US 20220053847A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2022/0053847 A1

van der Sleesen et al. (43) Pub. Date: Feb. 24, 2022

(54) PROTECTIVE GARMENT

(71) Applicant: **Vanson Leathers Inc.**, Fall River, MA (US)

(72) Inventors: **Michael van der Sleesen**, Lakeville, MA (US); **Matthew Silva**, Mattapoisett, MA (US); **Nadya Spodarik**, Easton, MA (US)

(21) Appl. No.: **16/999,573**

(22) Filed: **Aug. 21, 2020**

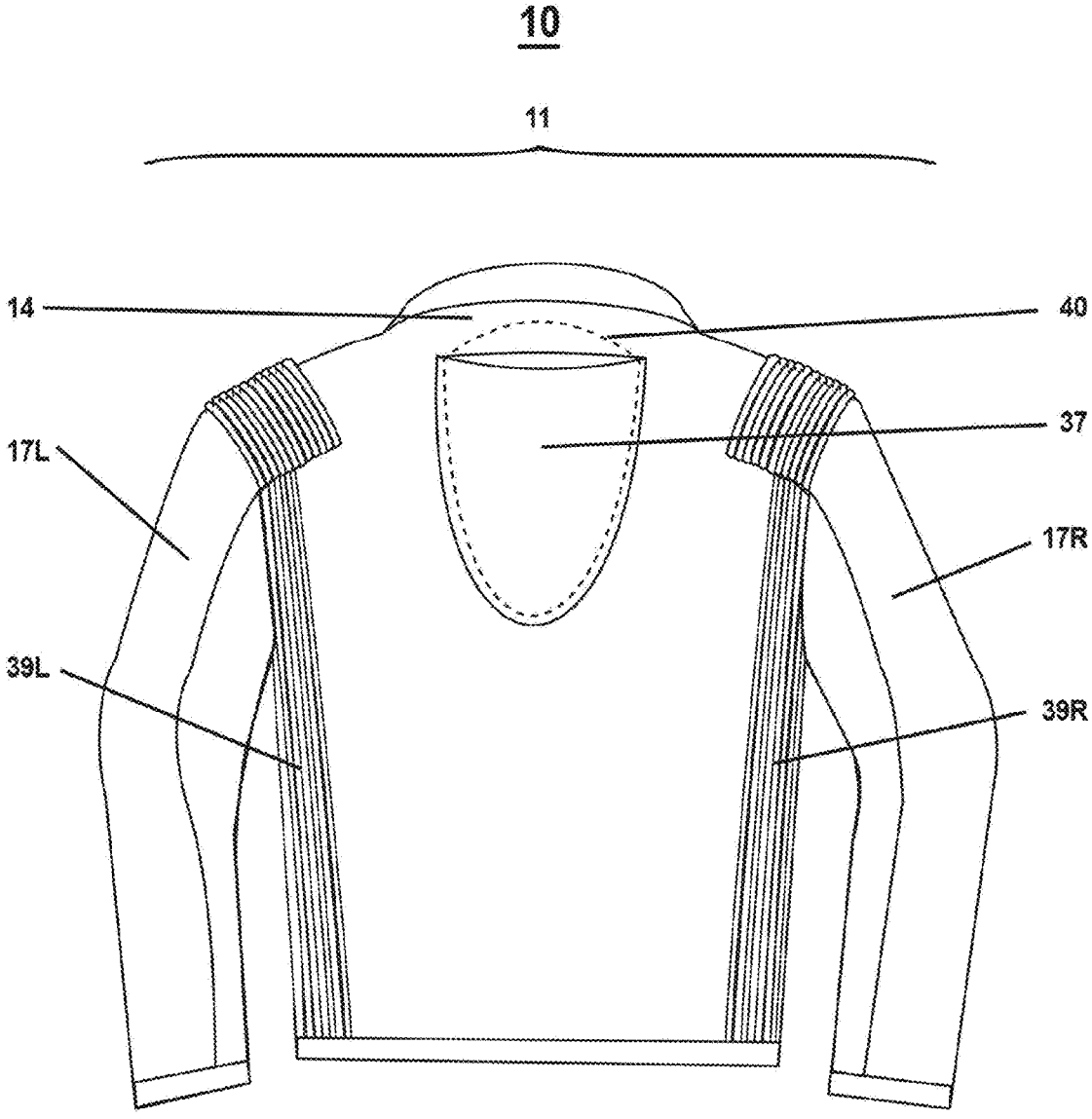
Publication Classification

(51) **Int. Cl.**
A41D 13/05 (2006.01)

(52) **U.S. Cl.**
CPC *A41D 13/0531* (2013.01)

(57) **ABSTRACT**

A garment includes a wearer protection assembly for a driver of an open vehicle, such as a motorcycle. The wearer protection assembly is operative to automatically detect for the driver wearing the garment, the driver's departure, for example, as a consequence of a highway accident, from the vehicle. In response to such detection, the wearer protection assembly deploys a normally (prior to departure from the motor vehicle) deflated bladder-like gas reservoir to be explosively inflated with a previously-stored compressed gas. The inflated bladder-like gas reservoir provides a gas-filled volume between an outer surface of the garment and body parts of the thrown person. That gas-filled volume is compressible and the gas within absorbs some of the energy encountered by the thrown person in response to external forces resulting from the accident or other separation-causing event.



