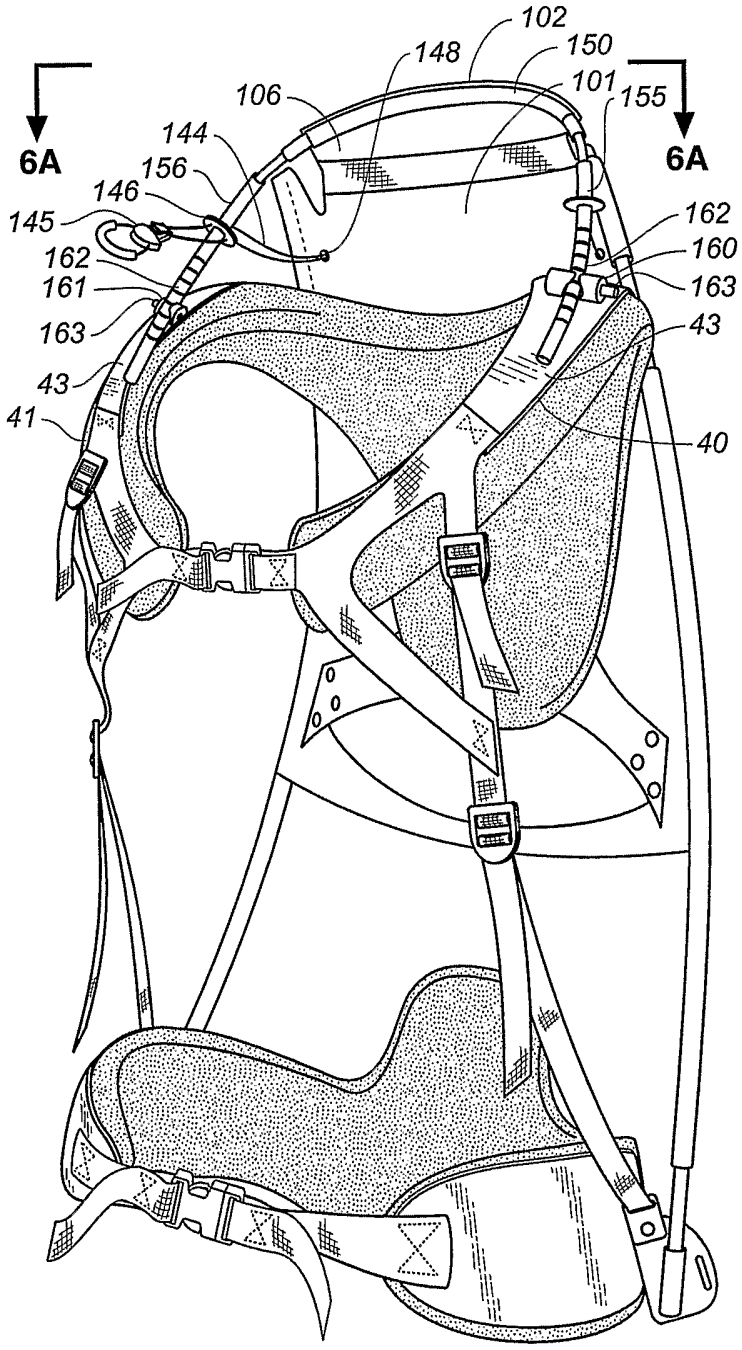

102
148
150
101
155
106
144
156
146
145
162
161
163
43
41
6A
6A
162
160
163
43
40

FIG._5A

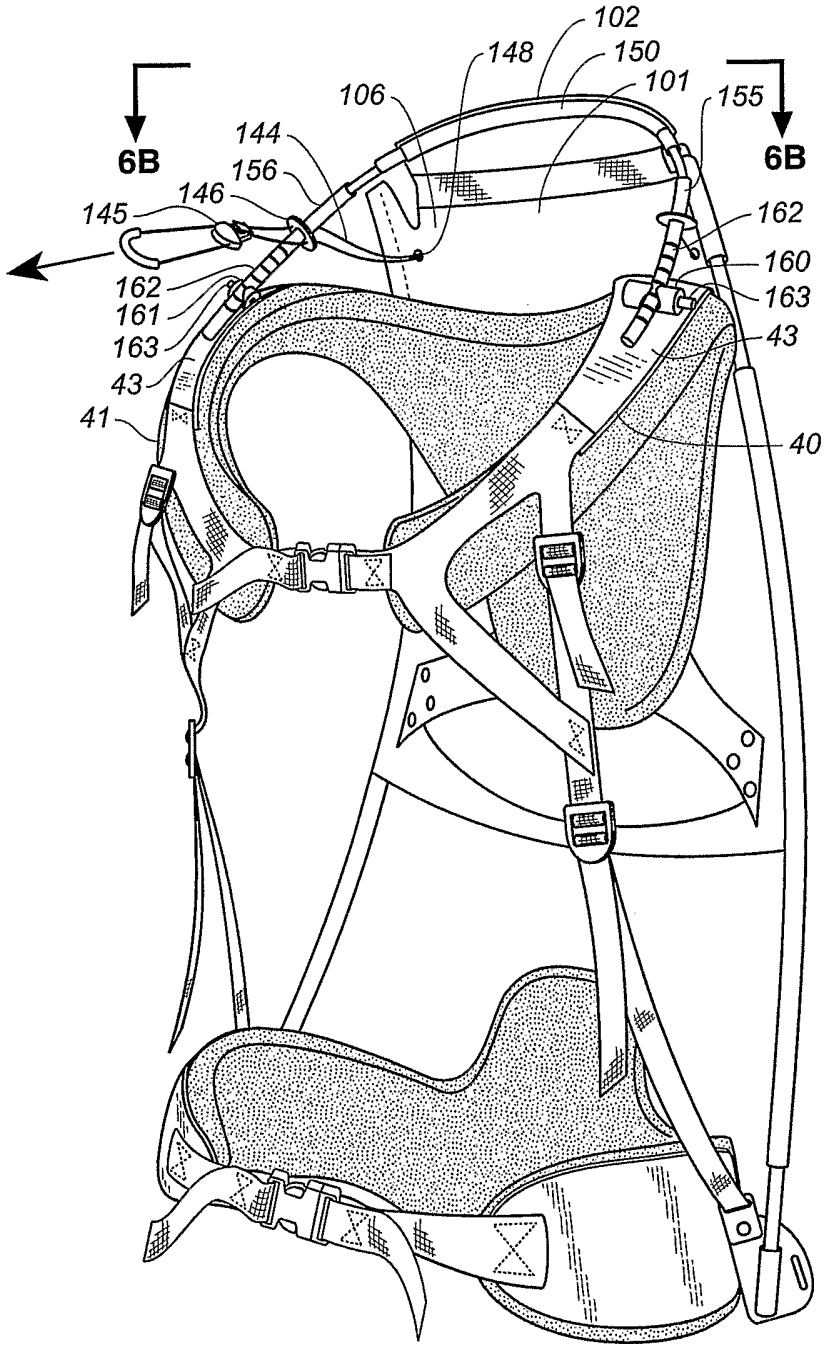

102
148
150
101
106
155
144
6B
6B
156
146
145
162
160
