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(54) **PROTECTIVE UNDER-CLOTHING APPARATUS, SYSTEM AND METHOD**

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(57) **ABSTRACT**

A customizable, scalable, armor-enhanced under-clothing system is provided that conforms more substantially to the user's body, providing better ballistic protection over every critical body area in different stages as selected by the user. In one embodiment, the present invention employs compression fabric as a base material in the top (e.g., shirt) and bottom (e.g., shorts) system elements, and further can include a static fabric material harness in the top system element. Anti-ballistic panels of suitable material and thickness can be inserted into the static fabric material harness element designed to carry the panels while preventing any undesirable bouncing effect.

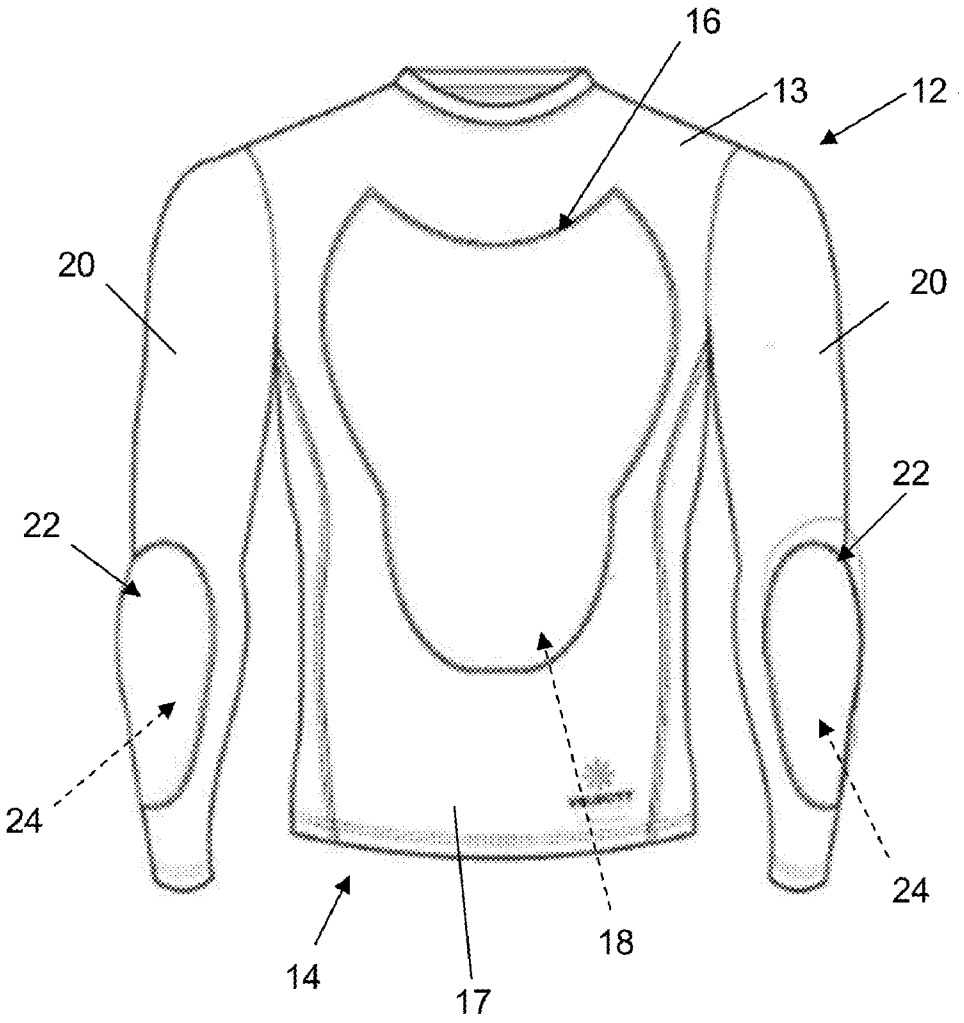


Fig. 2

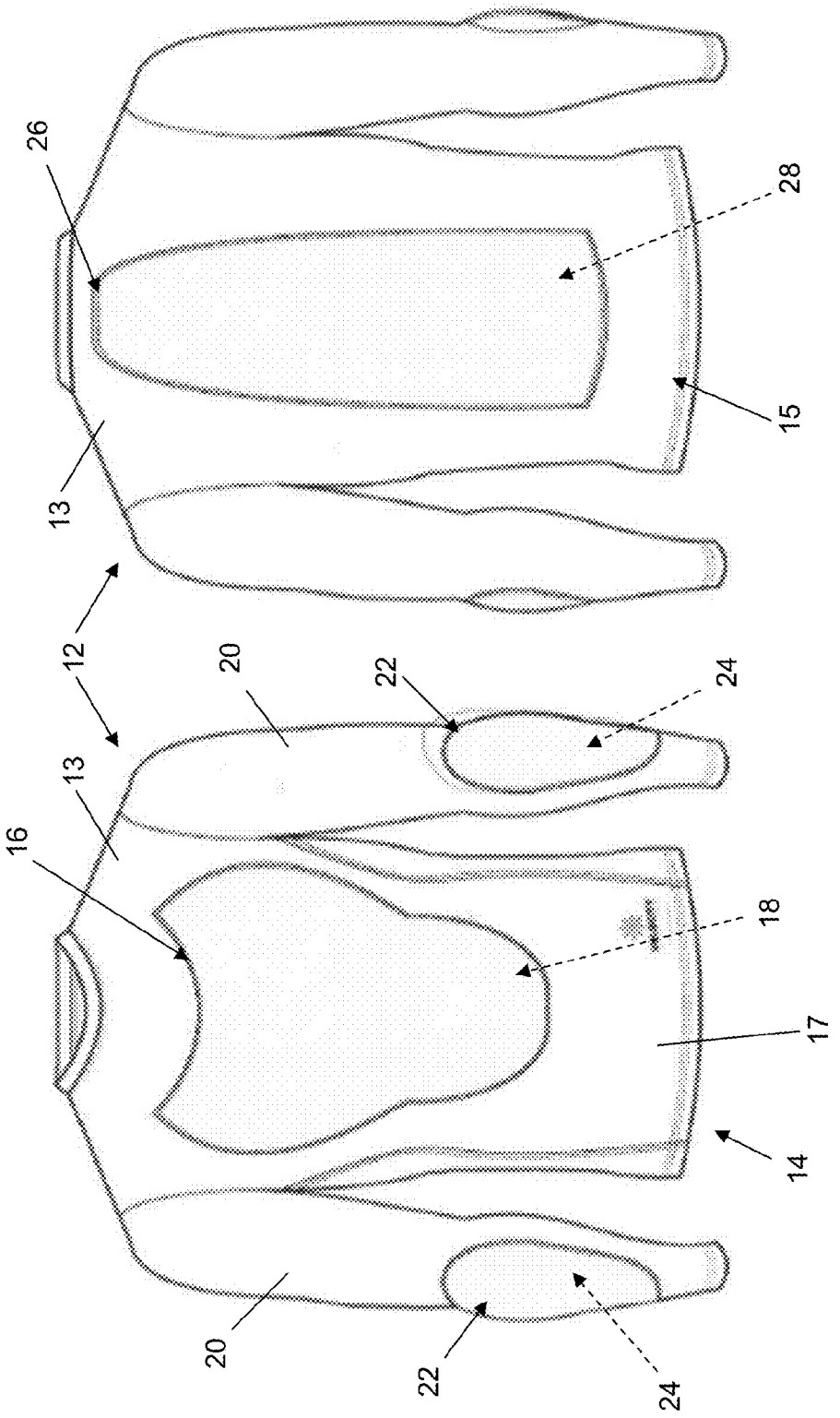


Fig. 1

Fig. 4

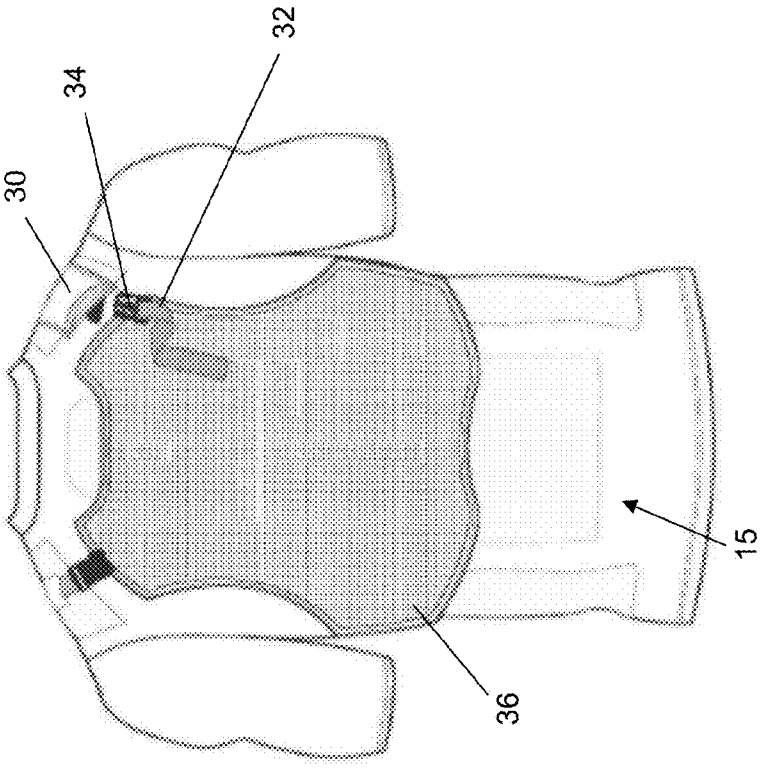


Fig. 3

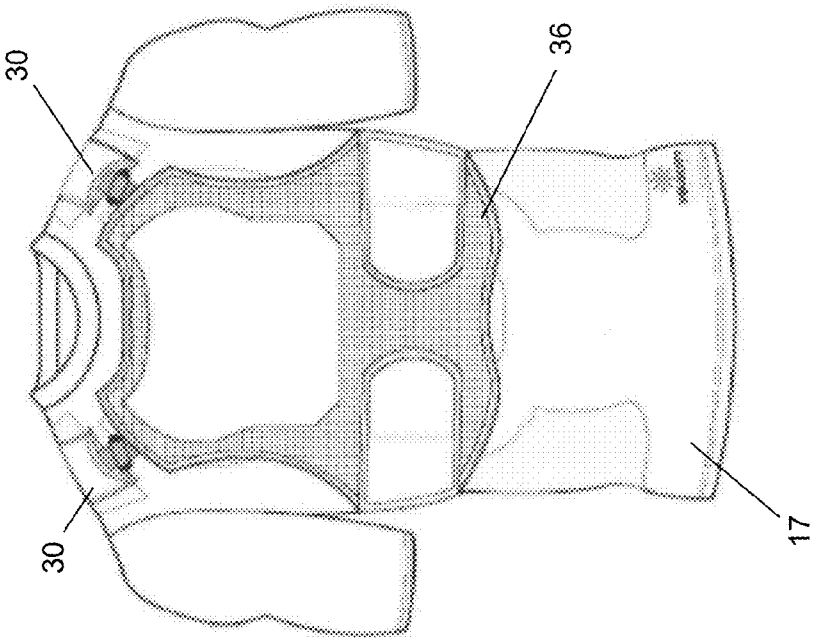


Fig. 6

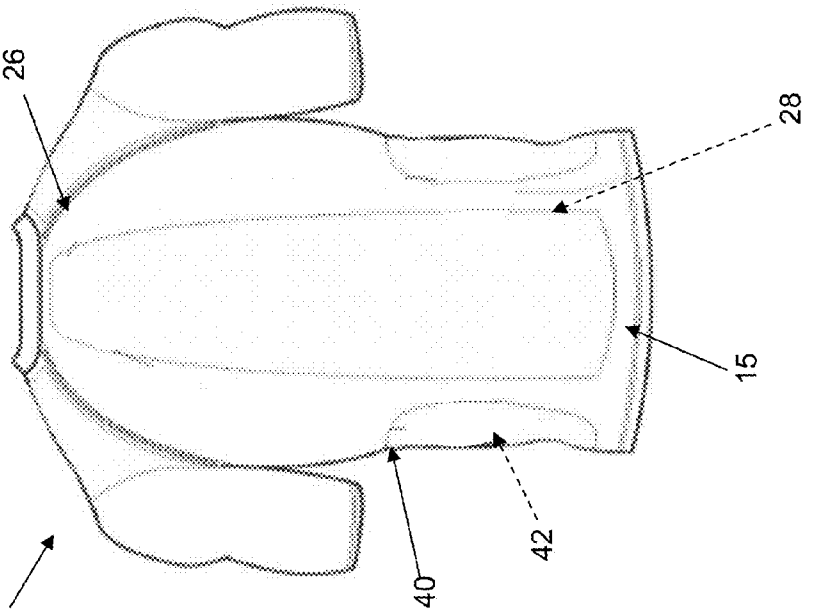
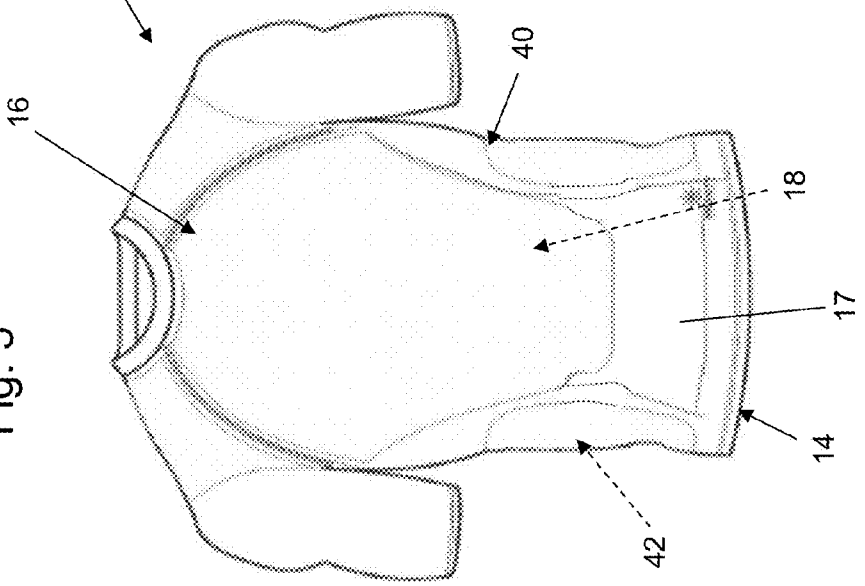


Fig. 5



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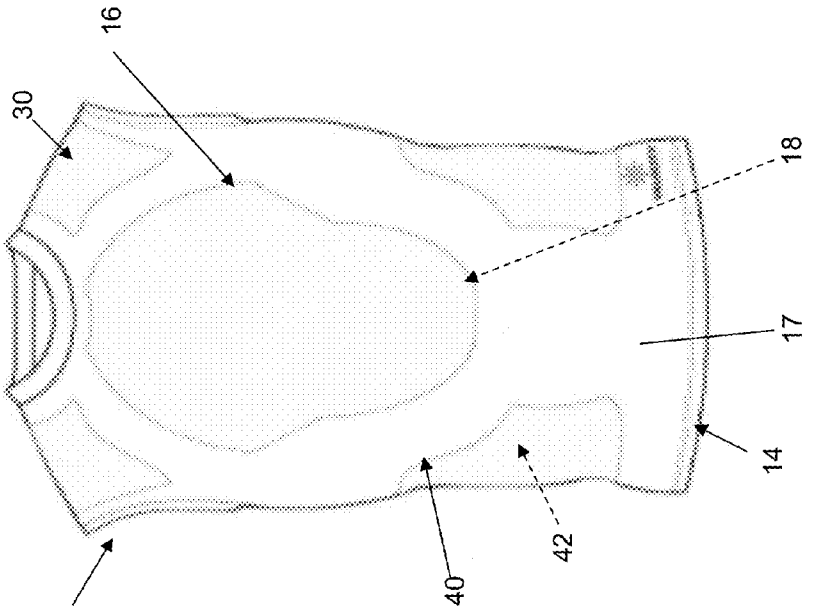