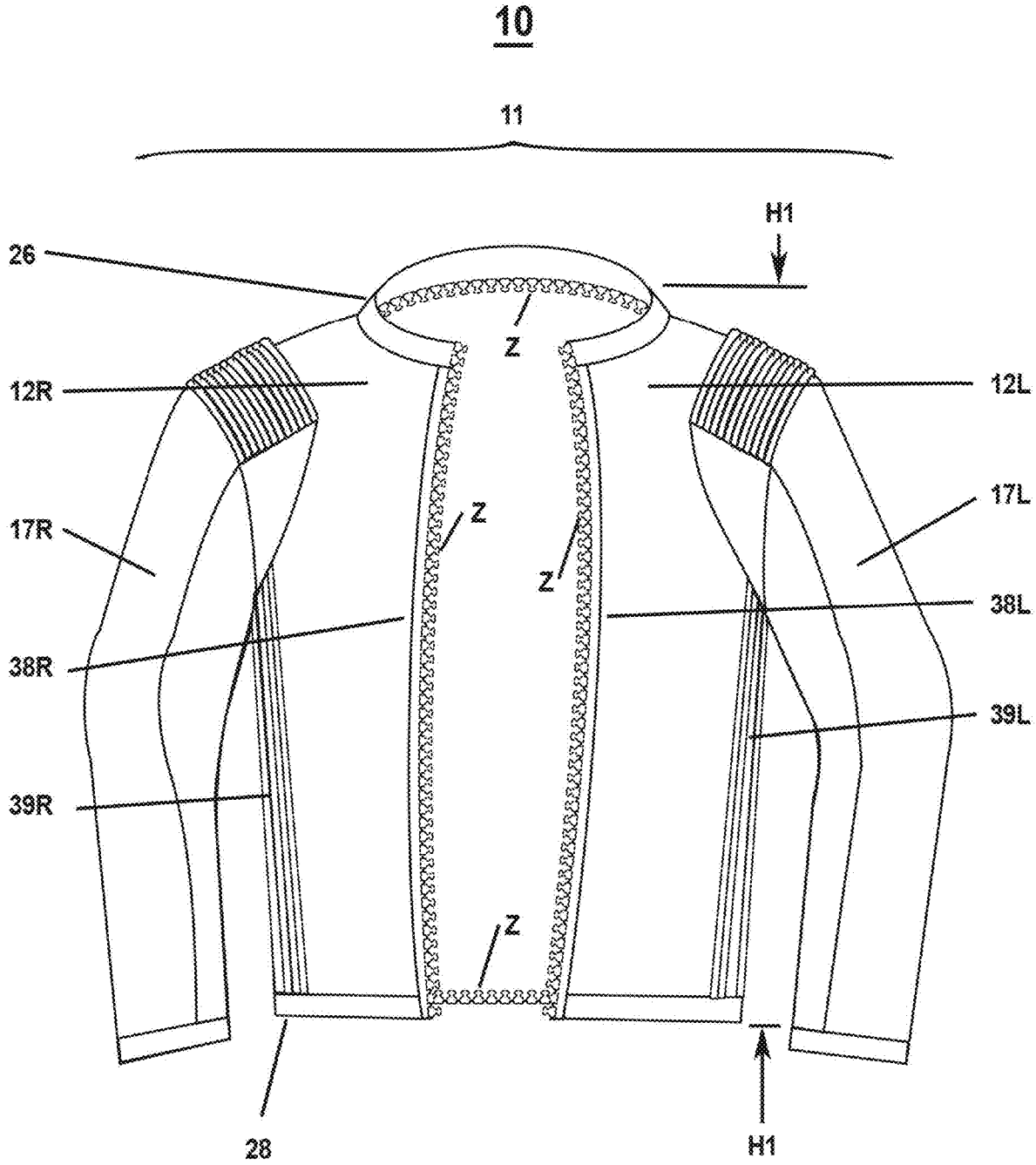


FIG. 1A

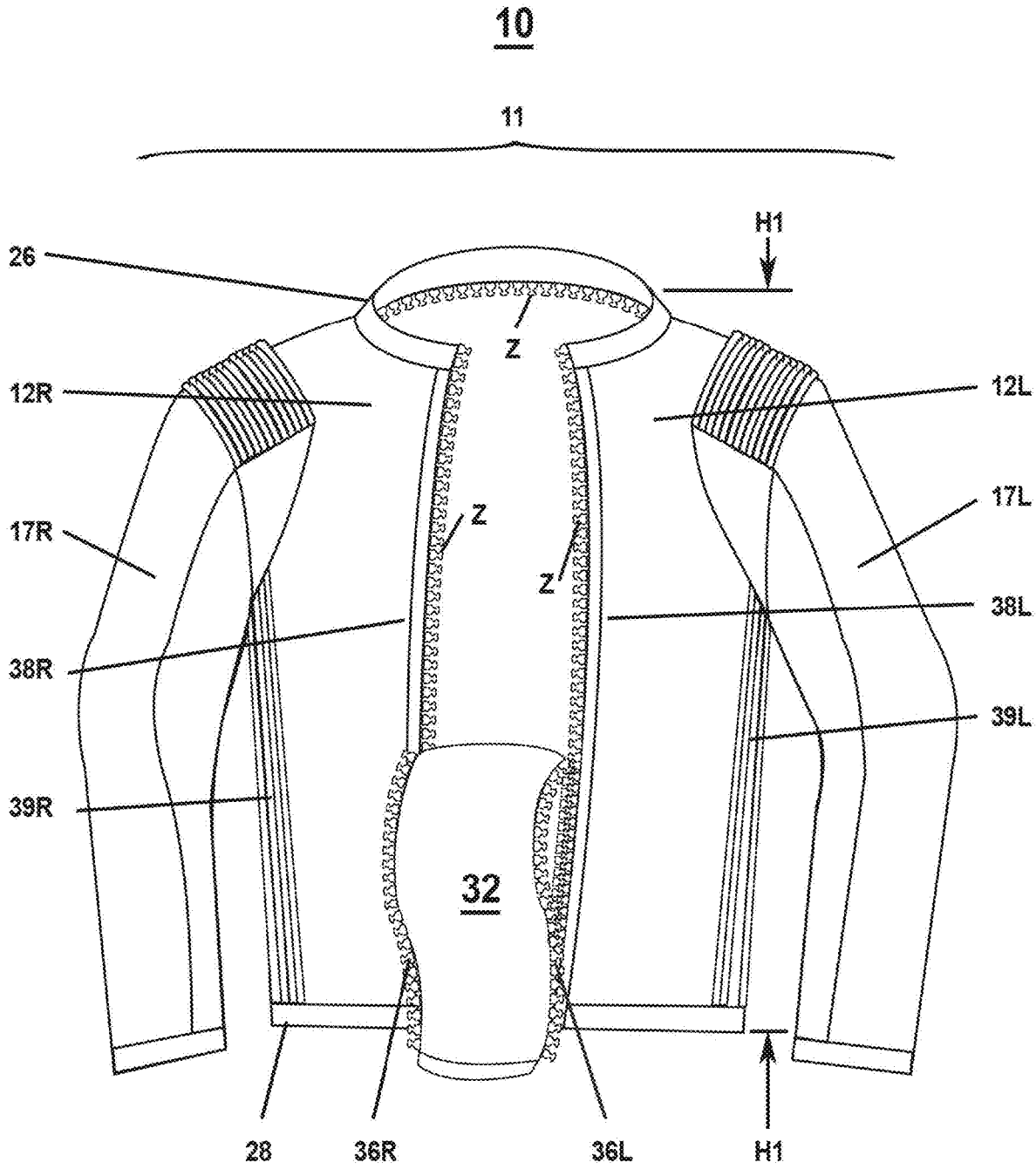


FIG. 1B

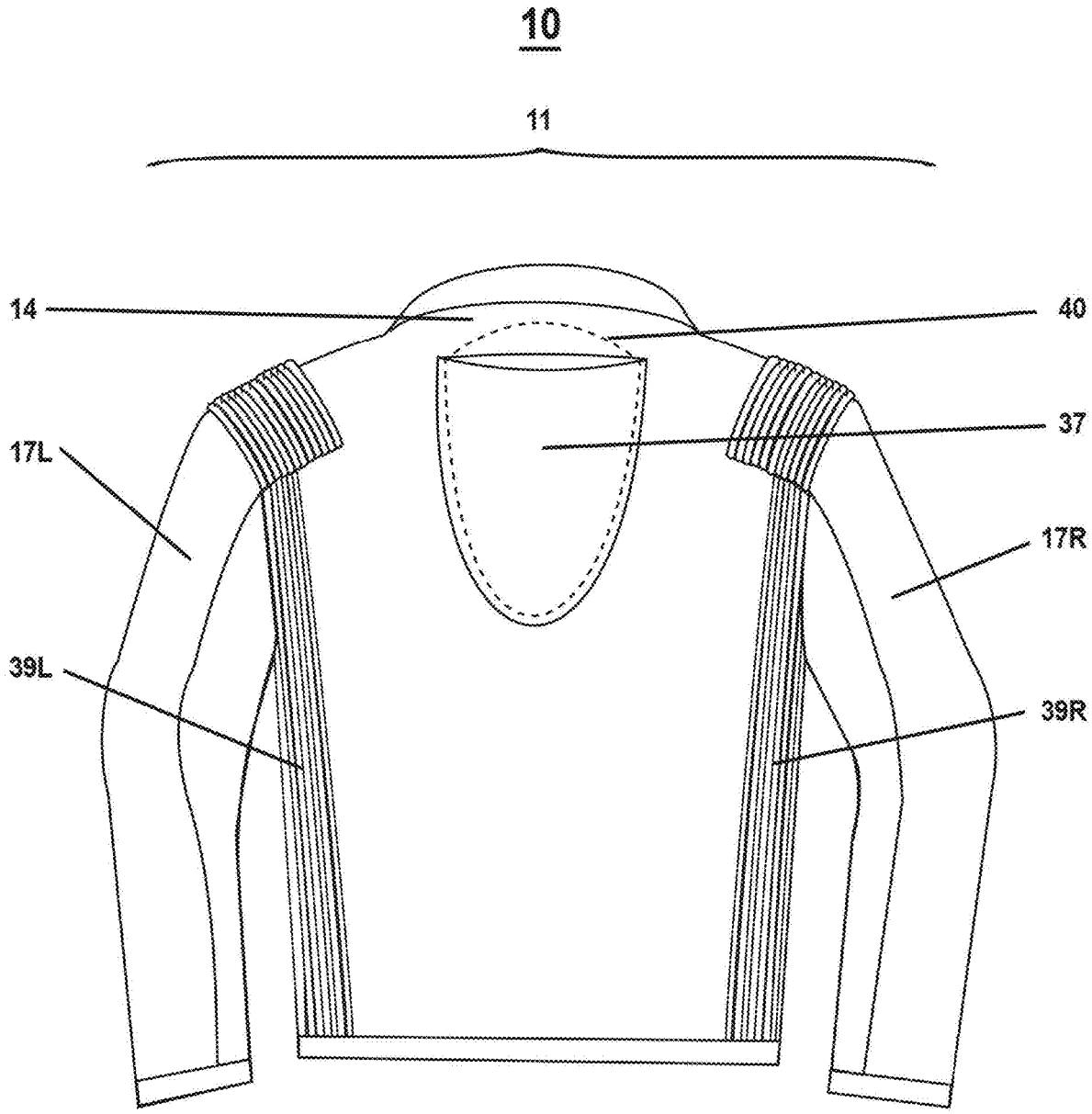


FIG. 2

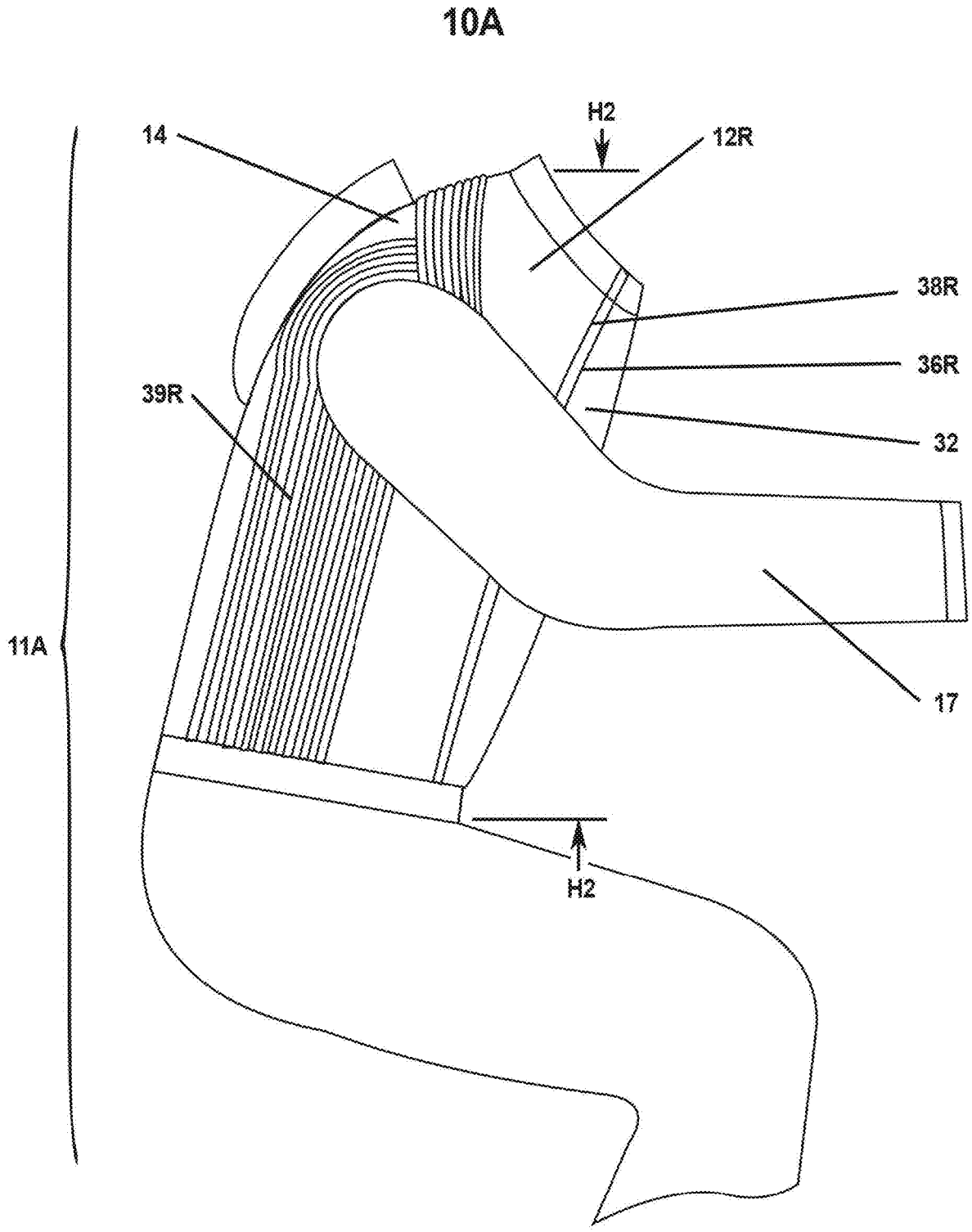


FIG. 3

100

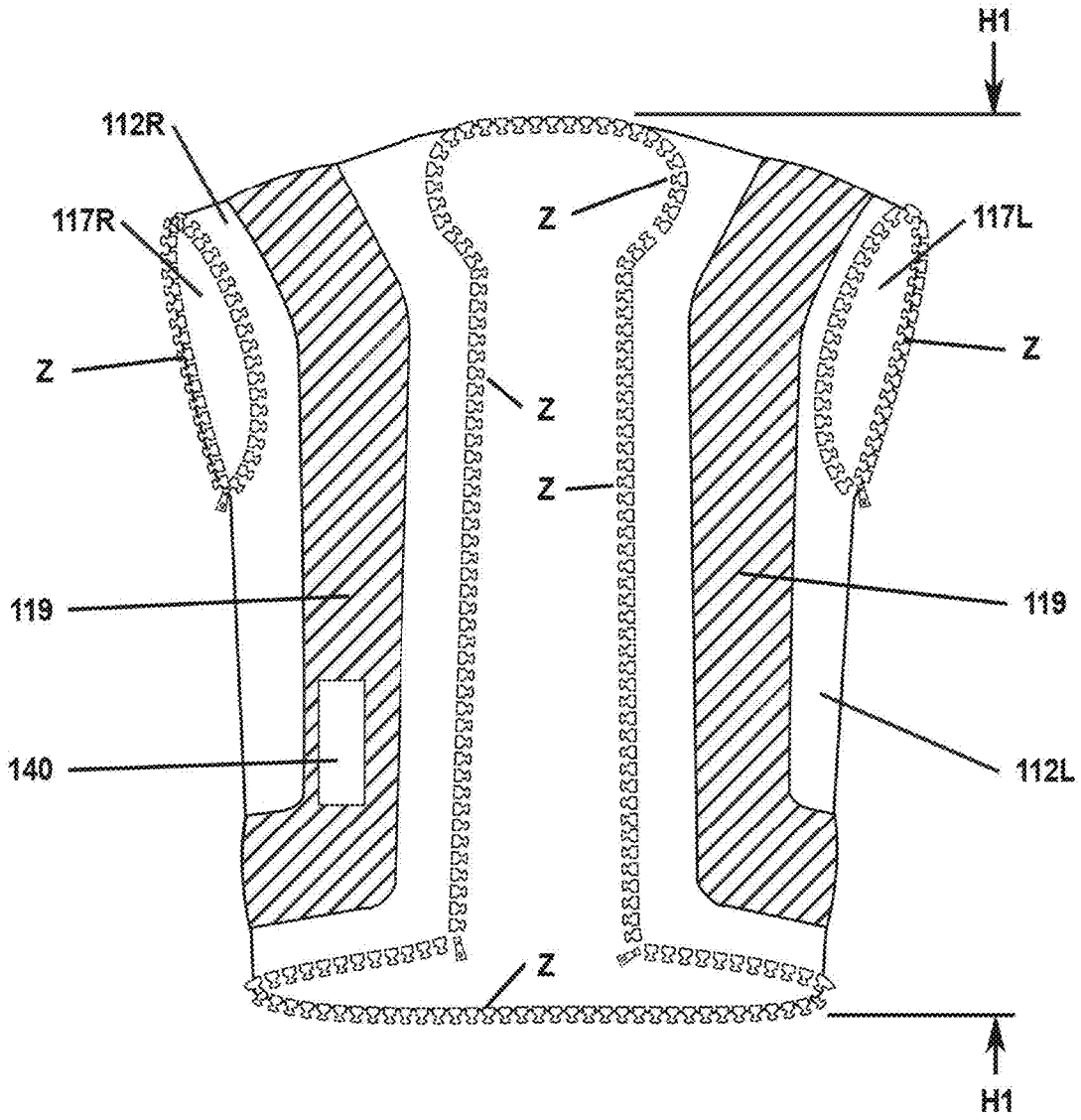


FIG. 4A

100

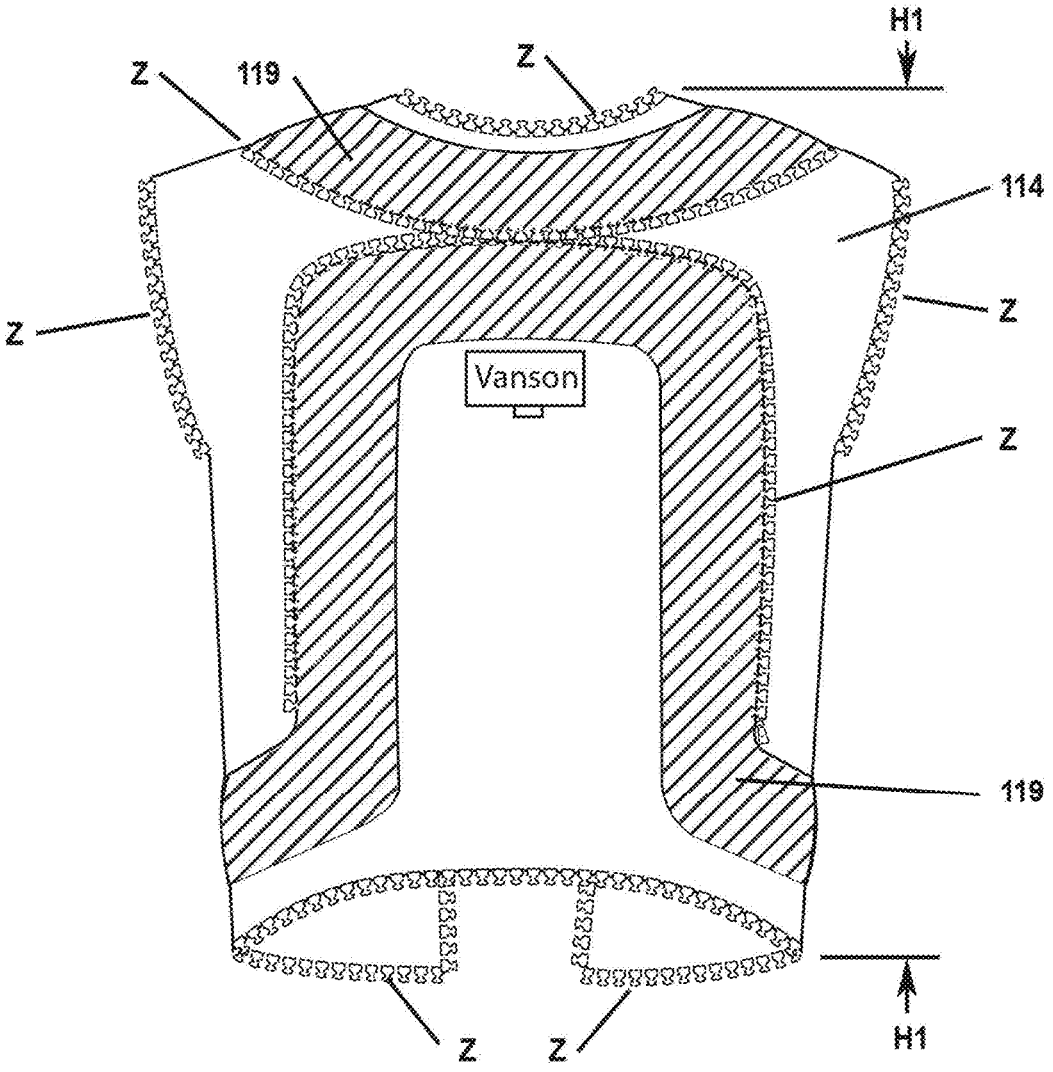


FIG. 4B

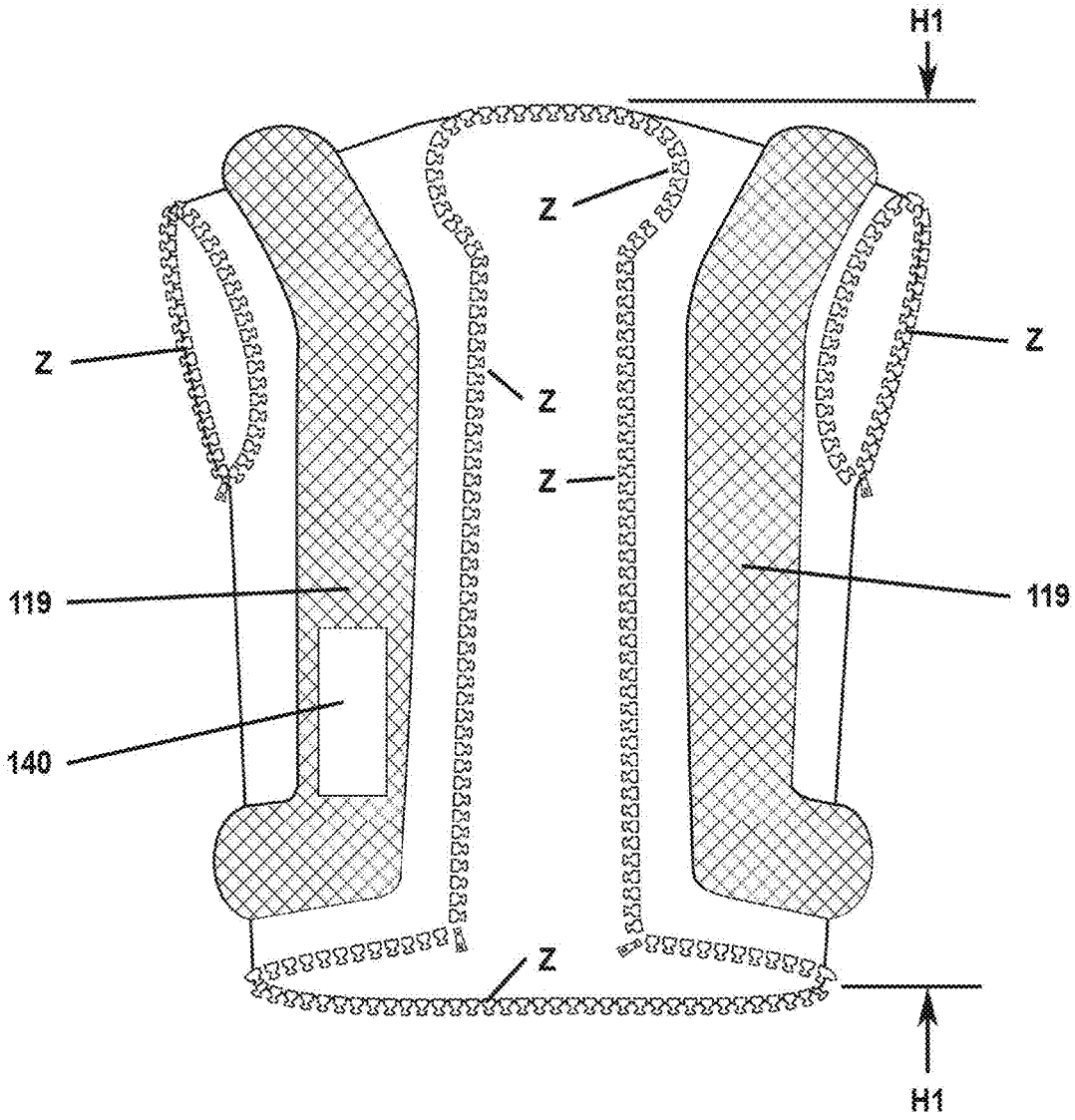


FIG. 4C

100

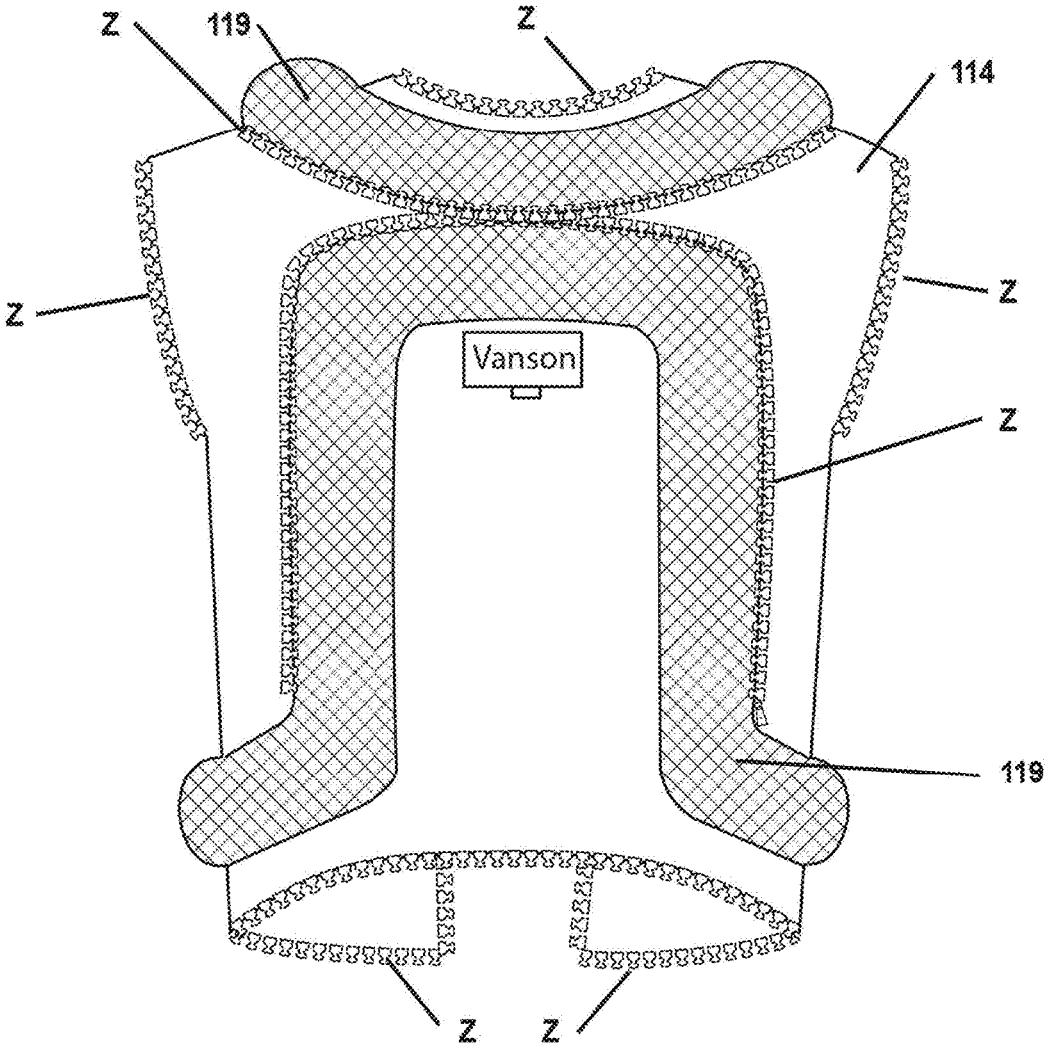