163
162
161
163
43
43
41
40

FIG._5B

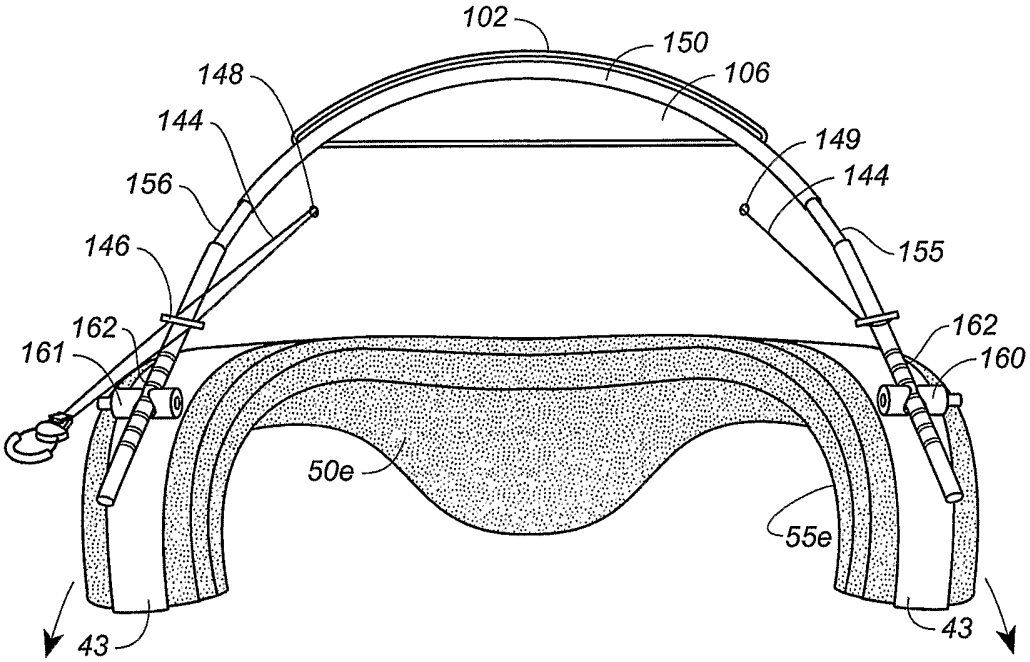

102
150
106
148
144
149
156
144
146
155
162
162
161
160
50e
55e
43
43

FIG._6A

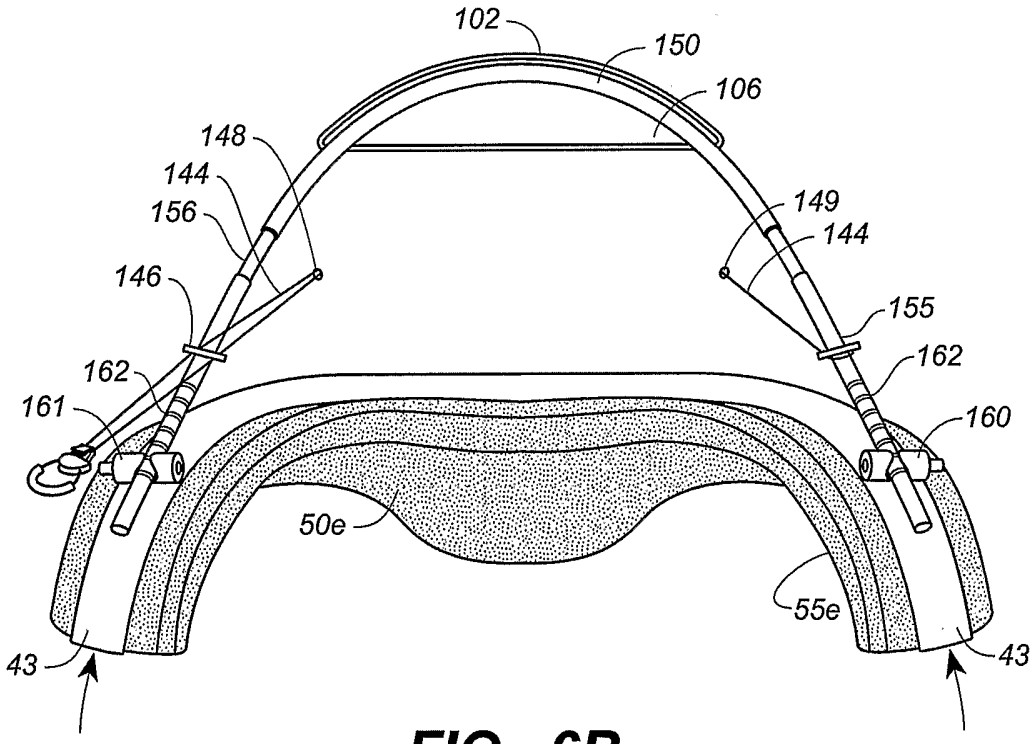

102
150
106
148
144
149
156