Fig. 8

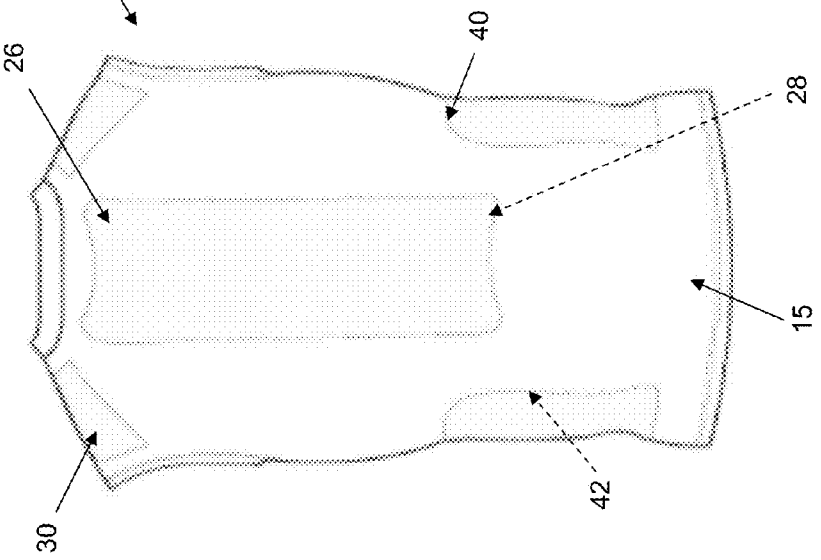


Fig. 10

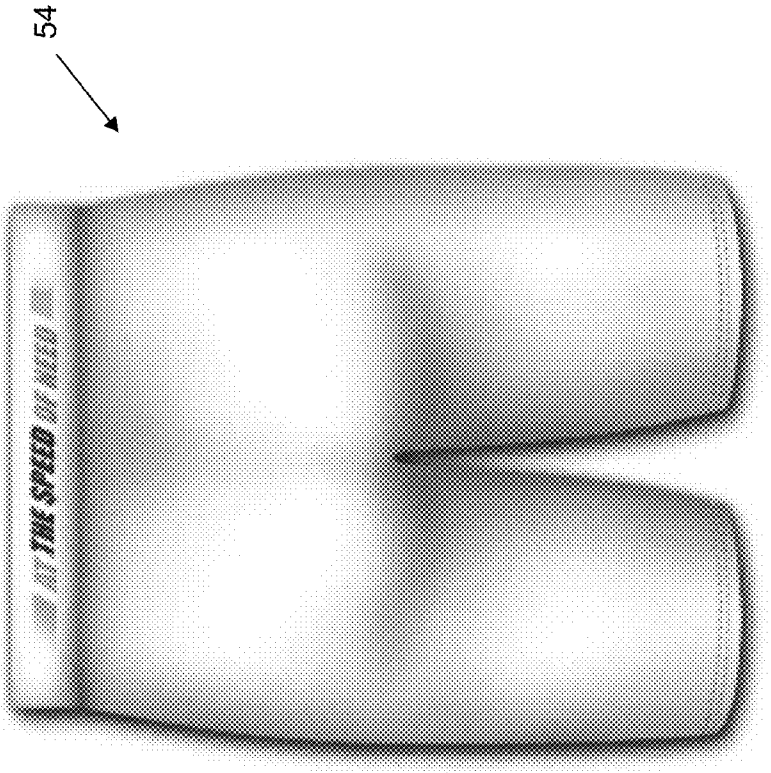
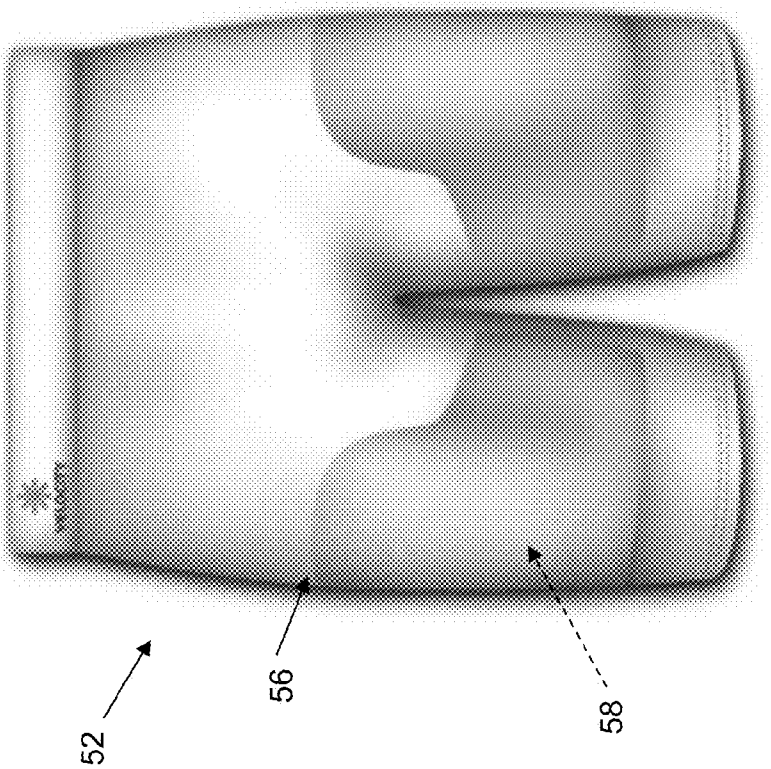


Fig. 9



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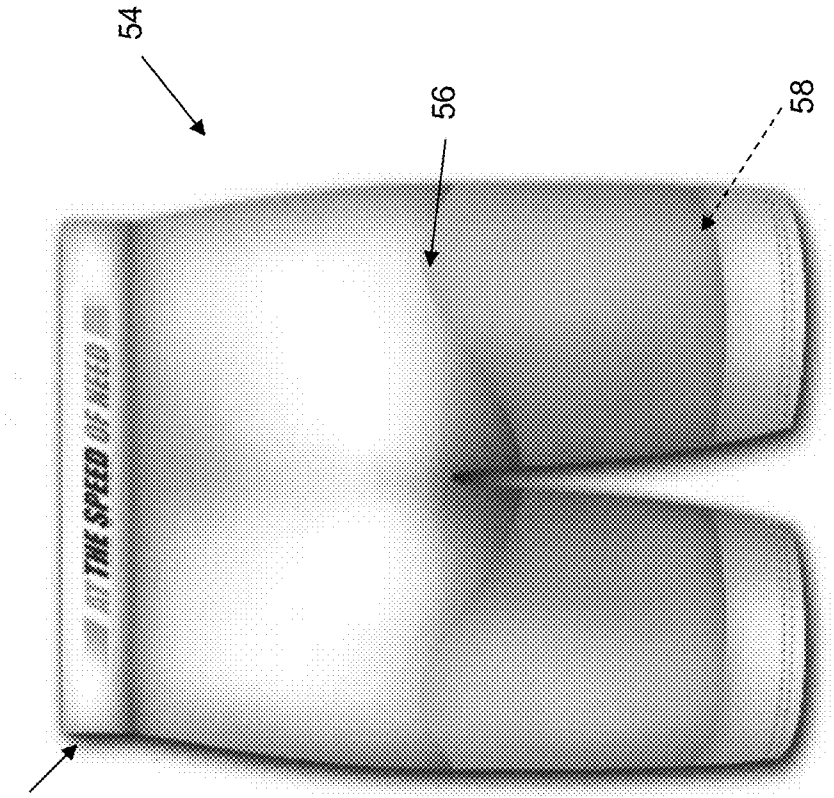