FIG. 4D

100

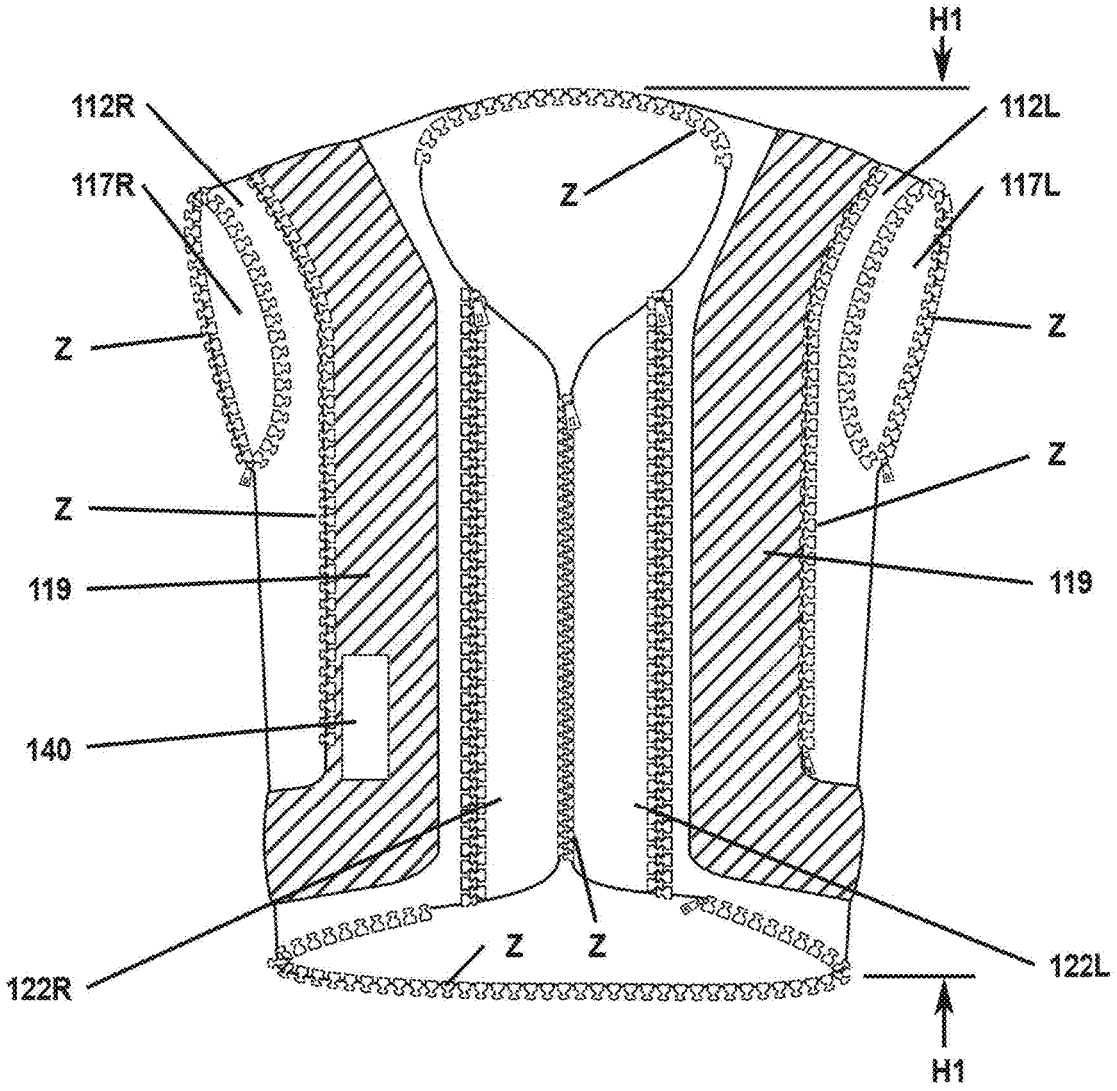


FIG. 5A

100

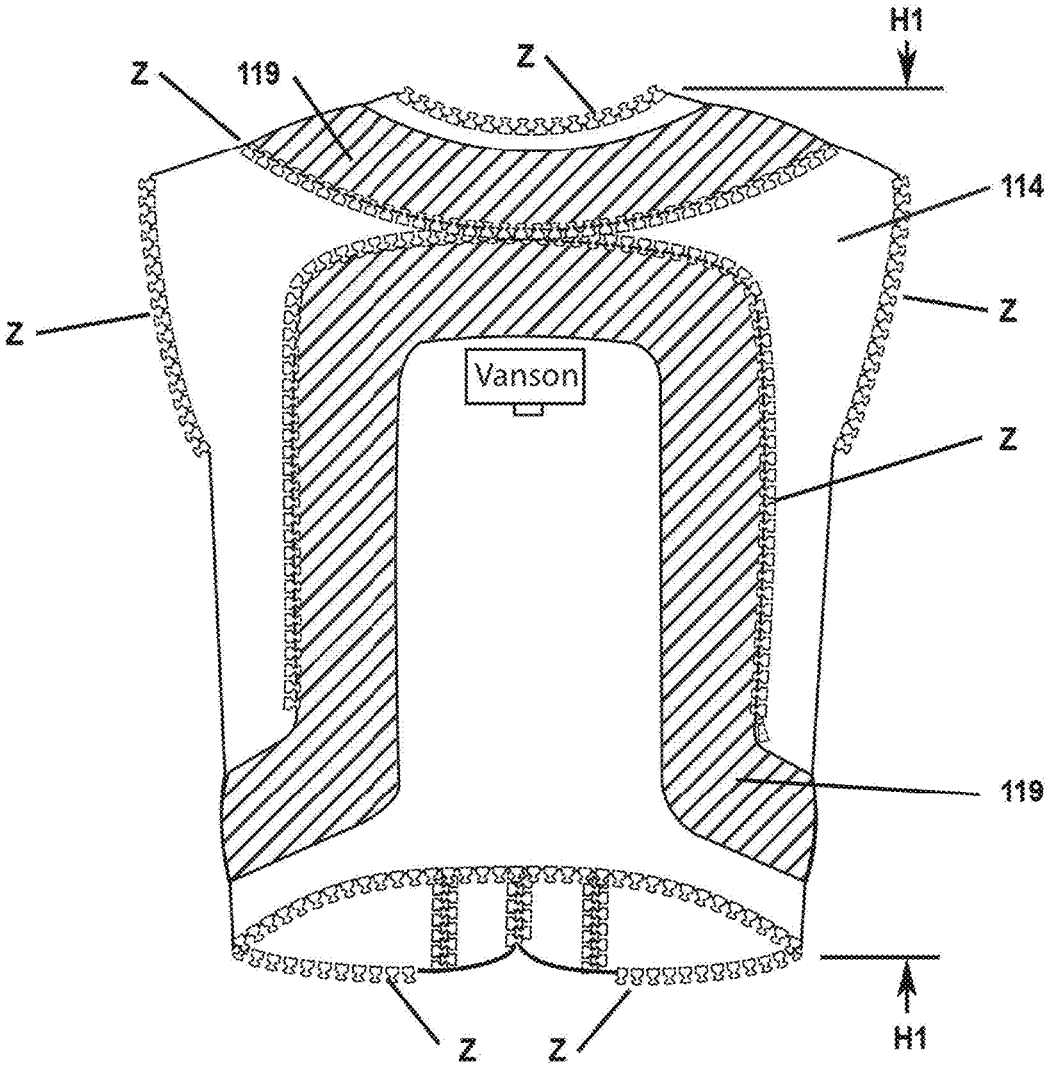


FIG. 5B

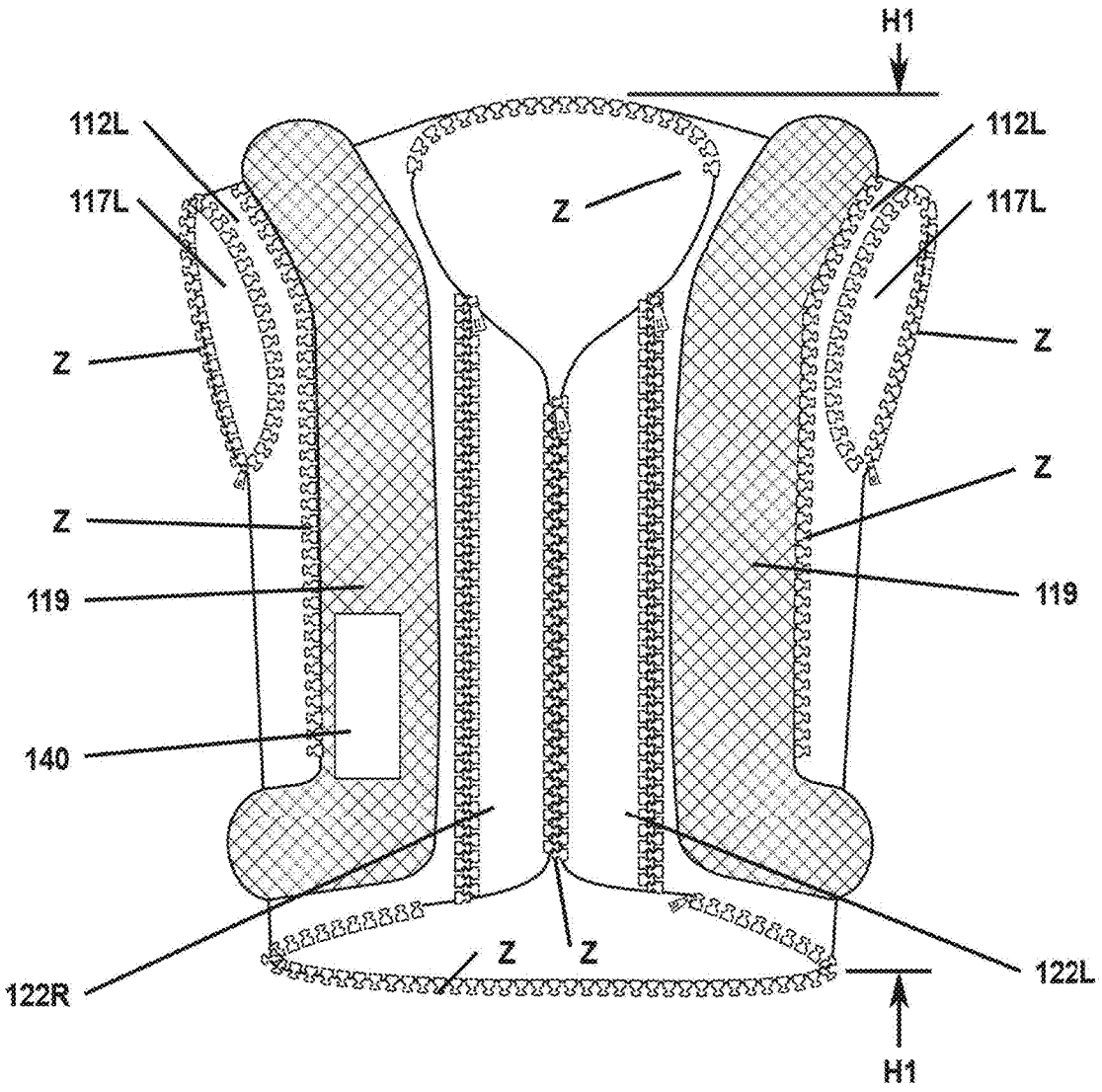


FIG. 5C

100

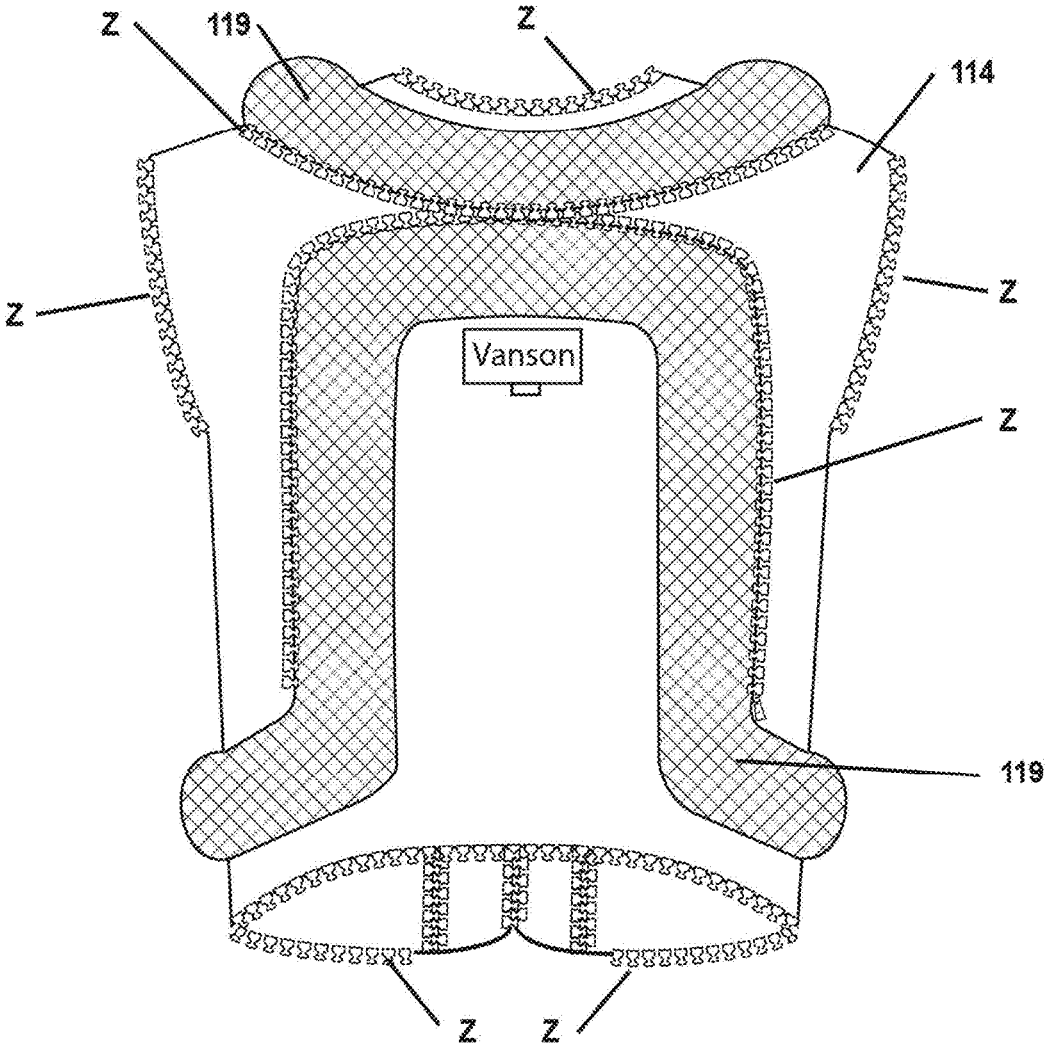


FIG. 5D

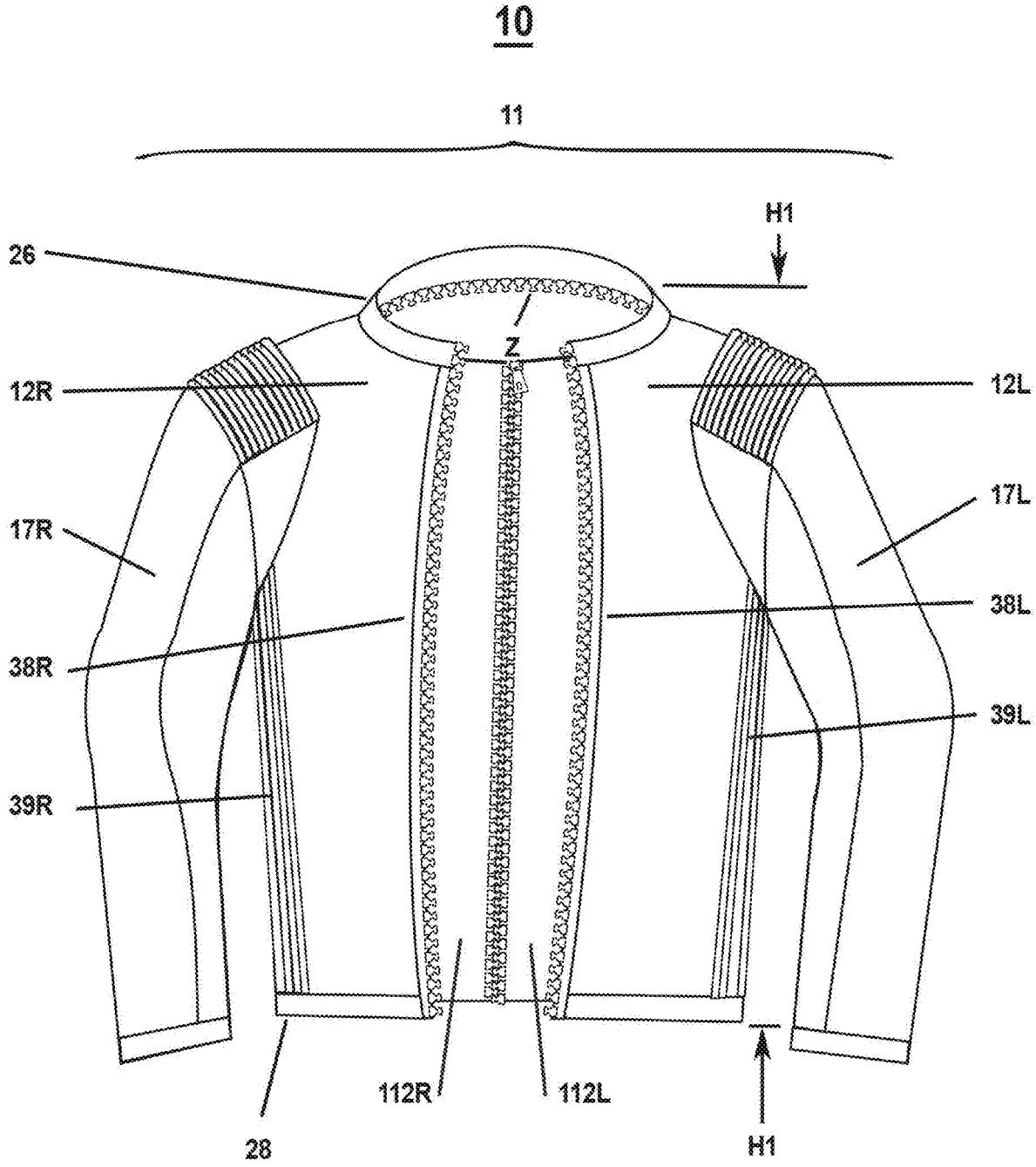


FIG. 6

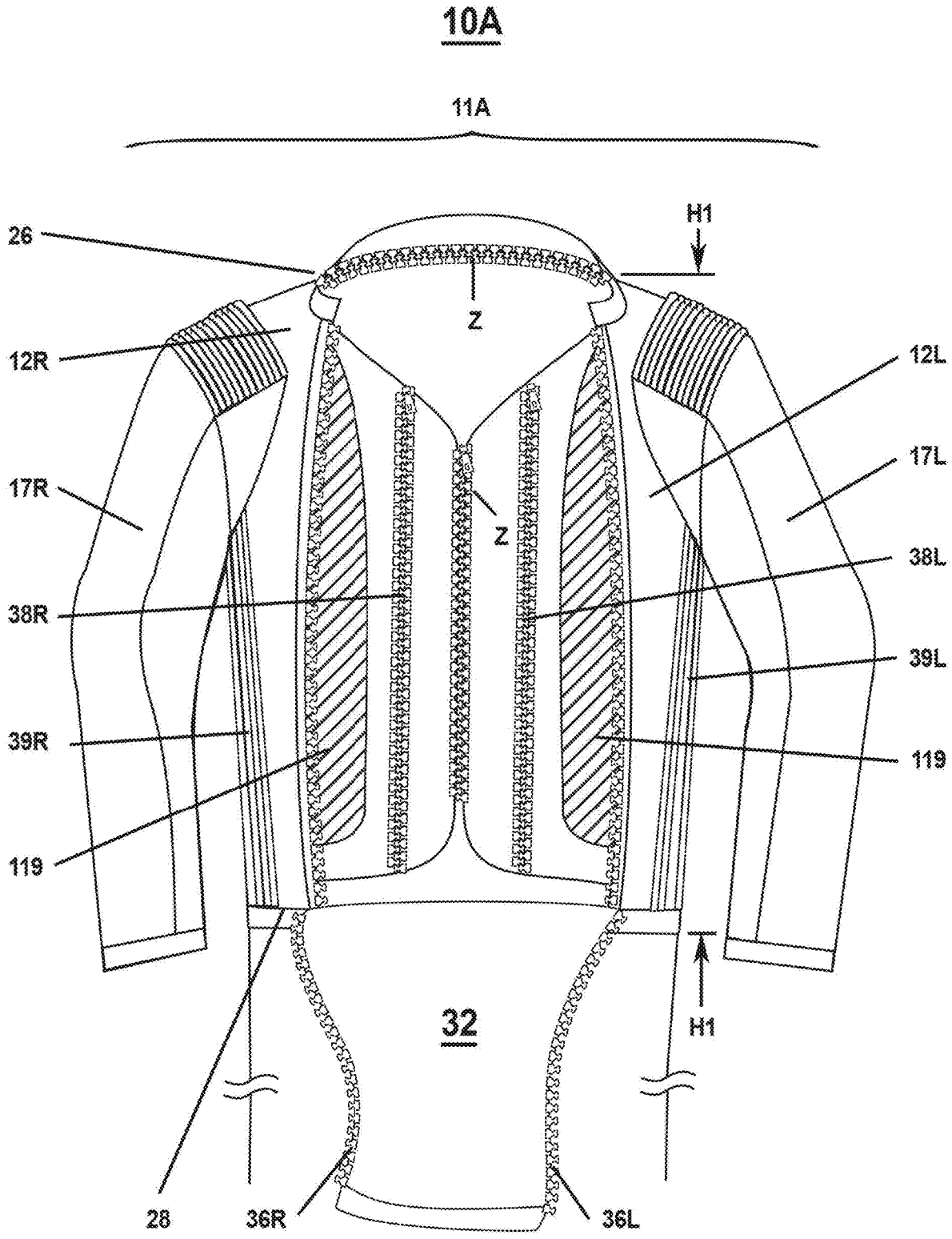

10A
11A
26
H1
Z
12R
12L
17L
17R
Z
38L
38R
39L
39R
119