144
146
155
162
162
161
160
50e
55e
43
43

FIG._6B

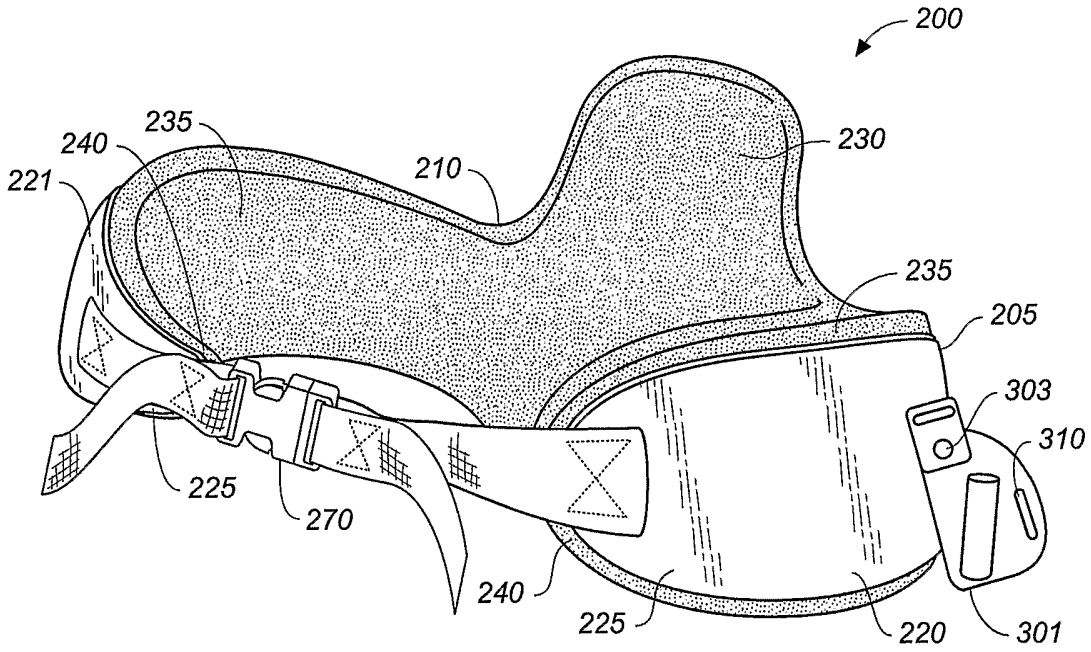


FIG._7A

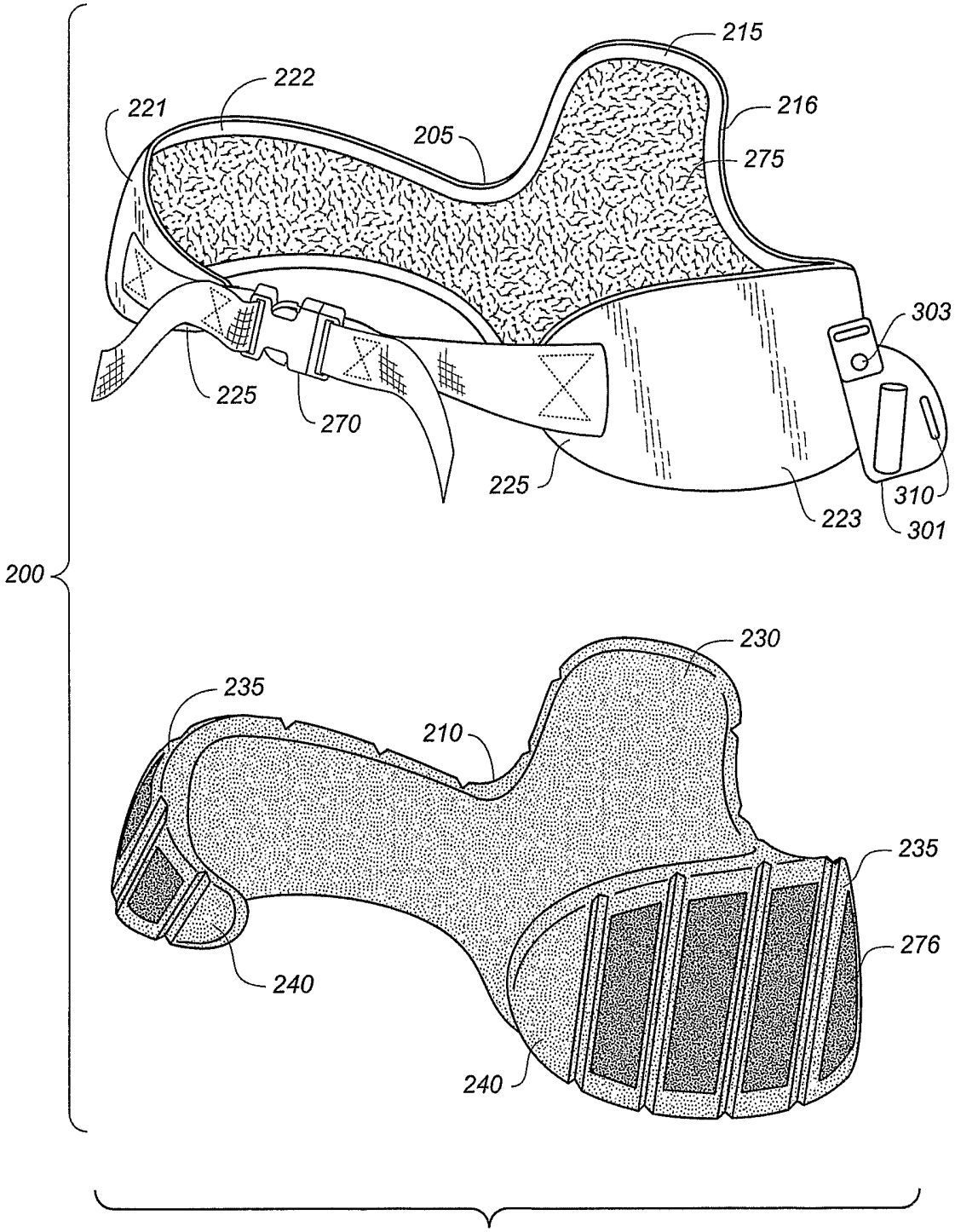

215
222
221
216
205
275
303
225
270
225
310
223
301
200
230
235
210
235
276
240
240