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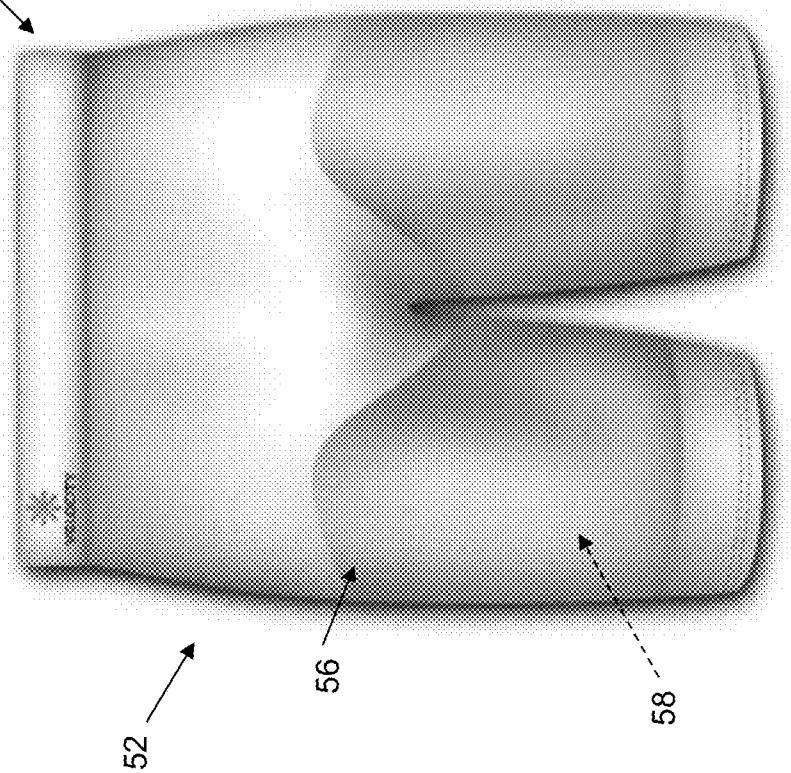
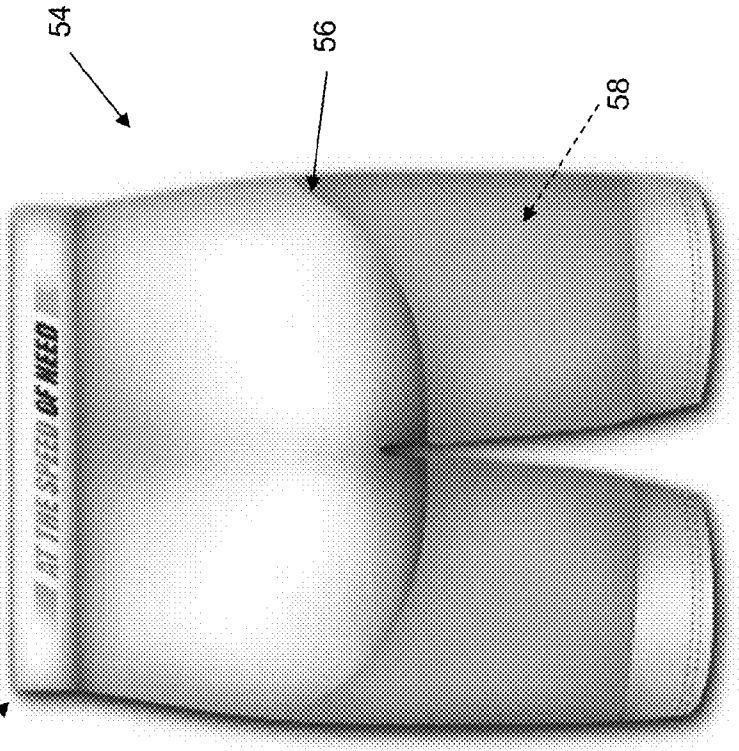


Fig. 14



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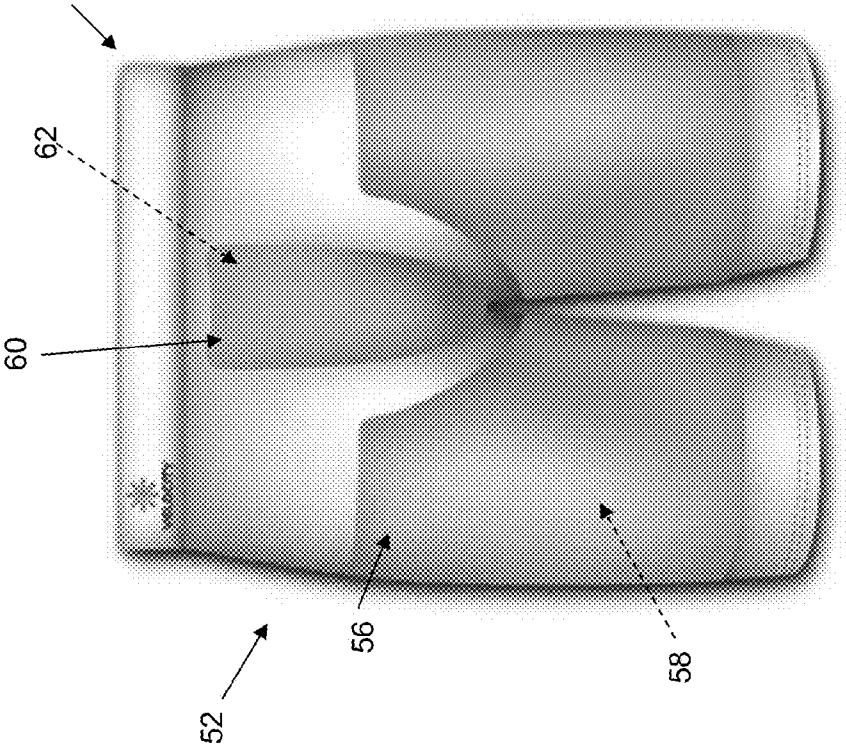