119
32
H1
28
36R
36L

FIG. 7

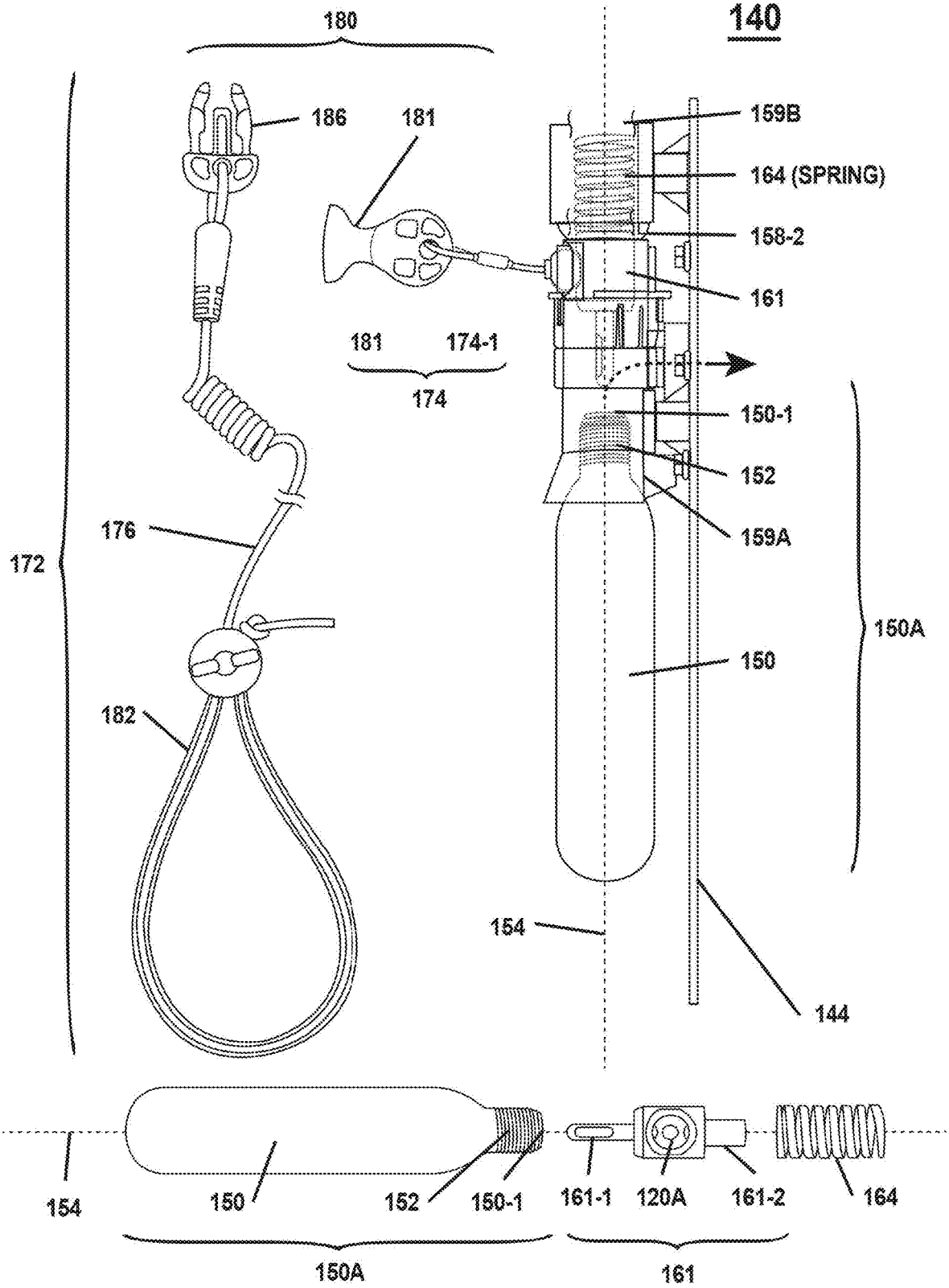

180
140
186
181
159B
164 (SPRING)
158-2
161
181
174-1
174
150-1
152
159A
176
172
150A
150
182
154
144
154
150
152
150-1
161-1
120A
161-2
164
150A
161

FIG. 8

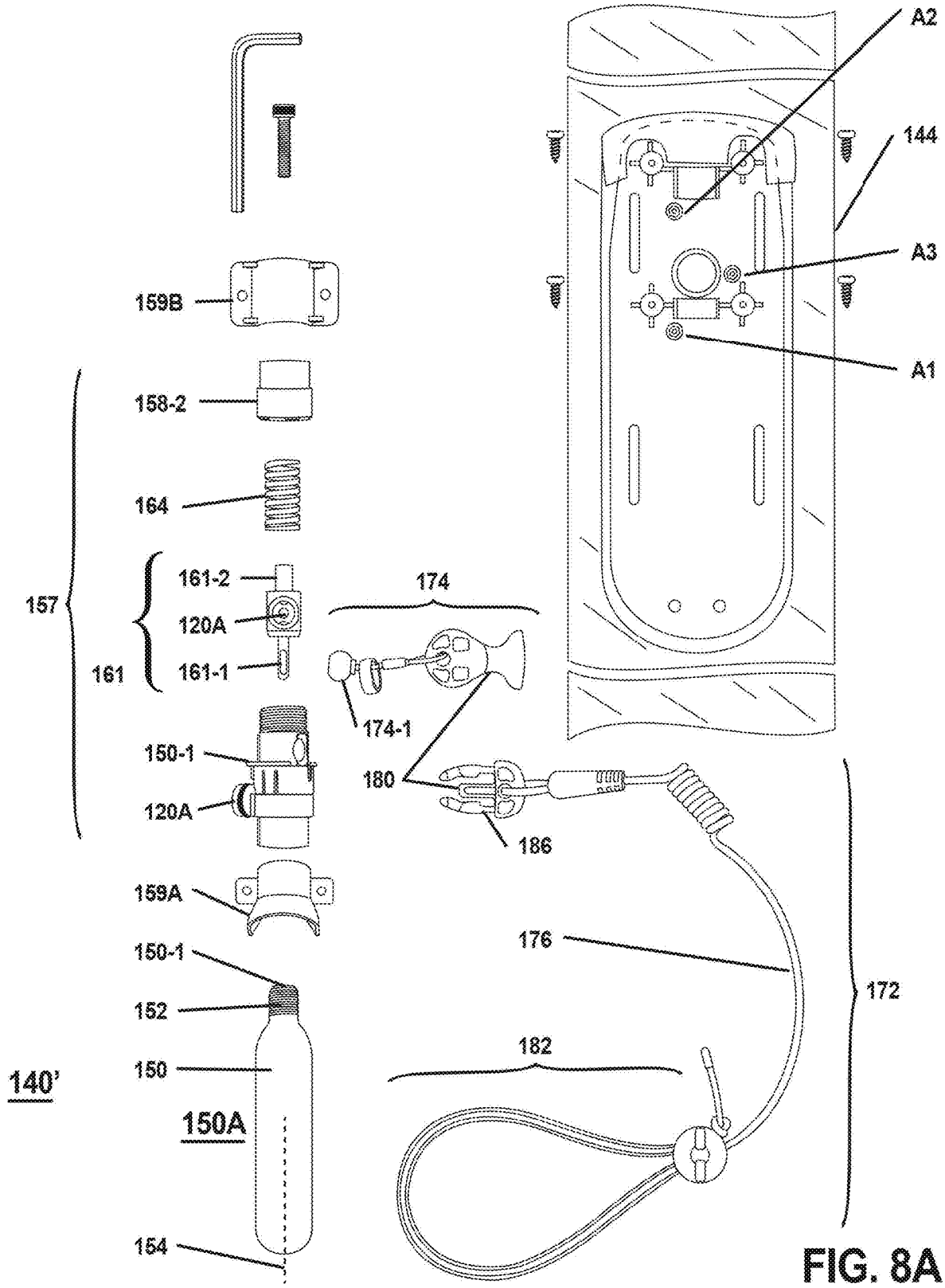

A2
144
A3
A1
159B
158-2
164
157
161-2
120A
161
161-1
174
174-1
150-1
120A
180
186
159A
150-1
176
172
152
182
140'
150
150A
154