FIG._7B

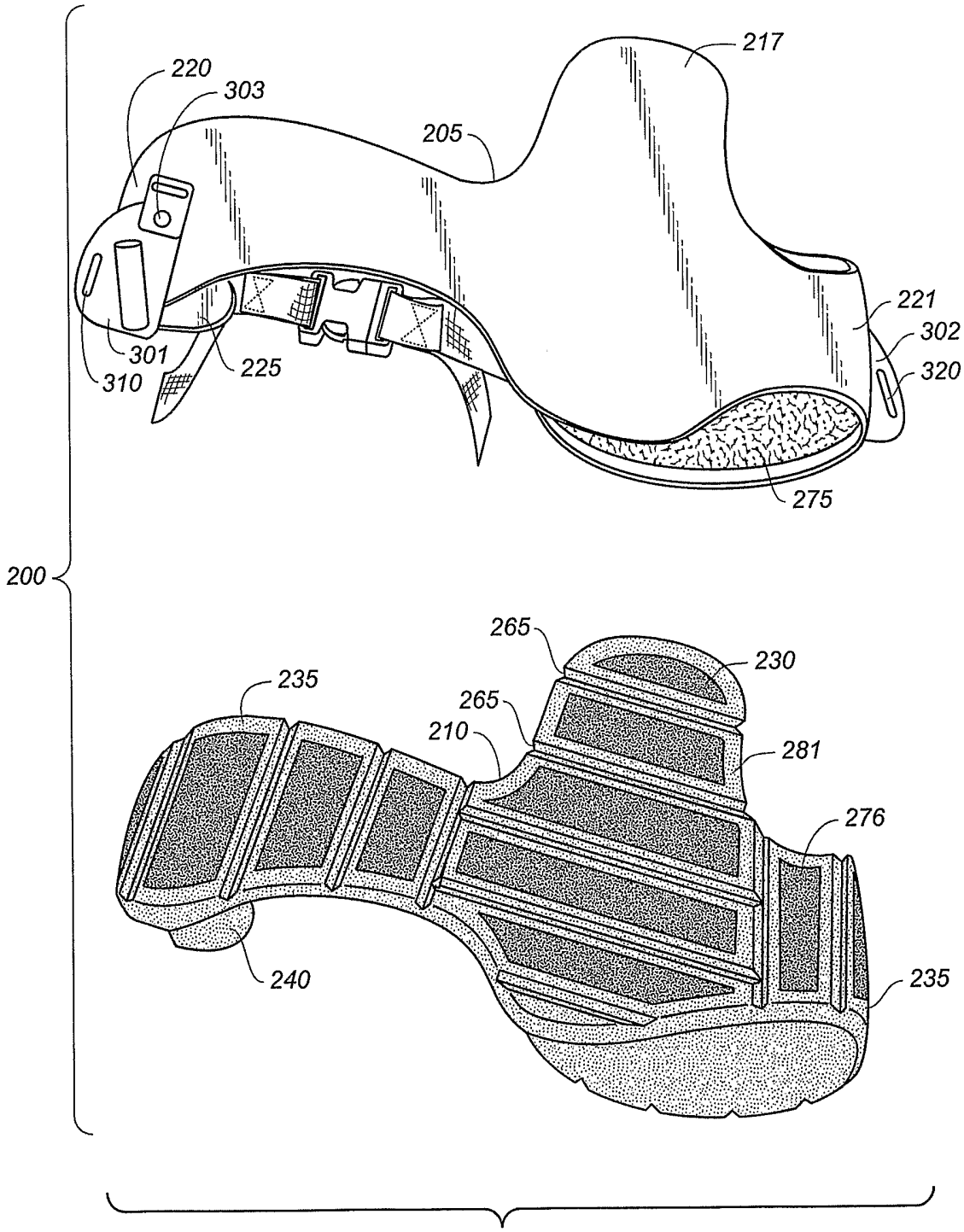

200
220
303
205
217
221
302
320
301
310
225
275
265
230
235
265
210
281
276
240
235