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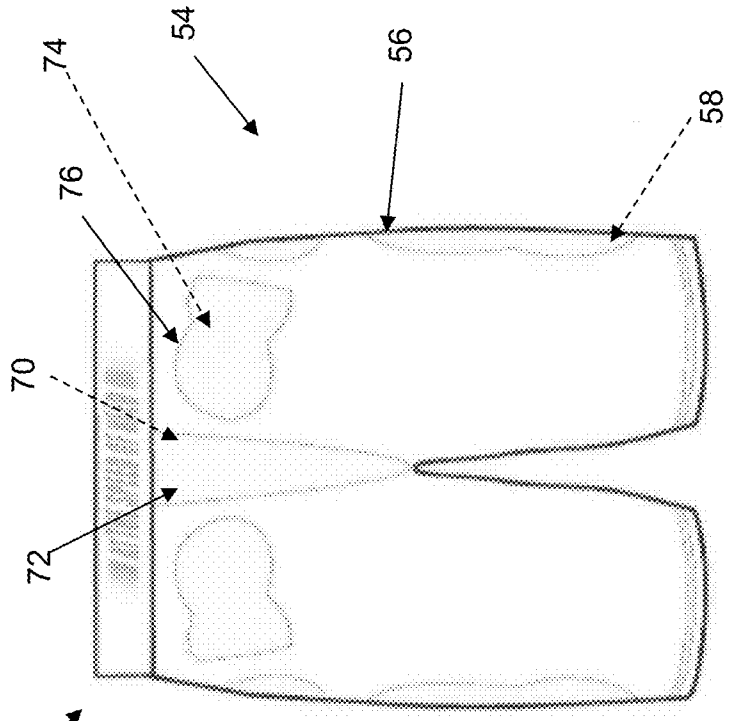

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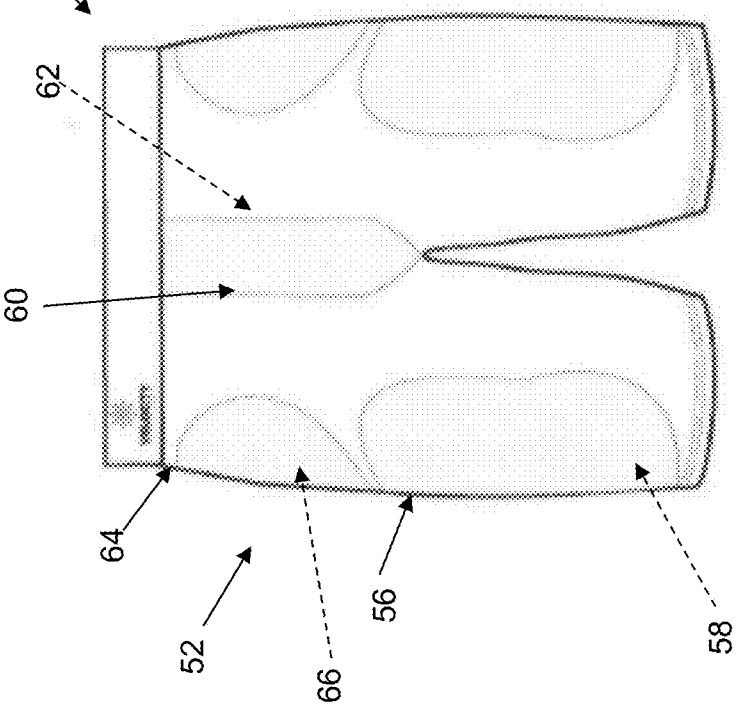