FIG. 8A

10A

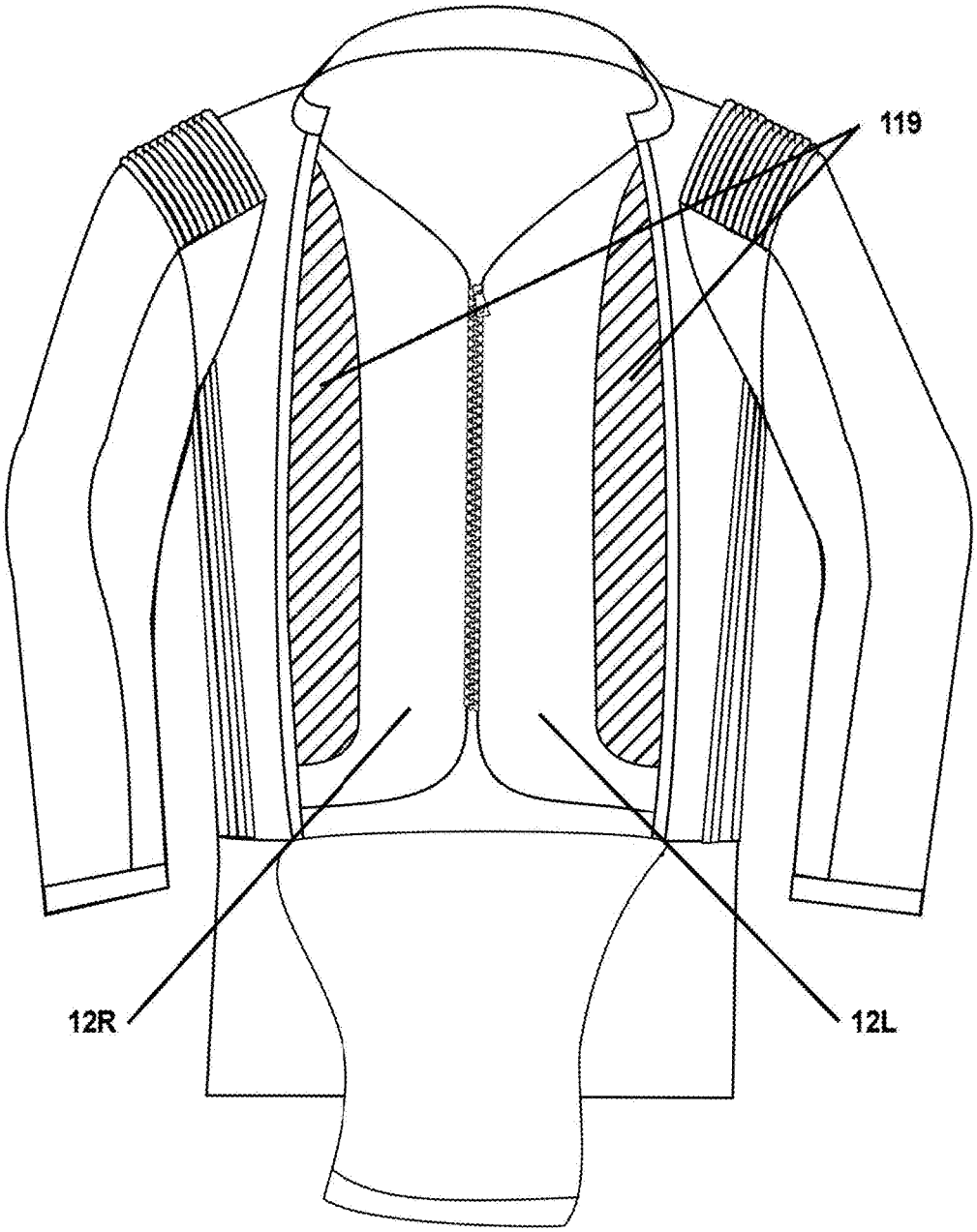


FIG. 9

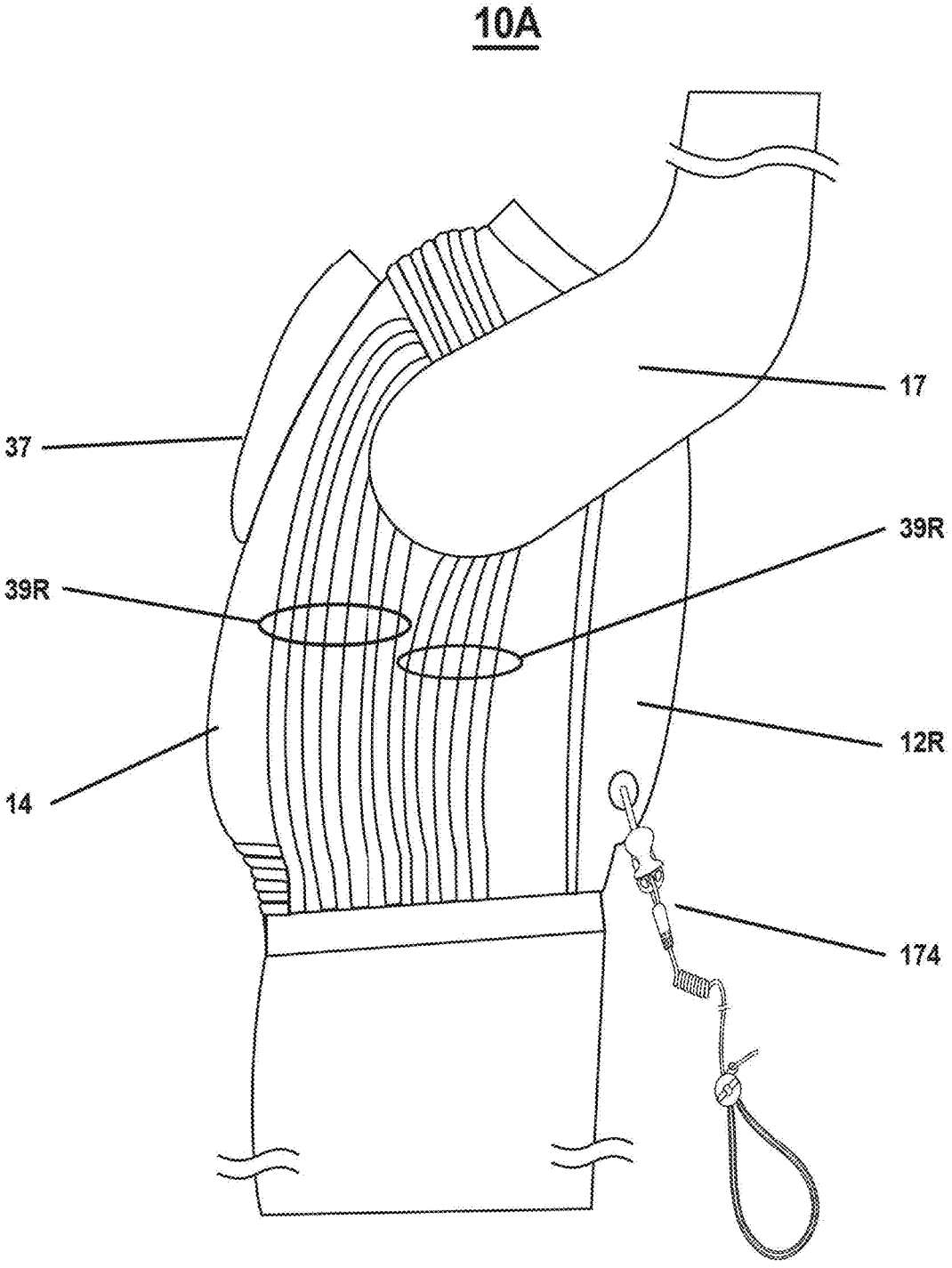


FIG. 10

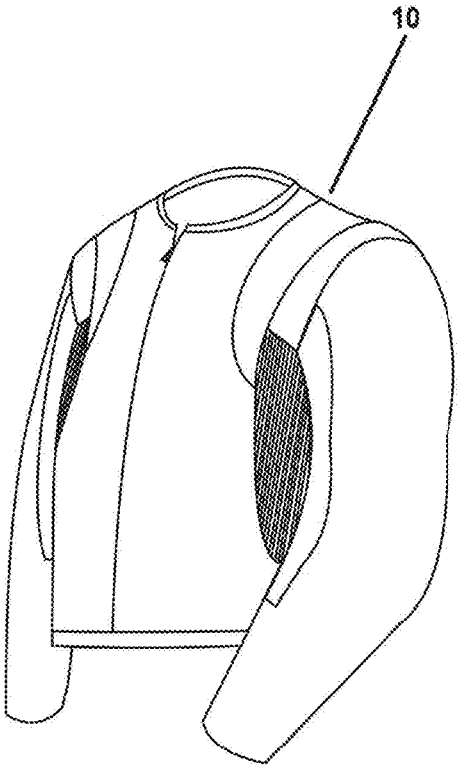


FIG. 11A

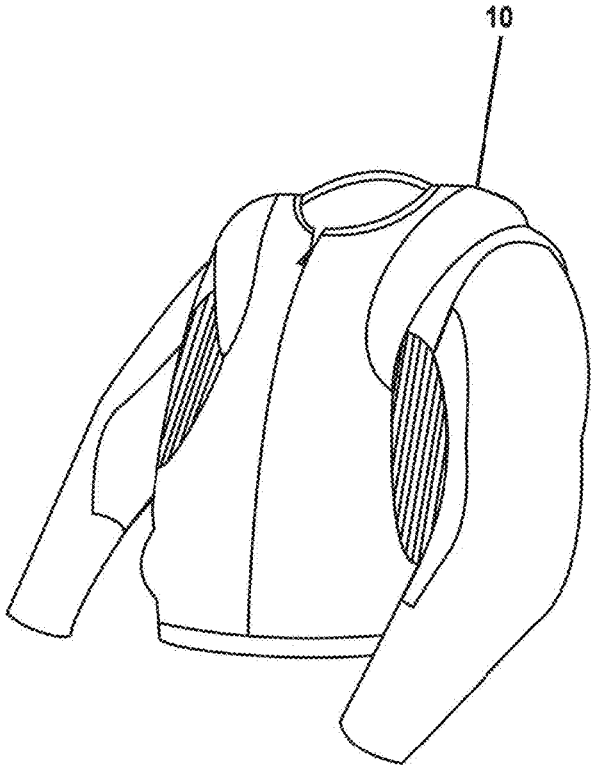


FIG. 11B

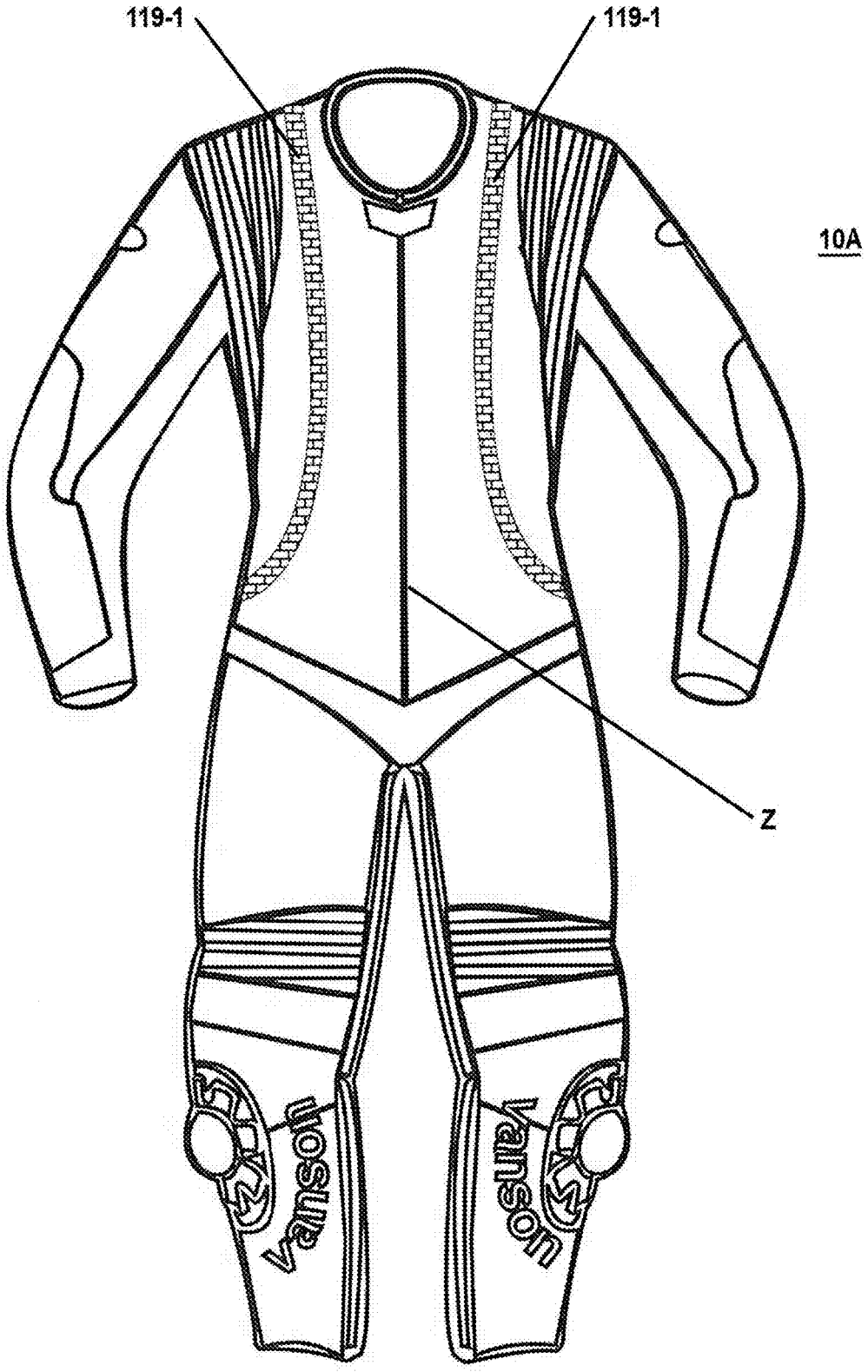


FIG. 12A

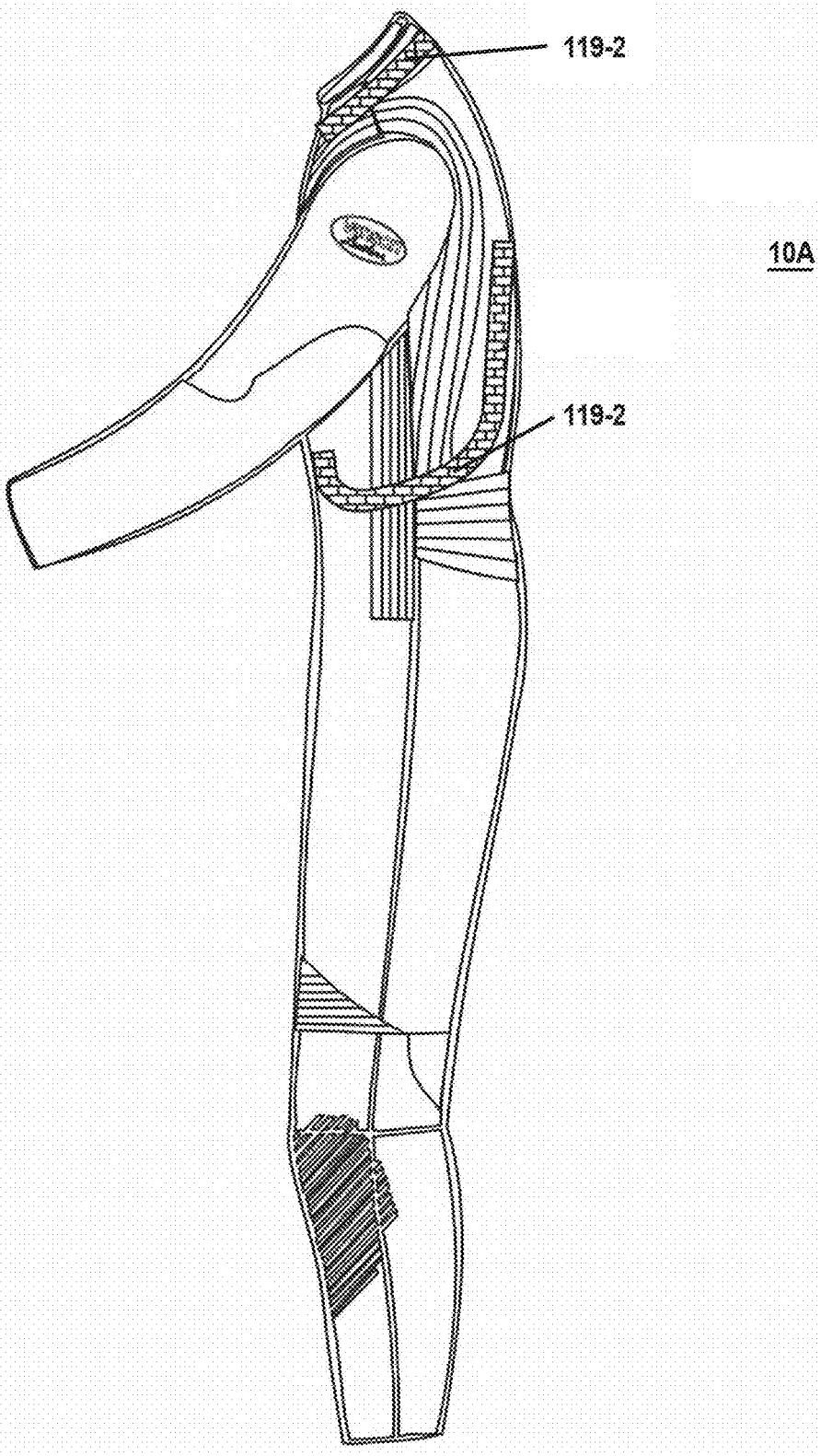


FIG. 12B

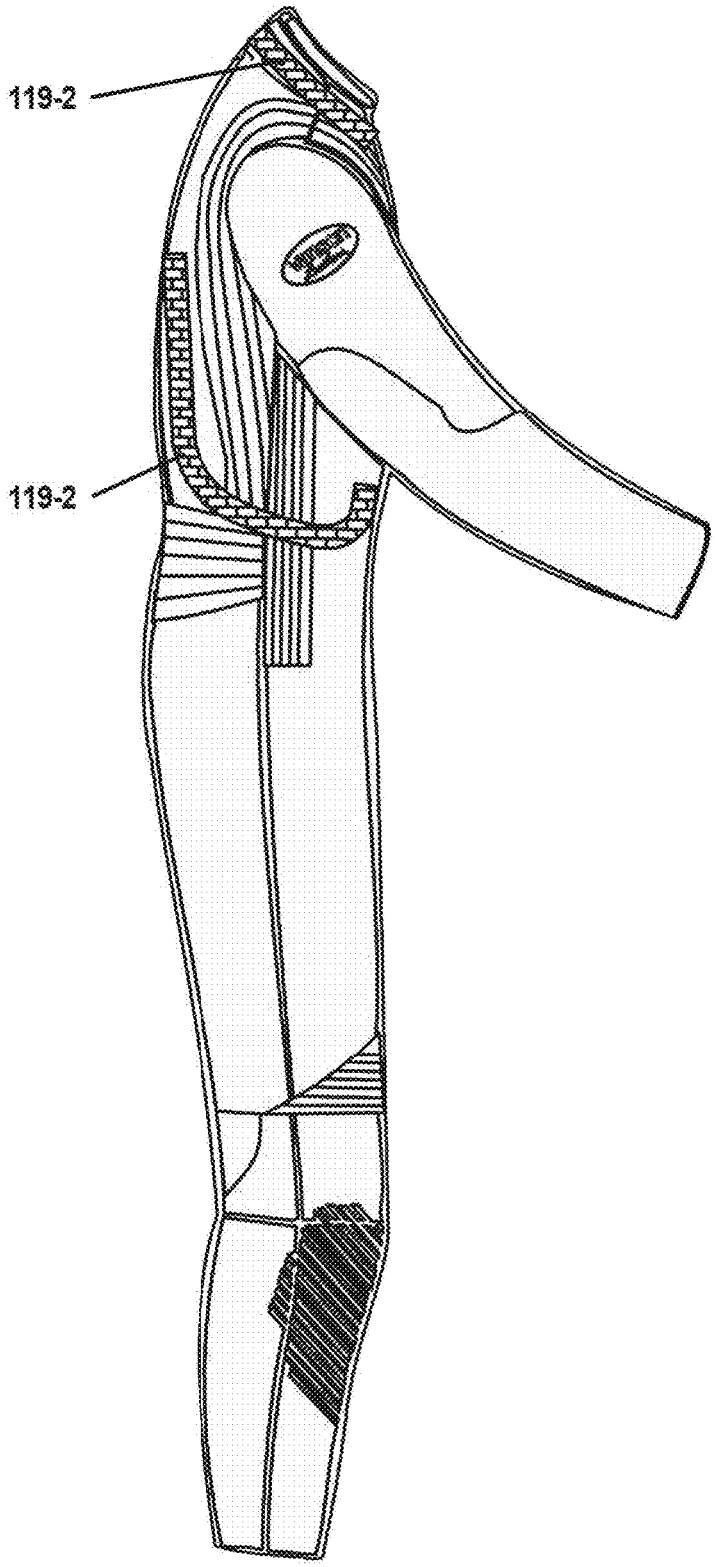


FIG. 12C

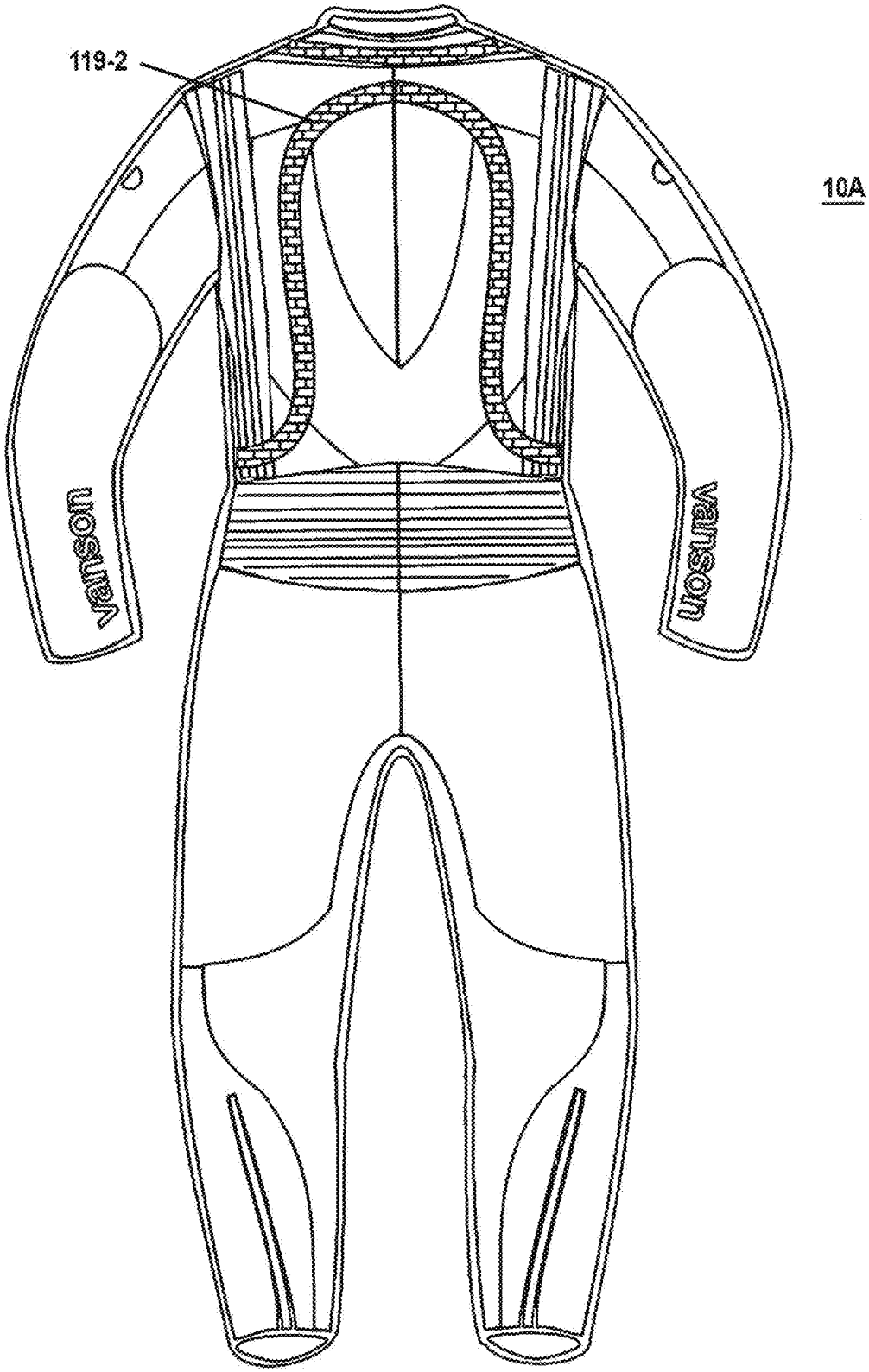


FIG. 12D

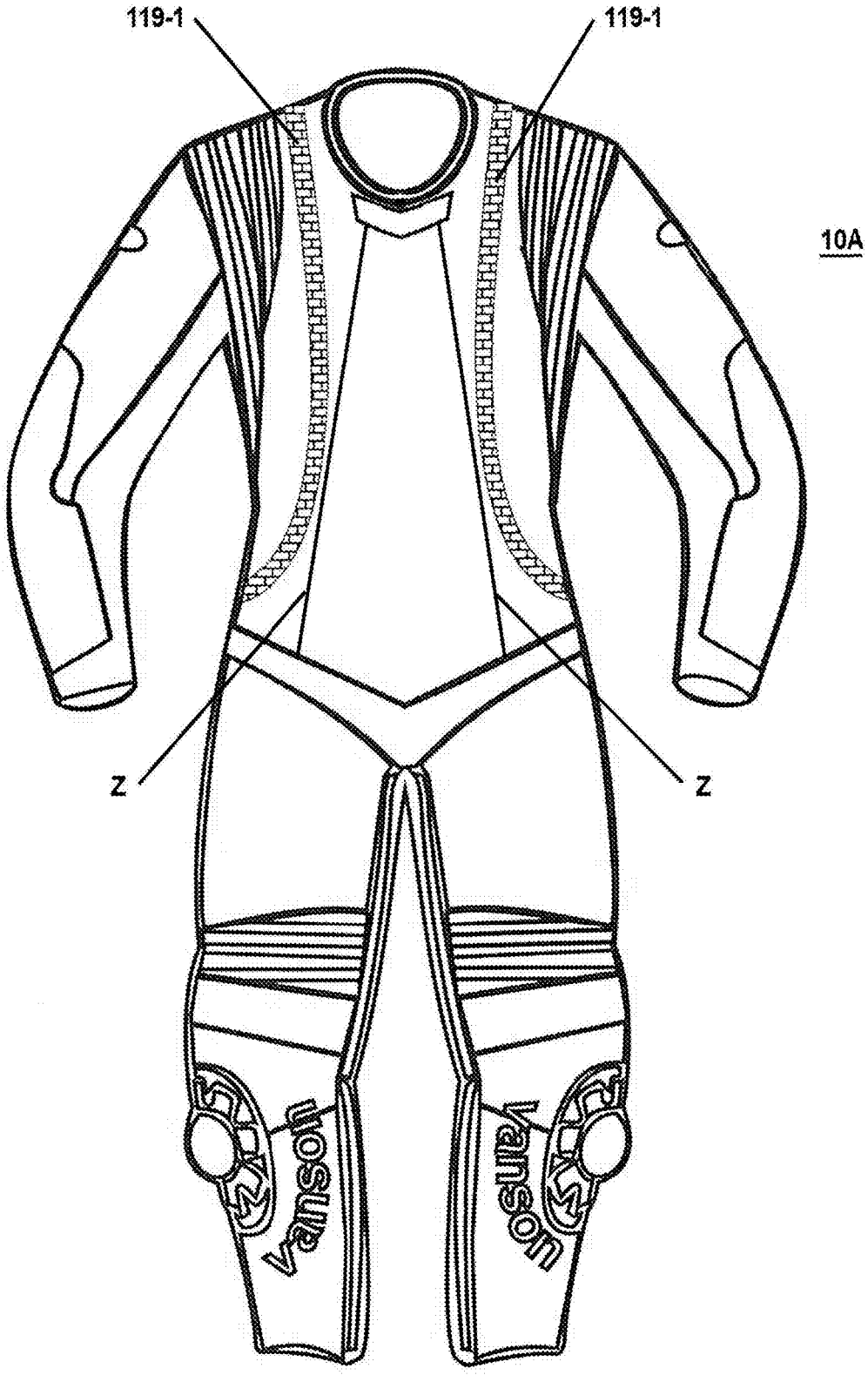


FIG. 12E

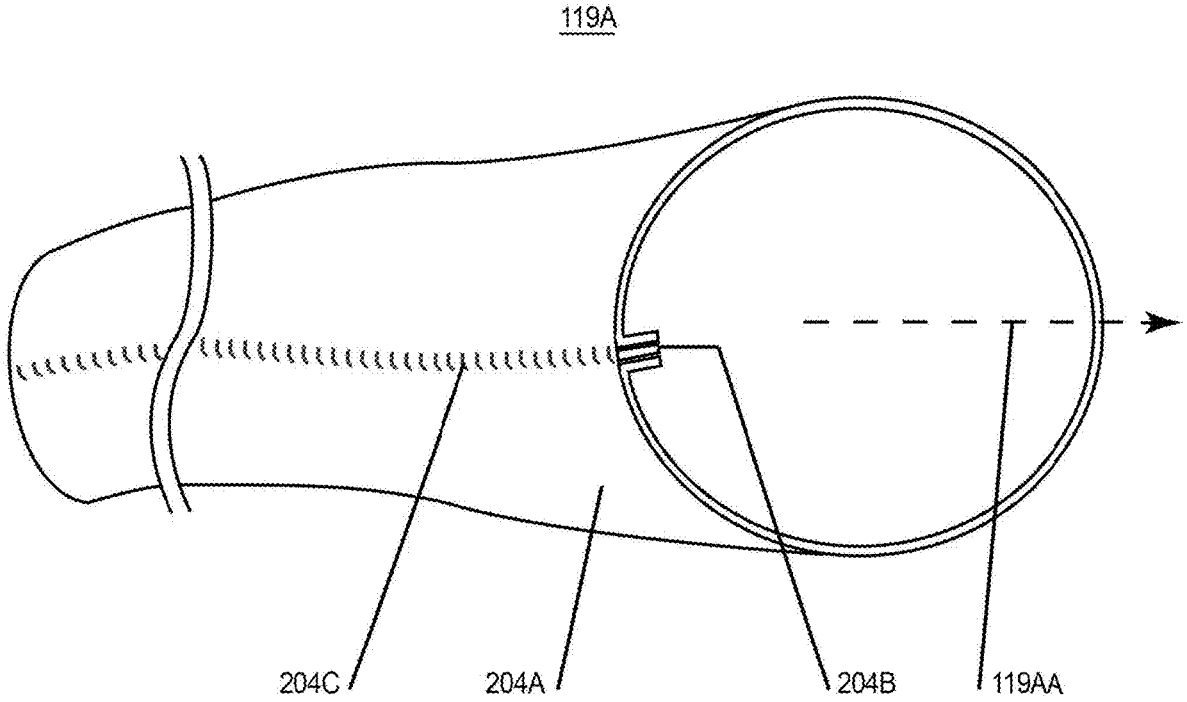


FIG. 13

PROTECTIVE GARMENT

TECHNICAL FIELD OF THE INVENTION

[0001] The present invention relates to protective garments designed for use by, for example, motorcycle riders.

BACKGROUND

[0002] Motorcycles are typically two-wheeled open motor vehicles adapted for riding by a single person driver, in the course of general recreational purposes, or in race competition. Often in connection with general recreational purposes, a passenger rides behind a driver. Sometimes, in connection with general recreational purposes, a motorcycle has a connected sidecar, making it a three-wheeled vehicle. Sometimes, such a vehicle has a partially open semi-enclosure extending partially about the passenger. In all of these situations, in the event of an accident, the driver and/or passenger, may incur serious injuries, particularly in the event any of such persons are separated from the vehicle pursuant to the accident.

[0003] Gear has been developed in the prior art for motorcycle riders to reduce chances of incurring serious injury during accidents.

[0004] Such gear worn by motorcycle riders should be relatively rugged to protect the rider in the event of a spill from the vehicle at any speed. Such protective gear preferably includes not only a helmet to protect the rider's head from injury, but also garments or outerwear which provide protective coverings for the rider's torso, arms and legs to prevent or minimize injuries that might arise from abrasion and laceration. Materials for the protective outerwear should be durable and rugged, yet relatively flexible and lightweight, aerodynamic, and aesthetically appealing.

[0005] U.S. Pat. Nos. 5,704,064, 5,507,042, 5,752,277 and 5,596,769, 6,070,274, issued to van der Sleesen and assigned to the assignee of the present invention, disclose representative protective garments for motorcycle riders. Although such garments are preferably made of a durable material, such as leather, additional protection may be conferred to the rider by including protective armor or shielding in portions of the garments which cover vulnerable areas of the rider's body, such as, for example, the elbows, knees, shoulders, ribs, stomach, and lower back. Such protective garments are effective in eliminating, or reducing the severity of, injuries to riders during accidents or most other events.

[0006] However, in the prior art, there has been little development of effective protection for a rider, or passenger, of a motorcycle, or similar vehicle, who has been thrown, or otherwise separated, from a such a vehicle in the course of an accident, or other event. The present disclosure addresses the shortcoming of the prior art and provides improved garments which particularly address that shortcoming.

SUMMARY OF THE DISCLOSURE

[0007] An improved garment is presented with a wearer protection (WP) assembly integral with the improved garment, which automatically detects for a driver, and/or passenger wearing the improved garment, a departure of one or both such persons, or other persons, from an open motor vehicle, such as a motorcycle. In most cases. The detected departure will be a consequence of a highway or track accident.

[0008] In response to such detection, a normally (i.e., prior to departure from the motor vehicle) deflated bladder-like gas reservoir is explosively inflated by an on-board previously-stored compressed gas. The garment is fitted with expandable portions to accommodate the increased size of the newly inflated gas reservoir.

[0009] The inflated bladder-like gas reservoir provides a closed gas-filled volume between an outer surface of the garment and body parts of the thrown persons. That gas-filled volume is compressible and the gas within absorbs some of the energy encountered by the thrown person in response to external forces resulting from the accident or other event. That absorption of energy is effective to reduce the effects of external forces on the thrown person, arising from the accident.

BRIEF DESCRIPTION OF THE DRAWING

[0010] FIG. **1**A shows a front view of a single-zipper outer shell of an exemplary garment embodying the protective technology of the disclosure;

[0011] FIG. **1**B shows a front view of a twin- (or dual-) zipper outer shell of an exemplary garment embodying the protective technology of the disclosure;

[0012] FIG. **2** shows a rear view of the outer shell of exemplary garments of FIGS. **1**A and **1**B;

[0013] FIG. **3** shows a side view of a form of another exemplary garment embodying the protective technology of the disclosure;

[0014] FIG. **4**A shows a front view of a first exemplary Wearer Protection Section adapted for residing in the interior of the single-zipper outer shell of the protective garment of FIGS. **1**A and **2**, prior to deployment of a gas to an interior gas containment reservoir;

[0015] FIG. **4**B shows a rear view of the Wearer Protection Sections of FIG. **4**A, adapted for residing in the interior of the outer shell of the protective garments of FIGS. **1**A and **2**, prior to deployment of gas to its interior gas containment reservoir;

[0016] FIG. **4**C shows a front view of the exemplary Wearer Protection Section of FIG. **4**A, after deployment of gas to its interior gas containment reservoir;

[0017] FIG. **4**D shows a rear view of the exemplary Wearer Protection Section of FIG. **4**A, after deployment of gas to its interior gas containment reservoir;

[0018] FIG. **5**A shows a front view of a second exemplary Wearer Protection Section adapted for residing in the interior of the dual-zipper outer shell of the protective garment of FIGS. **1**B and **2**, prior to deployment of a gas to its interior gas containment reservoir;

[0019] FIG. **5**B shows a rear view of the Wearer Protection Sections of FIG. **5**A, adapted for residing in the interior of the outer shell of the protective garments of FIGS. **1**B and **2**, prior to deployment of gas to its interior gas containment reservoir;

[0020] FIG. **5**C shows a front view of the exemplary Wearer Protection Section of FIG. **5**A, after deployment of gas to its interior gas containment reservoir;

[0021] FIG. **5**D shows a rear view of the exemplary Wearer Protection Section of FIG. **5**A, after deployment of gas to its interior gas containment reservoir;

[0022] FIG. **6** shows a front view of the outer shell of the protective garment of FIGS. **1**A and **2**, with the exemplary Wearer Protection Section of FIGS. **4**A-**4**D residing in the interior of the outer shell of FIGS. **1**A and **2**;

[0023] FIG. **7** shows a front view of the outer shell of the protective garment of FIGS. **1**B and **2**, with the exemplary Wearer Protection Section of FIGS. **5**A-**5**D residing in the interior of the outer shell of FIGS. **1**B and **2**;