FIG._7C

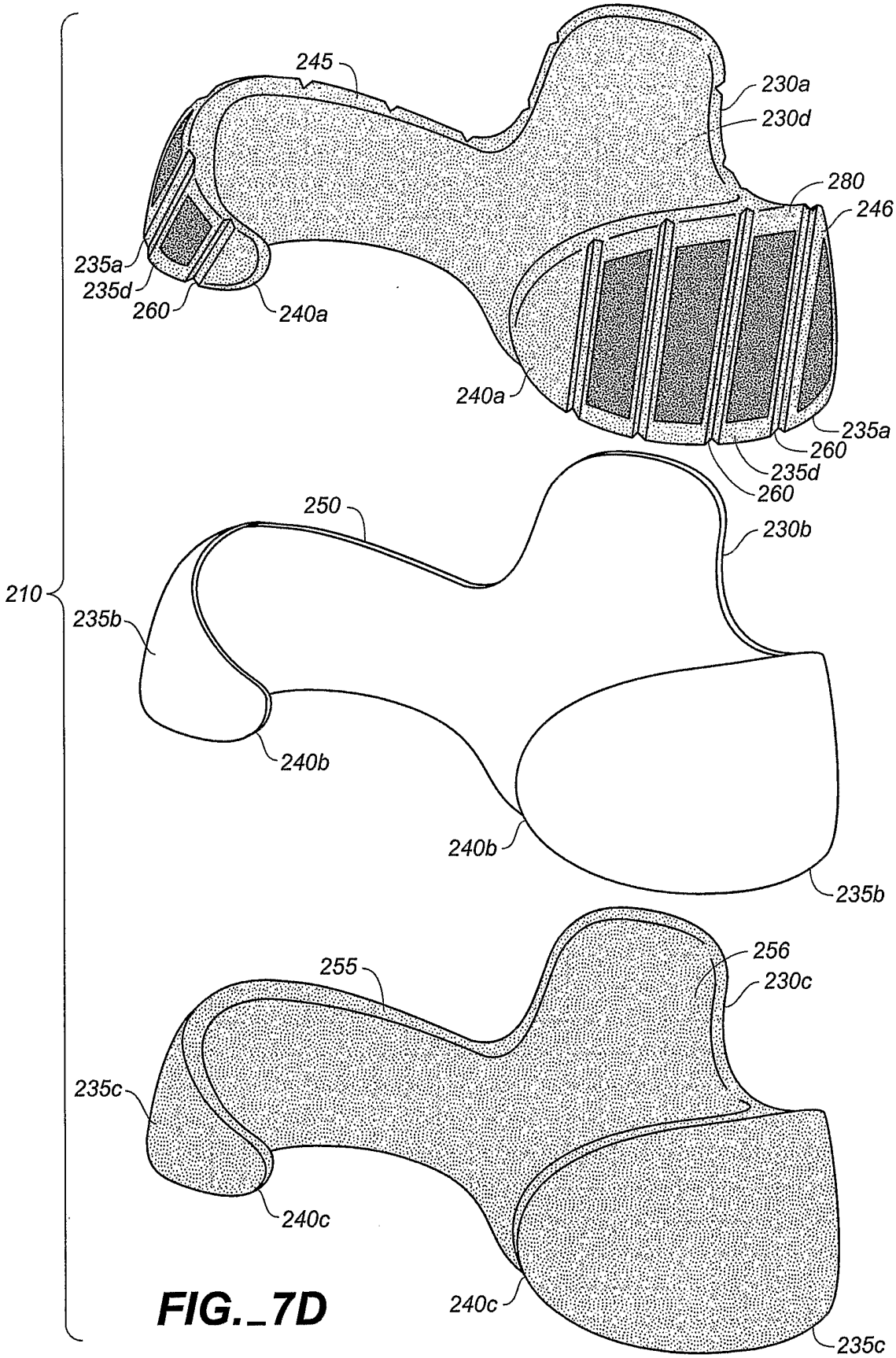

245
230a
230d
280
246
235a
235d
260
240a
240a
235a
260
235d
260
250
230b
210
235b
240b
240b
235b
255
256
230c
235c
240c
240c
235c