Fig. 18

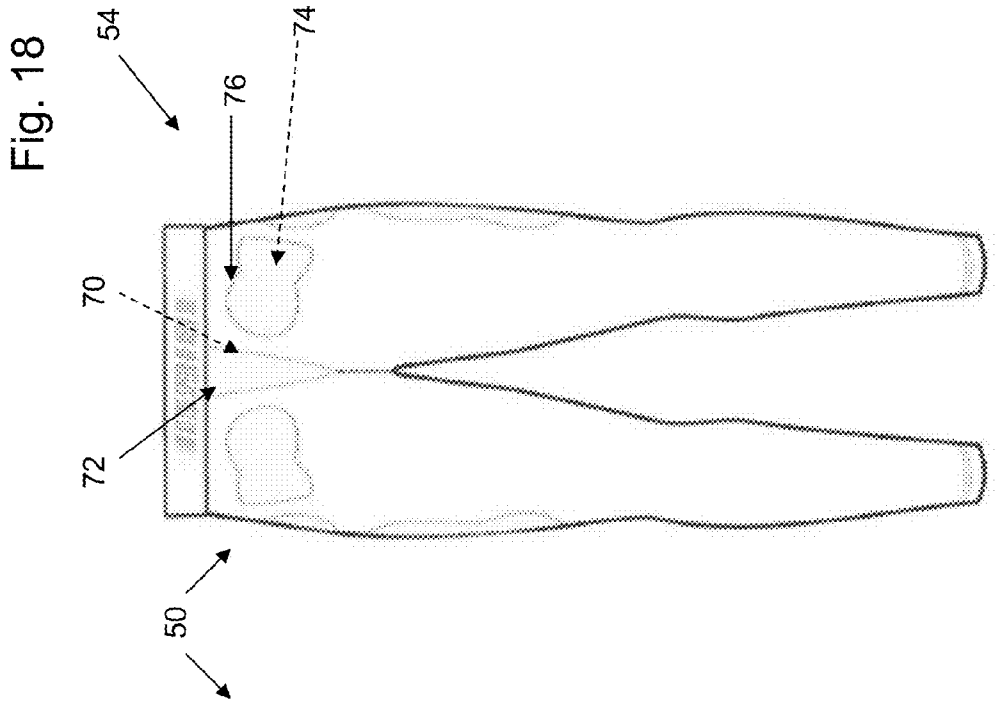

Fig. 17

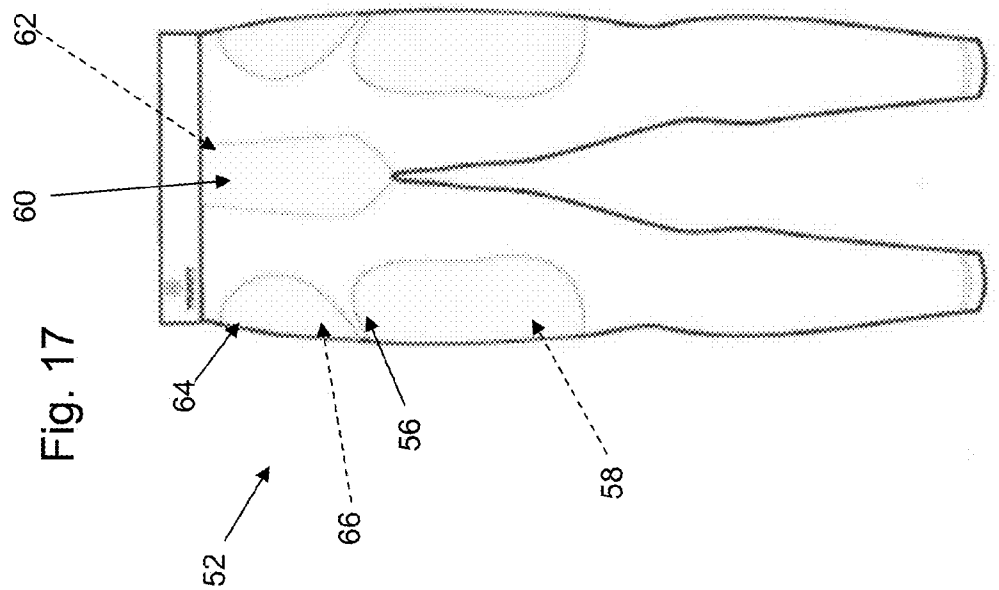

Fig. 20

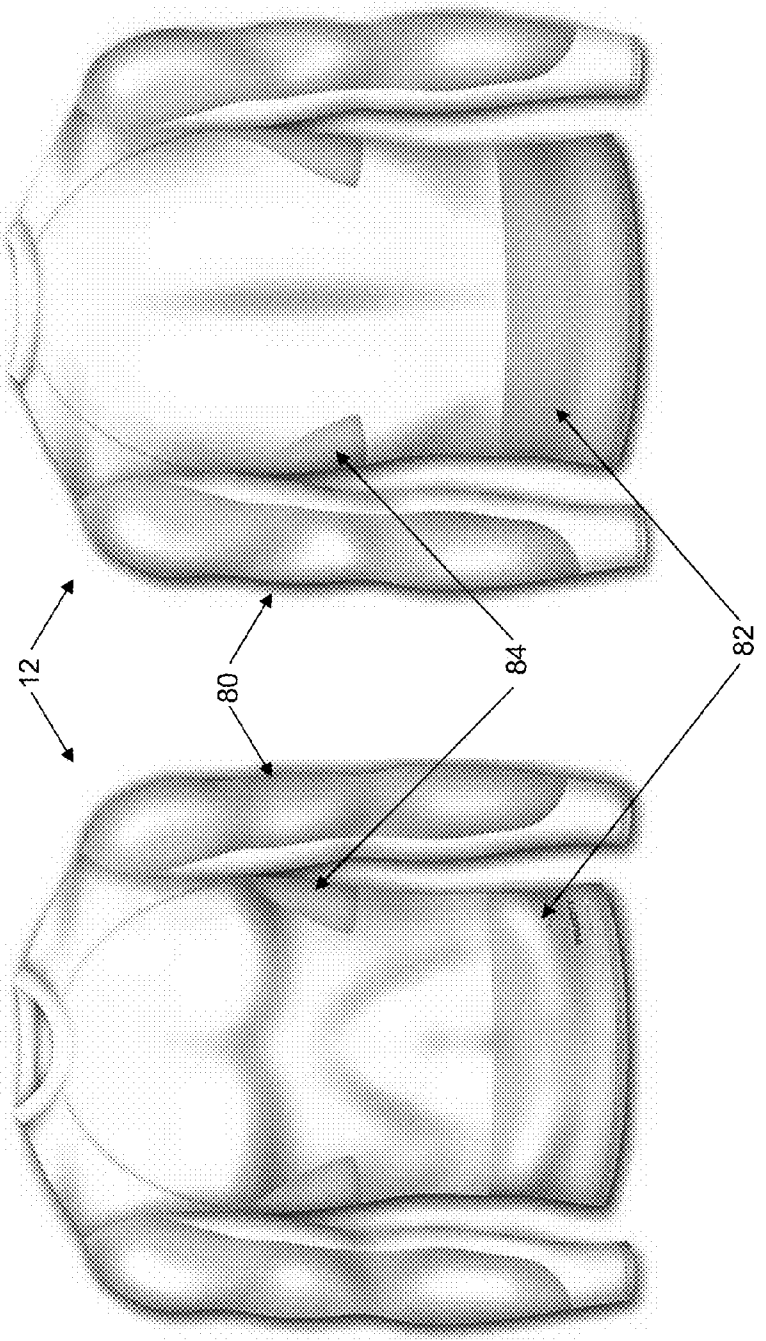

Fig. 19