[0024] FIG. **8** shows, in schematic diagram form, an exemplary a gas fill trigger/release assembly of the outer shell of the protective garments of FIGS. **1**A-**3**;

[0025] FIG. **8**A shows, in schematic diagram form, an exploded view of the cartridge gas-fill controller and trigger/release assembly of FIG. **8**;

[0026] FIG. **9** shows a front view of an alternate the form of a full-body suit embodying the protective technology of the disclosure;

[0027] FIG. **10** shows a side view the garment of FIG. **3** with the right-side sleeve raised to show areas which expand to accommodate inflation of an underlying gas containment reservoir;

[0028] FIG. **11**A and FIG. **11**B show side-frontal views of an exemplary protective garment of FIGS. **1**A and **2**, before and after deployment of gas from its interior gas containment reservoir, respectively;

[0029] FIGS. **12**A-**12**D, illustrate a front view, a left (viewed from the front) side view, a right (viewed from the front) side view and a rear view, respectively, of an exemplary single-zipper full body suit embodying the technology of the disclosure, including, in phantom, rectangular blocks representative of a "serpentine" double inverted-U balloon-like gas containment reservoir underlying an outer shell of the upper (jacket-like) portion of the full body suit;

[0030] FIG. **12**E illustrates a front view of an exemplary dual-zipper full body suit embodying the technology of the disclosure, including, in phantom, rectangular blocks representative of a "serpentine" double inverted-U balloon-like gas containment reservoir underlying an outer shell of the upper (jacket-like) portion of the full body suit; and

[0031] FIG. **13** shows an end of an exemplary sleeve for receiving the reservoir of a jacket or upper (jacket-like) portion of a full body suit embodying the technology of the disclosure.

DESCRIPTION

[0032] A protective garment of the disclosure can have a two-part form which includes a Jacket

[0033] Section defining an outer shell which is similar to, but not entirely the same as, a motorcycle jacket of the prior art and having a disposed-in-its-interior, and integral, novel Wearer Protection Section. In an alternative form, a protective garment of the disclosure can have a one-part form which includes a Wearer Protection Section. In the latter form, the Wearer Protection Section is similar, not entirely the same as, that of the two-part form, and is adapted for removable fixation to an interior portion of an outer shell of a jacket. In both forms, the outer shell forming the Jacket Section, and the Wearer Protection Section, are adapted to be positioned about or adjacent to at least a portion of a body of a wearer of the garment,

Exemplary Jacket Section and Full-Body Suit Section

[0034] FIGS. **1**A and **2** illustrate the front and rear of a "single-zipper" (or 1-zipper) exemplary

[0035] Jacket Section of a protective garment **10** in the form of a single-zipper jacket constructed with an outer shell **11** adapted to form an enclosure about the upper torso of a wearer, according an embodiment of the subject disclosure. The single-zipper Jacket Section includes a single zipper assembly comprising selectively joinable zipper sections along opposing edges **38**L and **38**R of outer shell **11**, enabling selective user-driven closure of the front of the outer shell **11**.

[0036] FIGS. **1**B and **2** illustrate the front and rear of a "dual-zipper" (or 2-zipper) exemplary Jacket Section of a protective garment **10** in the form of a dual-zipper jacket constructed with an outer shell **11** adapted to form an enclosure about the upper torso of a wearer, according an embodiment of the subject disclosure. The illustrated dual-zipper Jacket Section includes a pair of single zipper assemblies Z disposed on either side of a central bib section **32**, and comprising selectively joinable zipper sections along opposing edges **36**L and **38**L, and edges **36**R and **38**R of outer shell **11**, enabling selective user-driven closure of the bib section **32**, spanning opposing edges of the front of the outer shell **11**.

[0037] The outer shell **11** can have the form of a jacket, for example, of the type that may be used during a recreational use by a motorcycle rider. FIG. **3** shows a side view of an exemplary dual-zipper Full-Body Suit Section, an alternative exemplary protective garment **10**A forming a full-body racing suit constructed with an outer shell **11**A to form an enclosure about both the torso of a wearer and the wearer's lower body. The outer shell **11**A can have the form of a racing suit, for example, of the type that may be used in a race competition by a motorcycle racer. Although illustrated as jackets in FIGS. **1**A, **1**B and **2**, and as a full-body racing suit in FIG. **3**, the garment **10** can be in other forms, such as a vest, or pants-only, or other protective garments adapted for disposition about a wearer's body parts in combination with a similarly constructed Wearer Protection Section.

[0038] The outer shell **11** of garment **10**, and the upper portion of the outer shell **11**A of garment **10**A, are similar, with each defining an inward facing surface (adapted to fit about the contour of a wearer) and including left and right (as viewed from inside the outer shell) front panels **12**L and **12**R, respectively, and a rear panel **14**. The left and right front panels **12**L and **12**R, are joined to lateral edges of the of the rear panel **14**. Left and right sleeves **17**L and **17**R extend from junctions of rear panel **14** and respectively ones of front panels **12**L and **12**R. In the exemplary dual zipper form of FIG. **1**B, together, front panels **12**L and **12**R, rear panel **14** and sleeves **17**L and **17**R form a jacket-like structure, except that, if worn by a wearer, without more, the jacket-like structure is dimensioned such that it could not be closed about an appropriately sized wearer's body because there would be a gap between facing edges of front panels **12**L and **12**R.

[0039] As shown in the exemplary dual zipper form of FIG. **1**B, between a top (collar) region **26** and bottom (waist) region **28**, there is a wearer-openable bib element **32** removably disposed in the gap between the facing edges of front panels **12**L and **12**R. In a preferred form, a 2-element closure assembly is structured to allow a wearer, who is wearing the garment, to selectively couple or de-couple the left edge **36**L of the bib element **32** to the left **38**L edge of the left front panel **12**L, and selectively couple or de-couple the right edge **36**R of the bib element **32** to the right edge **38**R of the right front panel **12**R. In the exemplary embodiment of FIG. **1**B, the closure assembly Includes a 2-zipper assembly formed by a first zipper having complementary left zipper elements

Z extending along edges **36**L and **38**L and a left zipper joinder element, and a second zipper having complementary zipper elements Z extending along edges **36**R and **38**R and a right zipper joinder element. In other embodiments, alternatives to zippers are used to effect reversible closure.