FIG._7D

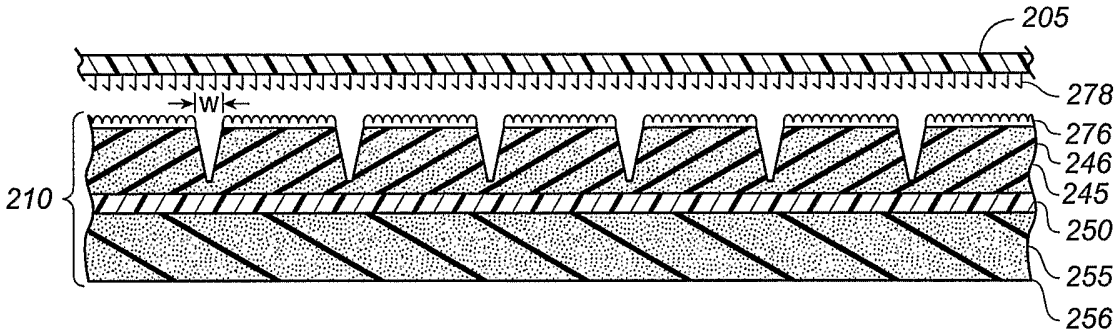


FIG._8A

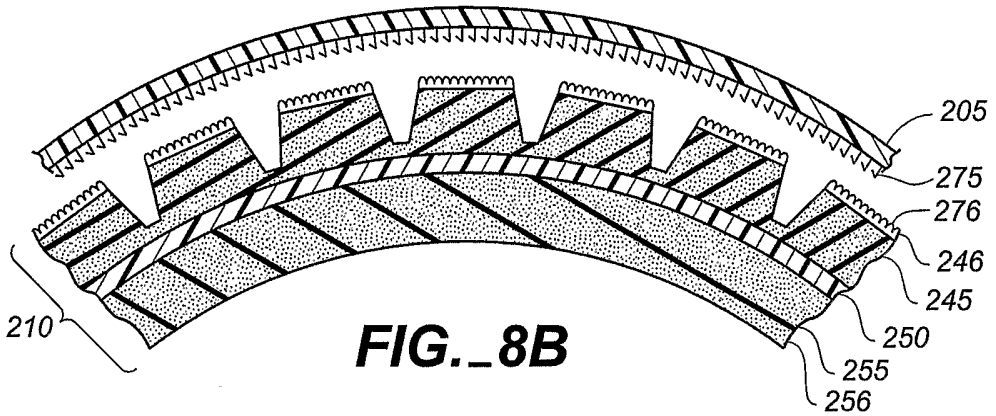


FIG._8B

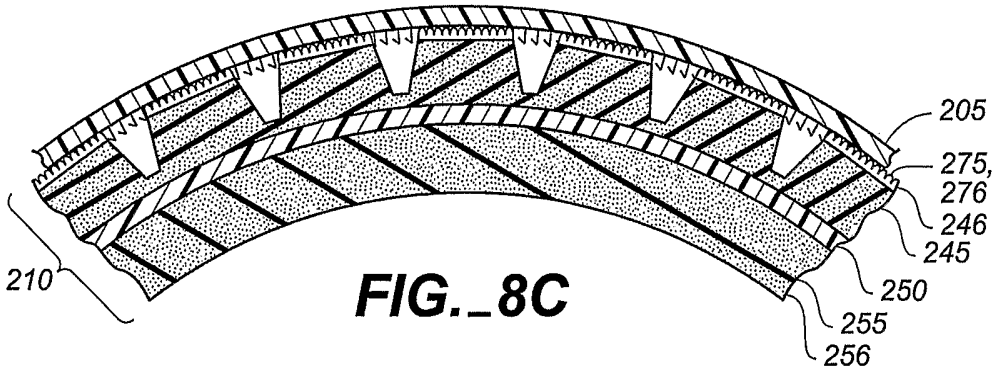


FIG._8C

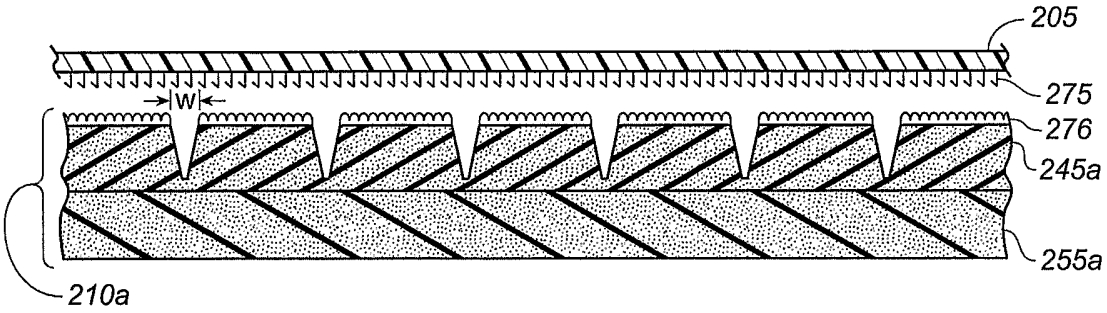


FIG._8D

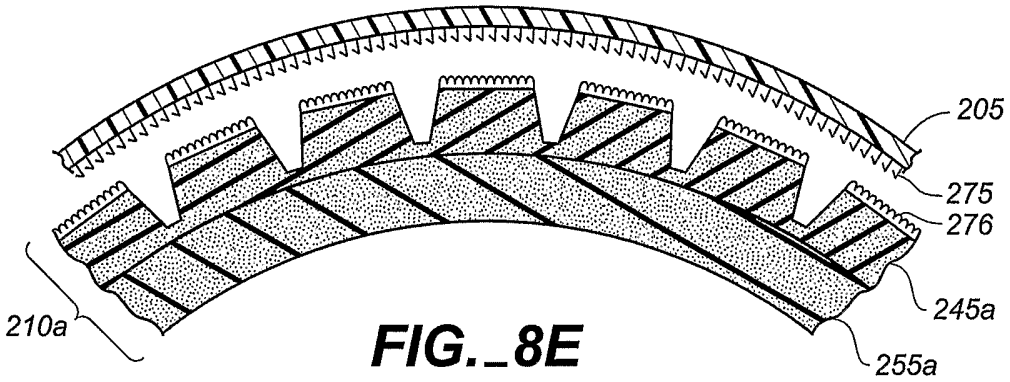


FIG._8E

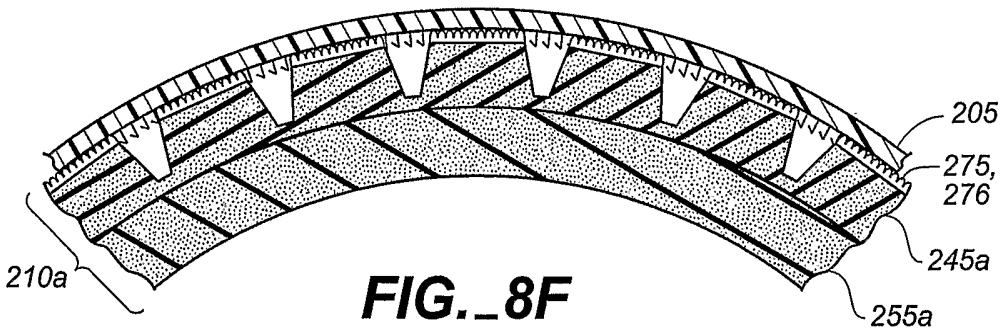


FIG._8F

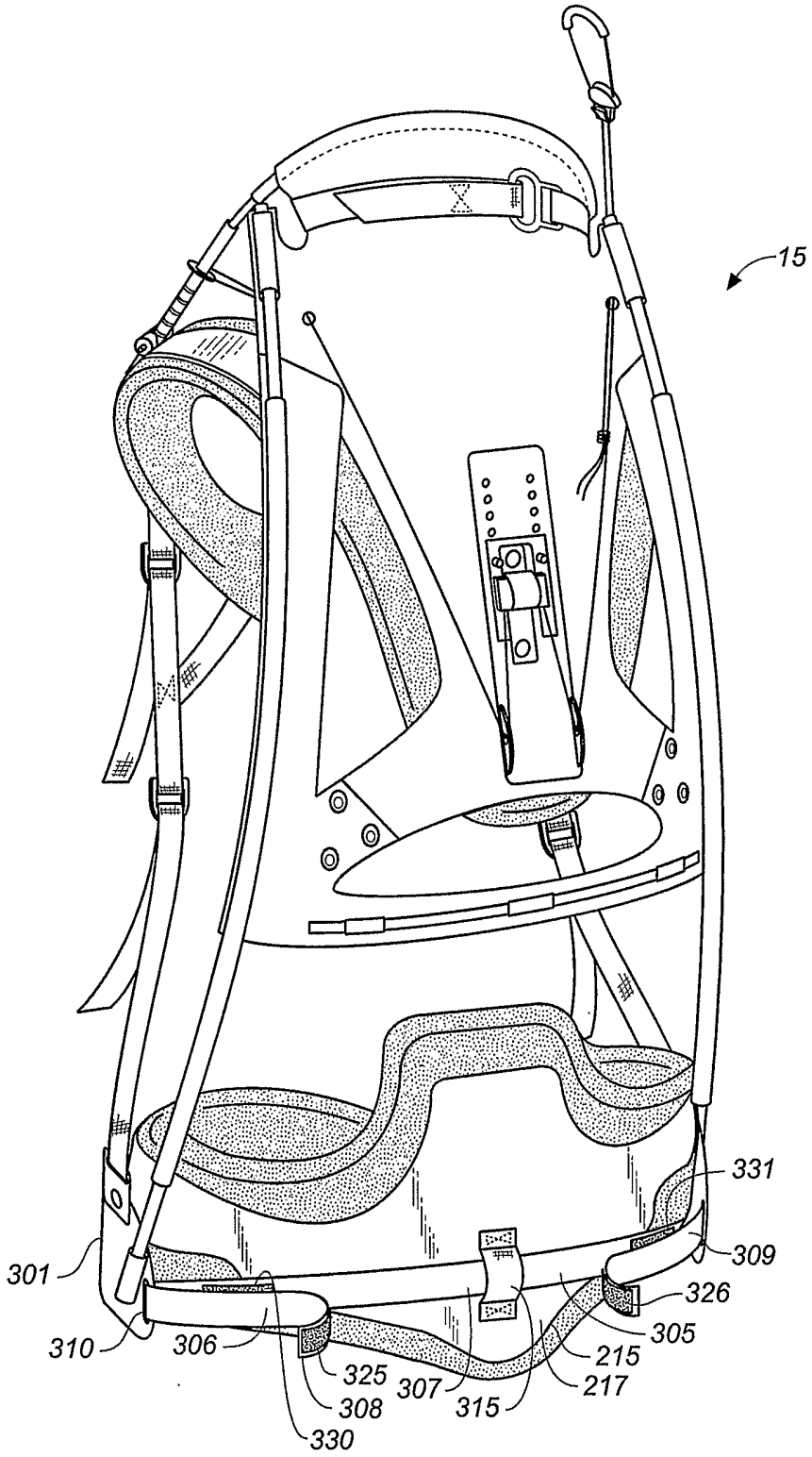


FIG._9A

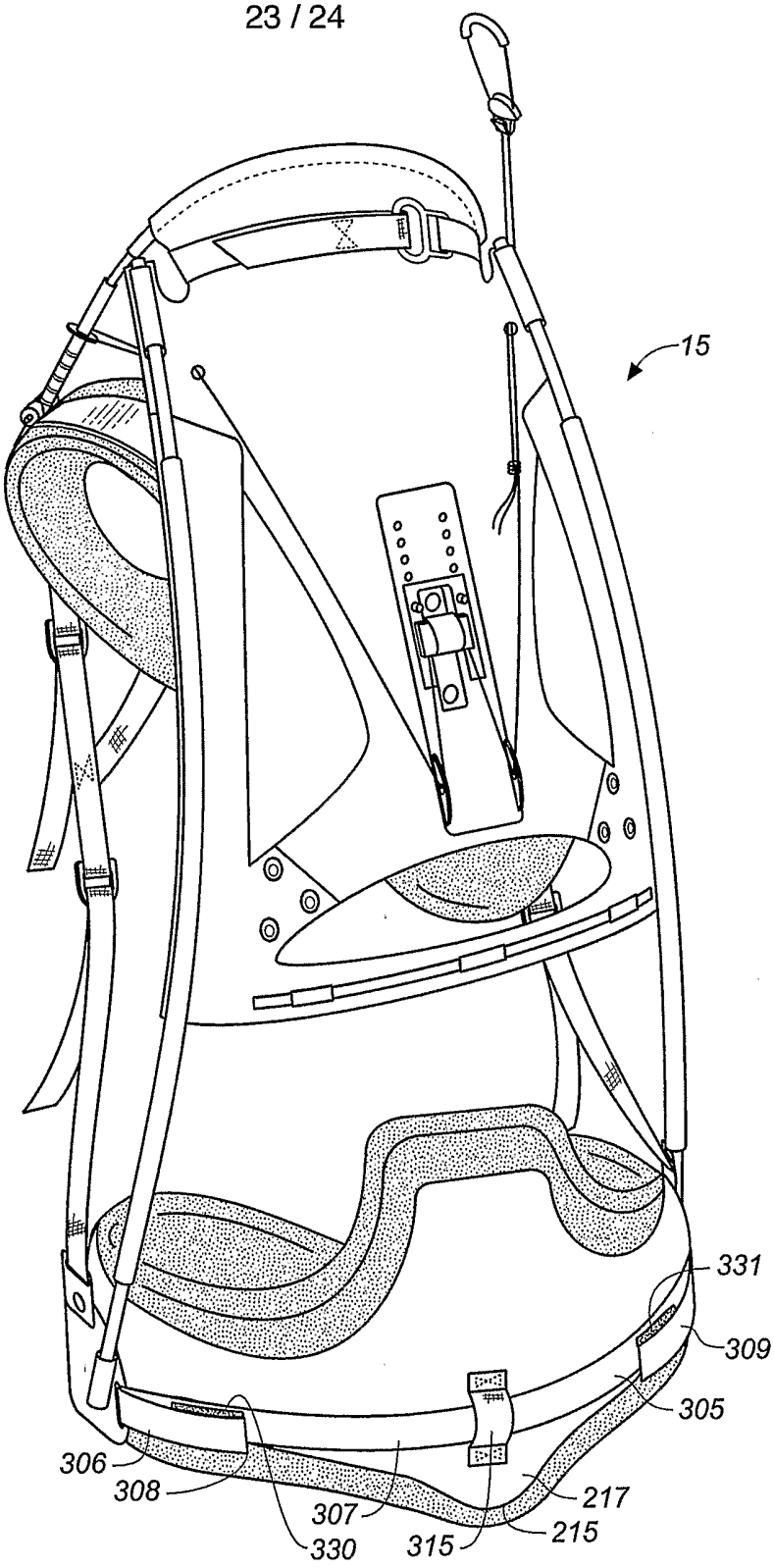


FIG._9B

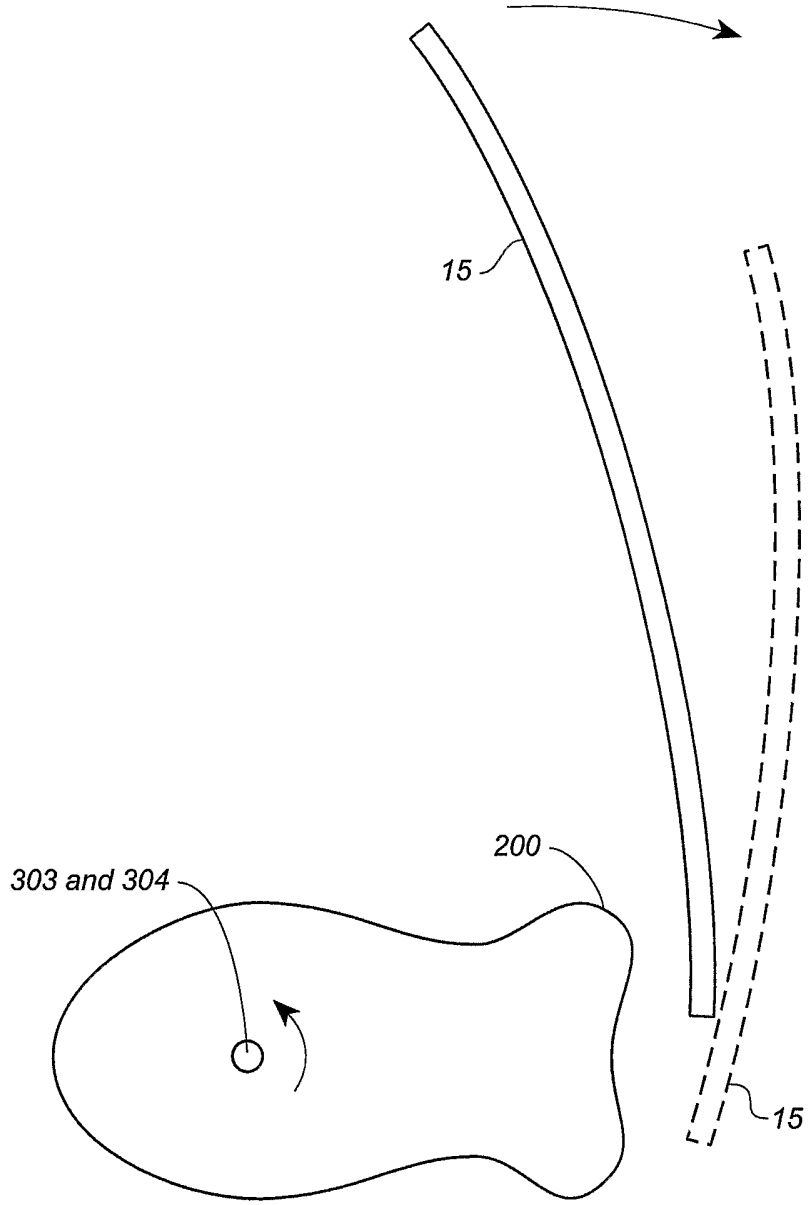


FIG._10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US05/27454

A. CLASSIFICATION OF SUBJECT MATTER
IPC(7) : A45F 3/04
US CL : 224/628,637, 641
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)
U.S. : 224/186,187,189,628,631,633,635,637,641,642