[0040] With the illustrated configuration of FIG. **1**B, the opposed elements of the respective zippers Z are adapted to selectively engage under the control of the wearer, permitting the wearer to maintain the closure element at or between (1) a "garment-closed" position whereby the bib element **32** fully spans the gap between top-to-bottom-running edges at the ends of left and right front panels **12**L and **12**R, and a (2) "garment-fully open" position whereby the bib element **32** is fully unzipped, whereby the material portions of the top-to-bottom-running edges at the ends of left and right front panels **12**L and **12**R are mutually spaced apart. When the garment **10** is in the garment-fully closed position, the wearer's upper torso is maximally enclosed by the outer shell **11**. A front panel and bib element and zipper assembly are similarly configured in shell **11**A of garment **10**A, shown in FIG. **3**.

[0041] The back panel **14** includes an open topped air scoop **37** (which may have the form of a conic section), which overlies an air permeable layer which allows relatively cool outer air to enter as the rider leans forward, via the scoop to the interior of the outer shells **11** or **11**A in use. That air may exit through conventional-style jacket vents. Scoop **37** also provides a portion of the Wearer Protection Section described below

[0042] Also as shown in FIG. **2**, front-to-back highly stretchable (compared to the material of front and rear panels **12**L, **12**R and **14**) corrugated material, or other forms of similarly highly elastic regions **39**L and **39**R, are disposed beside and below the junction of sleeves **17**L and **17**R to their respective front and rear panels **12**L and **12**R, and rear panel **14**, of the outer shells **11** and **11**A. A left-to-right similarly highly stretchable region **40** of outer shells **11** and **11**A is underlies air scoop **37**. Those highly stretchable regions contribute to the functionality of the Wearer Protection Section as described below.

[0043] In a form, as may be seen from FIGS. **1**B and **3**, when the bib element **32** is engaged with the front panels **12**L and **12**R by the zipper elements Z so that they effect closure of garment **10** about the wearer. For example, as may be desired during a motorcycle race, the overall height of the garment **10** (H**2** in FIG. **3**) is reduced relative to the height of the opened garment **10** (H**1** in FIG. **1**B). Similarly, the curvature of the garment is more pronounced when the panels are closed about the wearer, as shown by the relative heights H**1** and H**2** in FIGS. **1**B and **3**, where H**1**>H**2**. The zipper elements preferably, but not necessarily, operate to reduce the bulk of the outer shell **11** of garment **10** by forcing the "closed" garment into a curved profile that conforms to the profile the wearer would naturally assume when he is riding the vehicle while wearing the garment, as shown in FIG. **3**. Also, in the exemplary embodiments, the zipper elements Z follow a curved track along the front of the outer shell **11**, as illustrated in FIG. **1**, and this configuration forces the garment, when closed about the wearer, to assume a generally C-shaped upper torso profile that is aerodynamically and thermally beneficial for a rider.

[0044] Thus, FIG. **1**B illustrates a 2-closure (e.g., "dual-zipper") bib-type front for a garment, defined by two closures, for example, effected by zippers that extend from the collar area **26** of the garment to at least the waist or crotch area **28** or perhaps lower. When the bib is zipped up, the garment is closed and conforms to a curve that is suitable for aerodynamic performance as well as air-cooling of the wearer. Other configurations for the closure element are considered to be within the scope of the disclosure. For example, the garment might not include bib section **32** with two spaced apart zipper closure elements Z, but rather may include only a single closure element Z which extends centrally between front panels **12**L and **12**R (as shown on FIG. **1**A), or extends along the side of the front of the outer shell of the garment between asymmetrical front and rear panels, or which extends angularly across the front of the outer shell of the garment.

[0045] Much of the above-described Jacket Section and Full-Body Suit Section are somewhat similar to jackets and full-body suits of the prior art. However, there are a number of important differences which are adapted to contribute to the function of the Wearer Protection Section described below, for example, including but not limited to:

[0046] 1. a portion of the interior of outer shells **11** and **11**A, which includes a portion (not shown in FIGS. **1**A-**3**) of an affixation assembly for coupling (either permanently, or removably), for example, a Wearer Protection Section of the type described below in conjunction with FIGS. **4**A-**7**; for example, such affixation assemblies may be constructed by zippers or hook-and-loop fasteners, or other alternative fasteners;

[0047] 2. a rear panel scoop **37**; and

[0048] 3. stretchable corrugated (or otherwise highly stretchable relative to panels **12**L, **12**R and **14**) regions **39**L, **39**R and **40** of the outer shells **11** and **11**A.

Exemplary Wearer Protection Sections

[0049] A first exemplary form of the Wearer Protection Section (or Structure) **100** of the disclosure is shown in FIGS. **4**A, **4**B, **4**C and **4**D. A second exemplary form of the Wearer Protection Section (or Structure) **100** of the disclosure is shown in FIGS. **5**A, **5**B, **5**C and **5**D.

[0050] Those exemplary Wearer Protection Sections (or Structures) **100** generally reside, or are adapted to reside, within the interior of the outer shells of the exemplary garments of FIGS. **1**A-**3**, and, therefore, are not visible in those figures. FIG. **6** shows an outer shell **11** of the type shown in FIGS. **1**A and **2** disposed about the exemplary Wearer Protection Section (or Structure) **100** of FIGS. **4**A, **4**B, **4**C and **4**D. FIG. **7** similarly shows an outer shell **11**, but of the type shown in FIGS. **1**B and **2**, disposed about the exemplary Wearer Protection Section (or Structure) **100** of FIGS. **5**A, **5**B, **5**C and **5**D.

[0051] The Wearer Protection Sections (or Structures) **100** are adapted to be affixed removably or permanently to outward-facing surfaces of structure **100** and underlie at least a portion of the inward facing surface of the outer shell **11** of garment **10**. The method of fixation is reversible in some forms, for example by a zipper assemblies Z as in FIGS. **4**A-**5**D or is permanent in other forms.

[0052] In the exemplary embodiments of FIGS. **4**A-**4**D and **5**A-**5**D, Wearer Protection Sections (or structures) **100** are vest-like, having a left front panel **112**L, a right front panel **112**R, and a rear panel **114**, joined-together in a manner defining "sleeve openings" **117**L, **117**R at the junctions of panels **112**L/**114**L and **112**R/**114**R. Preferably, but not necessarily, an air permeable material (for example, a

mesh material) is used for the base structure of panels **112**L, **112**R and **114**, permitting, when the closure elements along edges **38**L and **38**R define the jacket **11** to be at least partially open, airflow through the jacket **11** and out through a vent in the back panel, for user cooling/comfort purposes. In the illustrated forms of Structure **100**, the sleeve openings **117**L, **117**R are reversibly coupled to the outer shell **11** by zipper assemblies Z.

[0053] Each of the exemplary embodiments of Wearer Protection Sections (or Structures) **100** shown in FIGS. **4**A-**4**D and **5**A-**5**D, includes an interior gas containment reservoir (sometimes referred to below as an "air bag") **119** disposed adjacent to and removably or permanently affixable to the outer surface of front panels **112**L, **112**R and rear panel **114** of structure **100**, or in some embodiments, to an inward-facing surface of outer shell **11**. The interior gas containment reservoir **119** is a gas-impervious, flexible (as opposed to rigid), and preferably elongated, closed structure having at least one inflatable (and highly stretchable) tubular region, defining an interior gas region. In the embodiments of FIGS. **4**A-**7**, the interior gas containment reservoir **119** includes a first inverted U-shaped portion **119-1** affixed to front panels **112**L and **112**R and a second inverted U-shaped portion **119-2** affixed to rear panel **114**. U-shaped portions **119-1** and **119-2** are pneumatically coupled, establishing an inflatable inverted double U-shaped balloon-like closed tube structure which defines the interior gas region.

[0054] As described in detail below, the interior gas containment reservoir **119** is adapted for rapid automatic inflation by an on-board compressed capsule, providing a closed, compressible and protective air volume disposed between an open vehicle rider/wearer and an external object, as might be encountered pursuant to a highway accident.

[0055] FIGS. **4**A and **4**B show front and rear views of an exemplary single-zipper Wearer Protection Section **100** as adapted for disposition in the interior of the outer shell **11** of the protective garment **10** of FIGS. **1**A and **2**, prior to deployment of gas to the inflatable interior gas containment reservoir (or "air" bag) **119** from an on-board compressed gas cartridge **150**. In FIGS. **4**A and **4**B, the interior gas containment reservoir **119** is deflated (denoted by parallel diagonal lines).

[0056] FIGS. **4**C and **4**D show front and rear views of that single-zipper Wearer Protection Section **100** after deployment of the gas to the interior gas containment reservoir, and resultant inflation of the reservoir **119**. In FIGS. **4**C and **4**D, the interior gas containment reservoir **119** is inflated (denoted by cross-hatched diagonal lines).

[0057] Similarly, FIGS. **5**A and **5**B show front and rear views of an exemplary dual-zipper Wearer Protection Section **100** as adapted for disposition in the interior of the outer shell **11** of the protective garment **10** of FIGS. **1**B and **2**, prior to deployment of gas to an inflatable interior gas containment reservoir from an on-board compressed gas cartridge **150**. In FIGS. **5**A and **5**B, the interior gas containment reservoir **119** is deflated (denoted by parallel diagonal lines).

[0058] FIGS. **5**C and **5**D show front and rear views of that dual-zipper Wearer Protection Section **100** after deployment of the gas to the interior gas containment reservoir, and resultant inflation of the reservoir **119**. As shown in FIG. **5**A and **5**C, Structure **100** includes zip-in extenders **122**L and **122**R to provide supplementary extensions to left panel **112**L and right panel **112**R, respectively, enabling full closure of the Structure **100** about the user's torso. Preferably, extenders **122**L and **122**R are constructed of a mesh material, to permit cooling air inflow when the bib section **32** is unzipped to be in its open or partially open state. In FIGS. **5**C and **5**D, the interior gas containment reservoir **119** is inflated (denoted by cross-hatched diagonal lines).

[0059] A gas fill port **120** is disposed at one end of interior gas containment reservoir **119**. In the embodiments of FIGS. **4-7**, the entire interior gas containment reservoir **119**, except for the potions pneumatically coupling the portions **119-1** and **119-2**, is tubular and inflatable (and expandable about an elongated central axis **119**AA extending at least partially along its length). Gas fill port **120** can be located at other positions in alternate embodiments.

[0060] In a form, the respective portions **119-1** and **119-2** of interior gas containment reservoir **119** are disposed within an overlying 2-portion elongate, highly expandable (compared to panels **112**L, **112**R and **124**), tubular volume control sleeve assembly **119**A, the portions of which are in turn respectively affixed to front panels **112**L and **112**R, and to rear panel **114**. The volume control sleeve assembly **119**A allows ready replacement by a user, of the gas containment reservoir **119**. In an alternate form, the respective portions **119-1** and **119-2** of interior gas containment reservoir **119** are connected (permanently or user-replaceable) without an exterior sleeve, directly to the outer surface of front panels **112**L and **112**R, and to rear panel **114**.

[0061] In a form of the type shown in FIGS. **1**B and **2**, a volume control sleeve assembly **119**A is disposed along an elongated curved central sleeve axis **119**AA and about at least the inflatable tubular regions of the respective portions **119-1** and **119-2** of interior gas containment reservoir **119**. In the form described above, a 2-piece sleeve **119**A includes two opposing sleeve sections disposed along the sleeve axis **119**AA. A first sleeve section is relatively stretchable between a rest state and a circumferentially stretched state, and a second sleeve section is relatively non-stretchable. The first sleeve portion faces away from the interior of the shell **11**, and the relatively non-stretchable second section faces toward the interior of the shell **11** and is affixed to panels **112** and **114**. An alternative form for volume control sleeve assembly **119**A is shown below in FIG. **13** and is described conjunction therewith.

[0062] As described below, with the exemplary disclosed configurations, inflation of the inflatable tubular portion(s) of the interior gas containment reservoir **119** is selectively effected by a gas released from an on-board (and preferably user-replaceable) capsule **150** containing a compressed gas in response to and Under control of a cartridge gas fill controller and trigger/release assembly **140** (hereinafter referred to as trigger/release assembly **140**). Preferably, the gas is released automatically upon sensing of conditions that are dangerous to a rider wearing the garment **10**, such as pursuant to a highway accident. The resultant released-to-reservoir **119** gas causes the gas containment reservoir **11** to rapidly inflate, expanding the reservoir **119** to establish a closed, gas-filled, energy absorbing region along at least portions of the gas reservoir containment sleeve axis **119**AA and between the outward-facing surface of structure **100** and the inward-facing surface of shell **11**.

[0063] In the exemplary forms of FIGS. **4**A-**5**D, trigger/release assembly **140**) is coupled to right front panel **12**R

(for example, illustrated schematically by a rectangular pouch overlying gas containment reservoir **119** as shown in FIGS. **4**A, **4**C, **5**A and **5**C).

[0064] A schematic representation of a trigger/release assembly **140**, shown in FIG. **8**, includes a housing plate **144** supporting a cartridge support **148** for receiving a gas cartridge **150**, and an associated trigger sub-assembly **157** and a gas fill actuator sub-assembly **172**. In the forms of FIGS. **4**A-**6**, for example, trigger/release assembly **140** is removably disposed in a pouch affixed to the right front portion of structure **100**, as shown in FIGS. **4**A, **4**C, **5**A and **5**C. In other forms, trigger/release assembly **140** is affixed to outer shell **11** with a flexible pneumatic coupling to interior gas containment reservoir **119**.

[0065] Cartridge support **148** of trigger/release assembly **140**, is adapted for receiving a gas cartridge **150**, having a compressed gas (for example, carbon dioxide) in a gas impervious interior cartridge reservoir **150**A. Gas cartridge **150** is "field replaceable", making the trigger/release assembly **140** re-useable by a wearer/user of the garment **10**. Gas cartridge **150** has a cartridge port **152**, which, when the cartridge is disposed along a cartridge axis **154** in the cartridge support **148**, and actuated as described below, is pneumatically coupled by way of a gas coupler port **120**A in housing **144**, to the gas fill port **120** of interior gas containment reservoir **119**. Prior to deployment of the compressed gas, the cartridge port **152** is spanned by a gas impervious, but pierceable membrane **150-1**, extending transverse to the cartridge axis **154** and preventing gas from escaping from the interior cartridge reservoir **150**A.

[0066] Trigger sub-assembly **157** of trigger/release assembly **140**, includes a piston/piercing pin assembly **161** extending in the direction of cartridge axis **154** and having at a cartridge-facing end, a piercing pin **161-1** axially aligned with the cartridge port **152** and transverse to the membrane **150-1** spanning cartridge port **152**.

[0067] Piercing pin **161-1** and pusher block **161-2** are spring-biased by a compression spring **160** to selectively drive a piston/pusher block **161-2** supporting piercing pin **161-1**, toward and through the membrane **150-1** when released by a release element **174-1**. The piercing pin **161-1**, piston/pusher block **161-2**, and spring **160** are disposed within a trigger housing **158**.

[0068] In a form, piercing pin **161-1** is side-ported and hollow, and includes an associated gasket so that when deployed, a substantially non-leaking junction is formed at port **152**. Upon release, i.e., deployment, by the release element **174-1**, a gas flow path is established between the cartridge interior reservoir **150**A to the interior of interior gas containment reservoir **119**, permitting expanded gas from cartridge **150** to pass through ports **120** and **120**A to inflate the-inflatable tubular portion of interior gas containment reservoir **119**.

[0069] The gas-fill actuator sub-assembly **172** of trigger/release assembly **140**, includes a cable/lanyard **176** connected, via a 2-element user-operated detachable clip assembly **180** (comprising a first element **181** and a second element **186**), between a motorcycle, or other vehicle of interest, and release element **174-1**. Operation of the assembly of FIG. **8** is described below in connection with the exemplary form of FIG. **8**A.

[0070] An exploded view of the mechanical cartridge gas-fill controller and trigger/release assembly **140'** is shown in FIG. **8**A. Assembly **140'** includes a 2-element trigger housing **158** (including elements **158-1** and end cap **158-2**) affixed to a cartridge support plate **144** by a cartridge guide bracket **159**A and an end cap bracket **15913**. Support plate **144** is adapted for fixture to an inward facing portion of the outer shell **11** by way of three machine screws (not shown) extending from juncture points on outer shell **11**, to associated nut and washer assemblies A**1**, A**2** and A**3** on support plate **144**. Trigger housing **158** includes a forward element **158-1** and an end cap **158-2**, joined together to define a contiguous interior trigger region.

[0071] Trigger housing **158** together with cartridge support plate **144**, support a compressed gas-filled cartridge **150** disposed along a cartridge axis **154**. Cartridge **150** includes a gas port **152** which, prior to activation, is initially sealed with pierceable membrane **150-1** traversing cartridge axis **154** and spanning gas port **152**.

[0072] A spring-biased seal-piercing assembly **161** is disposed in the interior region of trigger housing **158**. The assembly **161** includes a piston/piercing pin (comprising side-ported hollow pin **161-1** pneumatically coupled to port **120**A, and a pusher block **161-2**) adapted for selectively-initiated sliding motion along the cartridge axis **154**. At an end facing gas port **152**, elongated pin **161-1** extends along the cartridge axis **154**, and at the opposite end, pusher block **161-2** is disposed, adjacent to an end of a coaxial compression spring **164** extending between the pusher block **161-2** and an interior surface of the end cap **158-2**.

[0073] A trigger release assembly **172** controls activation of the seal-piercing assembly **161**.

[0074] Trigger release assembly **172** includes (i) an activation/blocking element **174** and (ii) a separate trigger cable/lanyard **176**. Activation/locking element **174** includes at a first end, a lock element **174-1** adapted for selective interfering engagement with the piston/piercing pin assembly **161**, and at a second end, a first coupling element **181**. Trigger cable/lanyard **176** includes a cable having at a first end, a vehicle coupler **182**, adapted to selectively engage or disengage a vehicle, and at a second end, a second coupling element **186** adapted to allow a user to selectively couple or de-couple with the first coupling element **181**.

[0075] In alternative forms, the mechanical cartridge gas-fill controller and trigger/release assembly **140**, is replaced by an electronically controlled (as opposed to mechanically controlled) assembly, for example including an inertial sensor-based trigger assembly, in place of the cable/lanyard **148** assembly of the form of FIG. **8**A.

[0076] In use, a rider first might load a compressed gas-filled cartridge (preferably filled with pressurized CO_2) to the cartridge support structure **144**/**148**, and then couple one end of the cable/lanyard **176** to the trigger/release assembly **140**. Then, before riding the vehicle, couple the other end of the cable/lanyard **176** to the vehicle. Before activation, the piston/piercing pin assembly **161** is held in a position with a distal tip of elongated pin **161-1** spaced apart from membrane **151-1** by lock element **174-1** of the activation/locking assembly **174**. Then the rider is ready to go. In the event the rider is unexpectedly separated from the vehicle, the cable/lanyard **176** which is coupled to the vehicle, pulls the lock element **174-1** from the trigger housing **158**, thereby causing the pin **161-1** to puncture the membrane **150-1**, releasing the compressed gas to inflate the bladder-like structure within the outer shell **11** of the garment **10**.

[0077] In use, when the wearer of garment **10** is separated from his or her motorcycle, for example, by an accident, the

wearer/user generally goes in a first direction and the motorcycle goes in a second direction. As the wearer and the motorcycle go in their respective directions, the cable/lanyard **176** first becomes taunt and then pulls the release element **174-1** from piston/piercing pin assembly **161**, indicative of detection of an accident. Thus, the gas-fill actuator sub-assembly **156** automatically "detects" when a connected garment **10** worn by a rider, is thrown, or otherwise separated from the motorcycle or other vehicle, by the cable **176** pulling the release element **174-1** from the spring-loaded pin **161-1** of piston/piercing pin assembly **161** of the trigger assembly **140** attached to front panel **112**R, thereby establishing entry into a "protect mode".

[0078] In response to detection of an accident, in the "protect mode", trigger/release assembly **140** drives the spring-loaded pin **161-1** of piston/piercing pin assembly **161**, through the membrane **150-1**, piercing it and establishing the gas flow path from the cartridge reservoir **150**A of cartridge **150** to the gas fill port of reservoir **119**.

[0079] A cartridge gas release controller is thus effected by the trigger/release assembly **140**, which is coupled to the cartridge gas release port **152** of a cartridge **150** received in the cartridge support structure **144**/**148**.

[0080] The compressed gas from then-open cartridge **150** passes via a port **120**A and enters port **120** and inflates the pneumatically coupled "double inverted-U" balloon-like gas containment reservoir **119**. The highly stretchable region **39**L, **39**R and **40** of outer shells **11** (and **11**A), which overlie the inflatable tubular portion(s) of gas containment reservoir **119**, readily expand as the tubular portions inflate. The resultant gas-filled double inverted-U balloon-like gas containment reservoir **119** provides a highly effective absorber of energy involved in the accident, thereby effecting a significant reduction in injury for the wearer/user of the garment **10**. The gas containment reservoir **119** can have other shapes than the double inverted-U shape illustrated in FIGS. **1**, **2** and **4-7**. Such other shapes are determined by the manufacturer, sometimes in a "custom" shape requested by the purchaser.

[0081] The exemplary gas containment reservoir **119** is shown in FIGS. **12**A-**12**D disposed within sleeve **119**-A, in a front view, left (viewed from the front) side view, right (viewed from the front) side view and rear view, respectively, of an exemplary jacket **10**. In those figures, reservoir **119**, and sleeve **119**A, form a "serpentine" double inverted-U balloon-like gas containment reservoir structure disposed between the outer shell **11** and panels **112**L, **112**R and **114**. Reservoir **119** is shown in phantom in FIGS. **12**A-**12**D by a series of uniformly spaced apart double lined sections in each of FIGS. **12**A-**12**D, filled with a multiple rectangle array. The various sections in the aggregate, represent a continuous balloon-like "serpentine" tubular structure of reservoir **119** that underlies outer shell **11**. A first inverted-U section extends from an end point under shell **11** near the bottom (see FIG. **12**A) of left front panel **12**L, to the back panel **14** and around an upper, or "neck", region and back to underlie the right front panel **12**R to an end point under shell **11** near the bottom (See FIG. **12**A) of right front panel **12**R. The lowermost portions of the first inverted U-section extend from their respective end points, across left and right sides panels (see FIGS. **12**B and **12**C), to form a second inverted U-section underlying back panel **14** and looping up (see FIG. **12**D) and joining at a point near the neck region. The tubular structure of reservoir **119** is joined (not shown) to the gas fill port **120**A of the trigger/release assembly **140'**, permitting sudden, rapid,"explosive"-like filling (and expansion) of the reservoir **119** in the event of an emergency encountered by a rider during use.

[0082] The reservoir **119** may take one of many forms. For example, the reservoir **119** described above, may be formed from a pair of elongated rectangular sheets sewn along their lateral edges wherein an innermost sheet is relatively non-stretchable and adapted for fixture to panels **112**L, **112**R and **114**, and an outermost sheet which is relatively highly transversely (with respect to a central axis **119**AA) stretchable elastic and is disposed between the innermost sheet and outer shell **11**. Together, the sheets form an inflatable tubular sleeve **119**A affixed permanently, for example by an adhesive, to the outer surface of panels **112** and **114** of Wearer Protection Section **100**.

[0083] In another form, for example as shown in FIG. **13**, the reservoir **119** may be disposed within a relatively flexible, expandable (compared to the material comprising panels **112**L, **112**R and **114** of shell **11** to which it is attachable). Reservoir containment sleeve **119**A, for example, is constructed from a single piece rectangular material, which is elongated (along central sleeve axis **119**AA) and is relatively highly stretchable transverse to its central sleeve axis **119**AA and relatively non-stretchable in directions parallel to that axis. In a form, sleeve **119**A may be constructed from a Spandex material. As shown in FIG. **13**, the main portion of reservoir containment sleeve **119**A has a C-shaped cross-section **204**A, where its lateral edges are folded inward and joined together about one-half of a coil zipper assembly **204** having a linear array of flexible teeth/elements (exemplified by coil tooth element **204**B in FIG. **13**), for example, made from coiled monofilament such as nylon, extending outward through tubular structure of reservoir containment sleeve **119**A from a flexible zipper tape **204**C joined between the inward-folded lateral edges of the main portion of reservoir containment sleeve **119**A.

[0084] A second, and mating, half of the coil zipper assembly **204** (similar to coil tooth elements **204**C and zipper tape **204**B, but not shown in FIG. **13**) is affixed at its flexible tape element to the outer surface of one or more of panels **112**L, **112**R and **114** of the Wearer Protection Section **100**. With that configuration, sleeve **119**A can be removably attached to Section **100** by selectively joining the flexible teeth of the two halves of coil zipper assembly **204**. The use of a "coil zipper" is advantageous because it allows the tubular structure of reservoir containment sleeve **119**A to be relatively highly flexible along its length, so that the tubular structure can take a desired shape between Structure **100** and the outer shell **11** depending on the placement of the second half of the coil zipper assembly **204**. Coil zippers offer highly flexible reversible coupling structures compared to otherwise-similar zipper structures constructed of rigid interlocking teeth, for example, zippers made with metal or plastic teeth, but the latter could be used in some configurations. By selective placement of the second half of coil zipper assembly **204**, the jacket **10** (and/or jacket **10**A) may be constructed with nearly any desired pattern of the inflatable tubular structure of reservoir **119**. In various embodiments, the mating half of the zipper assembly **204** for connecting to the teeth **204**C extending from sleeve **119**A, can be located on various elements, for example, the outer surface of Structure **100**, the inward-facing surface of Structure **100** or the inward-facing surface of outer shell **11** (or

11A). In this form too, the volume control sleeve **119**A allows ready replacement by a user, of the gas containment reservoir **119**.

[0085] In the illustrated embodiments, the scoop **37** overlies a highly stretchable (compared to the surrounding material of back panel **14**) air permeable vent panel **40** in back panel **14**. In normal usage, that scoop **37** allows flow-through ventilation (for example, from a flow path commencing at adjustable ports disposed on the front panels), cooling the wearer, and exiting through air permeable vent panel **40**. At least portions of scoop **37** and vent panel **40** both overlie an inflatable tubular portion of gas containment reservoir **119**, and act in concert to allow expansion of gas containment reservoir **119**.

[0086] In some embodiments, multiple trigger/release assemblies **140** are incorporated in jacket **10**, particularly where distinct gas containment reservoirs **119** are within the shell **11** of garment **10**. For example, in the general configuration of FIGS. **1** and **2**, the two inverted-U portions of the front of garment/jacket **10** and the rear of garment/jacket **10** shell might not be pneumatically connected. Instead they may be separately controlled by separate trigger/release assemblies **140**. In such configurations, each of the trigger/release assemblies **140** would act as a distinct cartridge gas release controller and an associated trigger assembly.

[0087] Views of various embodiments are set forth in FIGS. **9**-**11**B. FIGS. **5**A-**5**D shows a garment embodying the technology of the disclosure, with user-removable extenders **122**L and **122**R in Structure **100**. Fin contrast, FIG. **9** shows a garment embodying the technology of the disclosure, without user-removable extenders **122**L and **122**R in Structure **100**. FIG. **10** shows a side view image of a full body garment of FIG. **3** with raised arm **17**, showing the expandable portions **39**R of outer shell **11**A, after deployment of gas to interior gas containment reservoir **119**. FIG. **11**A and FIG. **11**B show side-frontal views of an exemplary protective garment of FIGS. **1**A and **2**, before and after deployment of gas to interior gas containment reservoir **119**, respectively.

[0088] Although the foregoing description of the embodiment of the present technology contains some details for purposes of clarity of understanding, the technology is not limited to the detail provided. There are many alternative ways of implementing the technology. The disclosed embodiment is illustrative and not restrictive.

1. A garment comprising:

an outer shell having an inward facing surface, wherein the outer shell is adapted to be positioned about at least a portion of a body of a wearer of the garment, including:

A. at least one wearer protection structure adapted for detachable coupling to a vehicle, and to be affixed to and underlie at least a portion of the inward facing surface of the outer shell, and defining an interior gas containment reservoir, wherein the interior gas containment reservoir includes at least one inflatable tubular region, and a gas fill port adapted to establish a gas containment reservoir input flow path from points exterior to the gas containment reservoir to the interior gas containment region,

B. at least one elongated tubular volume control sleeve disposed along a sleeve axis and about at least a portion of the tubular region of the interior gas containment reservoir,

C. a cartridge housing structure affixed to the outer shell for receiving at least one gas cartridge defining an interior cartridge reservoir region adapted to store a compressed gas therein, and including a cartridge gas release port adapted to selectively couple the interior cartridge reservoir region along a cartridge exit flow path to points external to the interior cartridge reservoir region,

D. a cartridge gas release controller and an associated trigger assembly, coupled to the cartridge gas release port of a cartridge received in the cartridge housing structure, wherein the controller and the trigger assembly are selectively operable to:

i. with the at least one wearer protection structure coupled to the vehicle, in a closed state, establish the interior cartridge reservoir region to be fully enclosed, whereby the compressed gas in the interior cartridge reservoir region remains in the interior cartridge reservoir region,

ii. upon separation of the at least one wearer protection structure from the vehicle, in an open state, establish a cartridge outlet flow path exiting the interior cartridge reservoir region by way of the gas release port, and entering the tubular region of the interior gas containment reservoir by way of the gas fill port of the at least one wearer protection structure, whereby at least a portion of the compressed gas in the interior cartridge reservoir region passes to the tubular region and inflating the tubular region of the interior gas containment reservoir of the at least one wearer protection structure.

2. A garment according to claim **1**, wherein the sleeve includes two opposing sleeve portions disposed along the sleeve axis and joined at lateral edges thereof to for a tubular structure, wherein a first sleeve portion is relatively stretchable between a rest state and a circumferentially stretched state, and a second sleeve portion is relatively non-stretchable.

3. A garment according to claim **1**, wherein the sleeve includes a tubular sleeve portion disposed along the sleeve axis, wherein a sleeve portion is relatively stretchable between a rest state and a circumferentially stretched state, and further including a first joinder region along the sleeve axis which is adapted for joinder to a second joinder region on an outer surface of the wearer protection structure.

4. A garment according to claim **3**, wherein the joinder is permanent.

5. A garment according to claim **4**, wherein the permanent joinder is effected by an adhesive.

6. A garment system according to claim **3**, wherein the joinder is reversible.

7. A garment according to claim **6**, wherein the reversible joinder is effected by a zipper assembly having a first zipper element attached to the first joinder region and a second zipper element attached to the second joinder region.

8. A garment according to claim **7**, wherein the zipper assembly is coil zipper.

9. A garment according to claim **1**, when the cartridge gas release controller and an associated trigger assembly are in the open state, compressed gas from the interior gas containment reservoir is disposed both in the interior cartridge reservoir and the interior gas containment region, and the

interior gas containment region within the sleeve is stretched from its rest state toward its circumferentially stretched state.

10. A garment according to claim **1**, wherein the tubular region of the interior gas containment reservoir is expandable.

11. A garment according to claim **1**, wherein the compressed gas is carbon dioxide (CO_2).

12. A garment according to claim **1**, wherein the at least one wearer protection structure is adapted for fitment about at least a portion of the upper torso of a wearer.

13. A garment according to claim **12**, wherein the second sleeve portion is affixed to the inward facing surface of the outer shell.

14. A garment according to claim **13**, wherein the garment is a jacket.

15. A garment according to claim **11**, wherein the at least one wearer protection structure includes a liner underlying at least a portion of the outer shell.

16. A garment according to claim **15**, wherein the second sleeve portion is disposed between the shell and the second sleeve portion is affixed to the liner.

17. A garment according to claim **13**, wherein the garment is a jacket.

18. A garment according to claim **1**, wherein:

A. the cartridge gas release port includes:

i. a rigid closed frame having a pierceable membrane spanning the frame transverse to the cartridge exit flow path, and

B. the trigger assembly includes

i. an elongated pointed-end lance element movable along a lance axis transverse to the cartridge exit flow path, wherein the lance element is spring-loaded toward the pierceable membrane, and wherein the pointed tip is displaced from the membrane in the closed state in response to an applied restraining force, and extends through the membrane in the open state following release of the restraining force, and

ii. an activation element for selectively releasing the restraining force applied to maintain the lance element in the closed state.

19. A garment according to claim **1**, wherein the garment is a jacket wherein the outer shell includes:

i. a back panel adapted to be positioned adjacent to the back of the wearer of the jacket, and a portion of the back panel is air permeable within a vent boundary,

ii. a scoop element affixed to the back panel adjacent to the vent boundary, wherein the scoop element includes an upward-facing inlet aperture and an inward-facing outlet aperture spanning the air permeable portion of the back panel, thereby defining an air flow path from regions outside the shell, through the air permeable portion of the back panel and out through the inward-facing aperture,

wherein the scoop element includes at least one void region therein adapted to receive the at least one gas cartridge, and wherein the at least one gas cartridge-to-gas containment reservoir coupler is elongated to establish the gas flow path coupling the cartridge outlet flow path to the reservoir inlet flow path by way of the interior gas confinement region.

20. A garment according to claim **16**, wherein a portion of the outer shell opposite the second sleeve portion attached to the liner, is stretchably corrugated, wherein the corrugated portion is attached to a stretchable intermediate layer.

21. A garment according to claim **1**, wherein the outer shell is stretchably corrugated in at least one region adjacent to the at least one inflatable tubular regions of the interior gas containment reservoir.

22. A garment comprising:

A. an outer shell having an inward facing surface, wherein the outer shell is adapted to be positioned about at least a portion of a body of a wearer of the garment,

B. an inner protective structure adapted for detachable coupling to a vehicle, and disposed within the outer shell, including:

i. at least one wearer protection structure adapted to be affixed to and underlie at least a portion of the inward facing surface of the outer shell, and defining an interior gas containment reservoir, wherein the interior gas containment reservoir includes at least one inflatable tubular region, and a gas fill port adapted to establish a gas containment reservoir input flow path from points exterior to the interior gas containment reservoir to the at least one inflatable tubular region,

ii. at least one elongated tubular volume control sleeve disposed along a sleeve axis and about at least a portion of the tubular region of the interior gas containment reservoir, wherein the sleeve includes two opposing sleeve portions disposed along the sleeve axis, wherein a first sleeve portion is relatively stretchable between a rest state and a circumferentially stretched state, and a second sleeve portion is relatively non-stretchable,

iii. a cartridge housing structure affixed to the outer shell for receiving at least one gas cartridge defining an interior cartridge reservoir region adapted to store a compressed gas therein, and including a cartridge gas release port adapted to selectively couple the interior cartridge reservoir region along a cartridge exit flow path to points external to the interior cartridge reservoir region,

iv. a cartridge gas release controller and an associated trigger assembly, coupled to the cartridge gas release port of a cartridge received in the cartridge housing structure, wherein the controller and the trigger assembly are selectively operable to:

a. with the inner protective structure coupled to the vehicle, in a closed state, establish the interior cartridge reservoir region to be fully enclosed, whereby the compressed gas in the interior cartridge reservoir region remains in the interior cartridge reservoir region, and

b. upon separation of the inner protective structure from the vehicle, in an open state, establish a cartridge outlet flow path exiting the interior cartridge reservoir region by way of the gas release port, and entering the tubular region of the interior gas containment reservoir by way of the gas fill port of the at least one wearer protection structure, whereby at least a portion of the compressed gas in the interior cartridge reservoir region passes to the tubular region and inflating the tubular region of the interior gas containment reservoir of the at least one wearer protection structure.

23. A garment according to claim **22**, when the cartridge gas release controller and an associated trigger assembly are in the open state, compressed gas from the interior gas containment reservoir is disposed both in the interior cartridge reservoir and the interior gas containment region, and the interior gas containment region within the sleeve is filled whereby the first portion of the sleeve is stretched from its rest state toward its circumferentially stretched state.

24. A garment according to claim **22**, wherein the tubular region of the interior gas containment reservoir is expandable.

* * * * *