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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,954,253 A (Swetish) 21 September 1999 (21.09.1999) entire document	1-11 and 15-77
Y	US 4,420,103 A (Douglass) 13 December 1983 (13.12.1983) entire document, especially Figure 3 and column 4, lines 48-51	1-5, 7-11, 15-21, 23-28, 30-37, 39-46, 48-53, 55-62, 64-68, 70-74, 76, and 77
Y	US 4,981,135 A (Hardy) 01 January 1991 (01.01.1991) entire document, especially column 4, lines 17-24 and column 6, lines 2-5	1-5, 7-11, 15-21, 23-28, 30-37, 39-46, 48-53, 55-62, 64-68, 70-74, 76, and 77
Y	US 6,083,080 A (Lawson et al.) 04 July 2000 (04.07.2000) entire document	1-5, 7-11, 15-21, 23-28, 30-37, 39-46, 48-53, 55-62, 64-68, 70-74, 76, and 77
Y	US 6,607,108 B2 (Mydans) 19 August 2003 (19.08.2003) entire document	6,22,29,38,47,54,63,69, and 75

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
14 November 2005 (14.11.2005)

Date of mailing of the international search report
15 DEC 2005

Name and mailing address of the ISA/US
Mail Stop PCT, Attn: ISA/US
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
Facsimile No. (571) 273-3201

Authorized officer
For
Nathan J Newhouse

Telephone No. (571)-272-3700

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

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US05/27454

C. (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6,276,584 B1 (McLachlan) 21 August 2001 (21.08.2001) entire document, espcially member 20	12-14
A	US 6,199,732 B1 (Swetish) 13 March 2001 (13.03.2001) entire document, especially sockets 64 and 66	12-14
A	US 6,024,265 A (Clements) 15 February 2000 (15.02.2000) entire document, especially hoop 20	12-14