Fig. 22

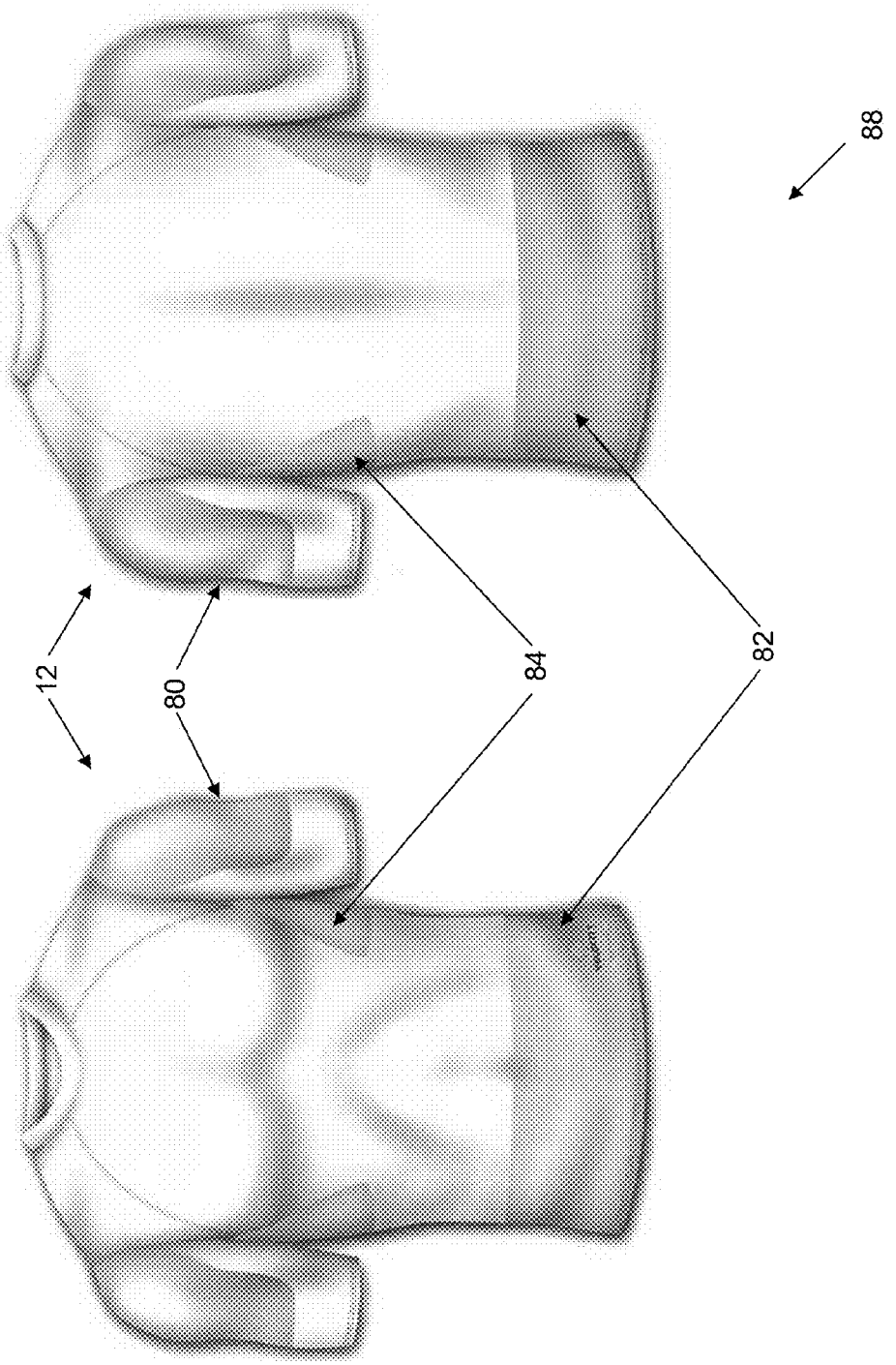

Fig. 21

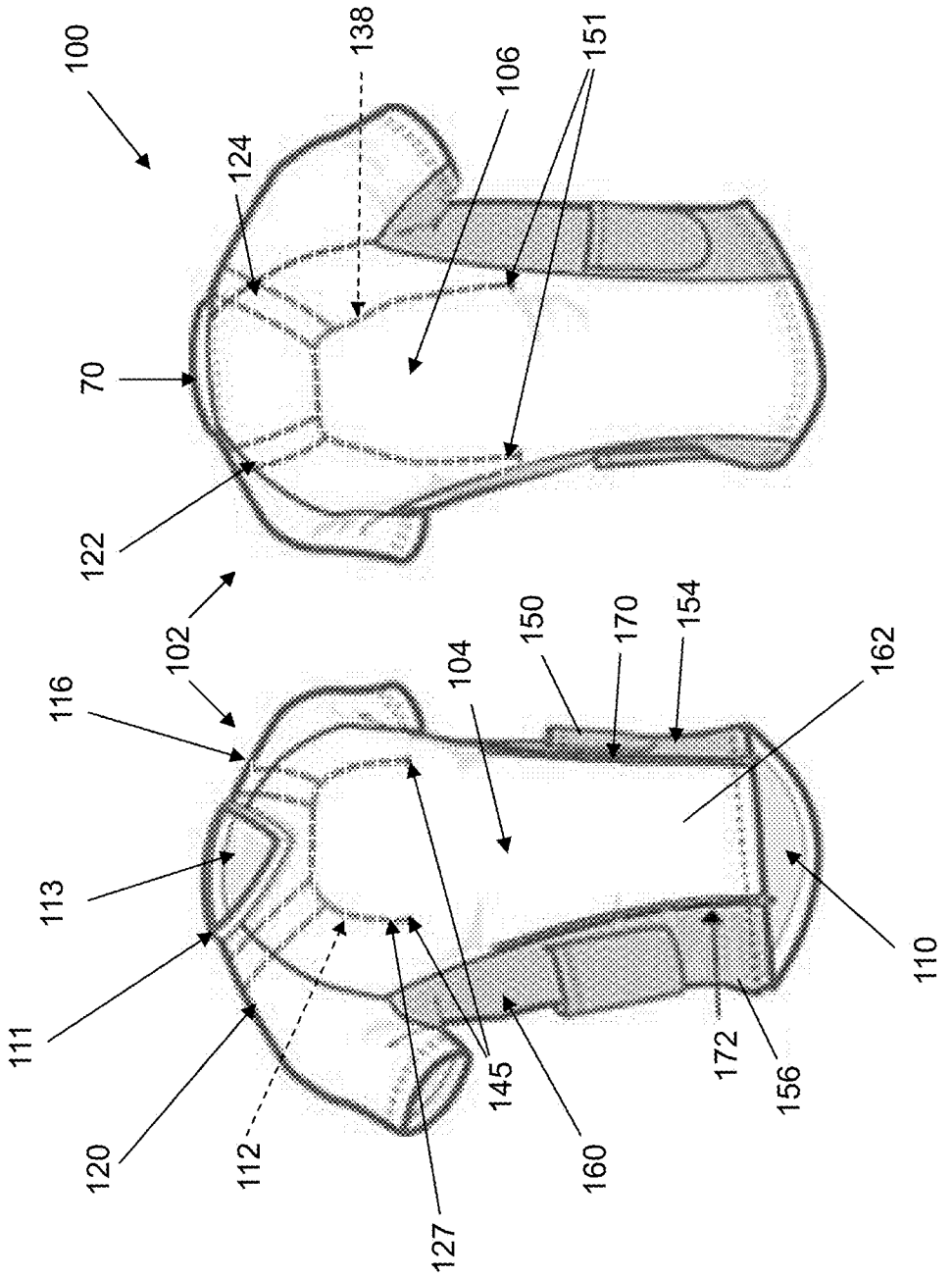
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Fig. 23

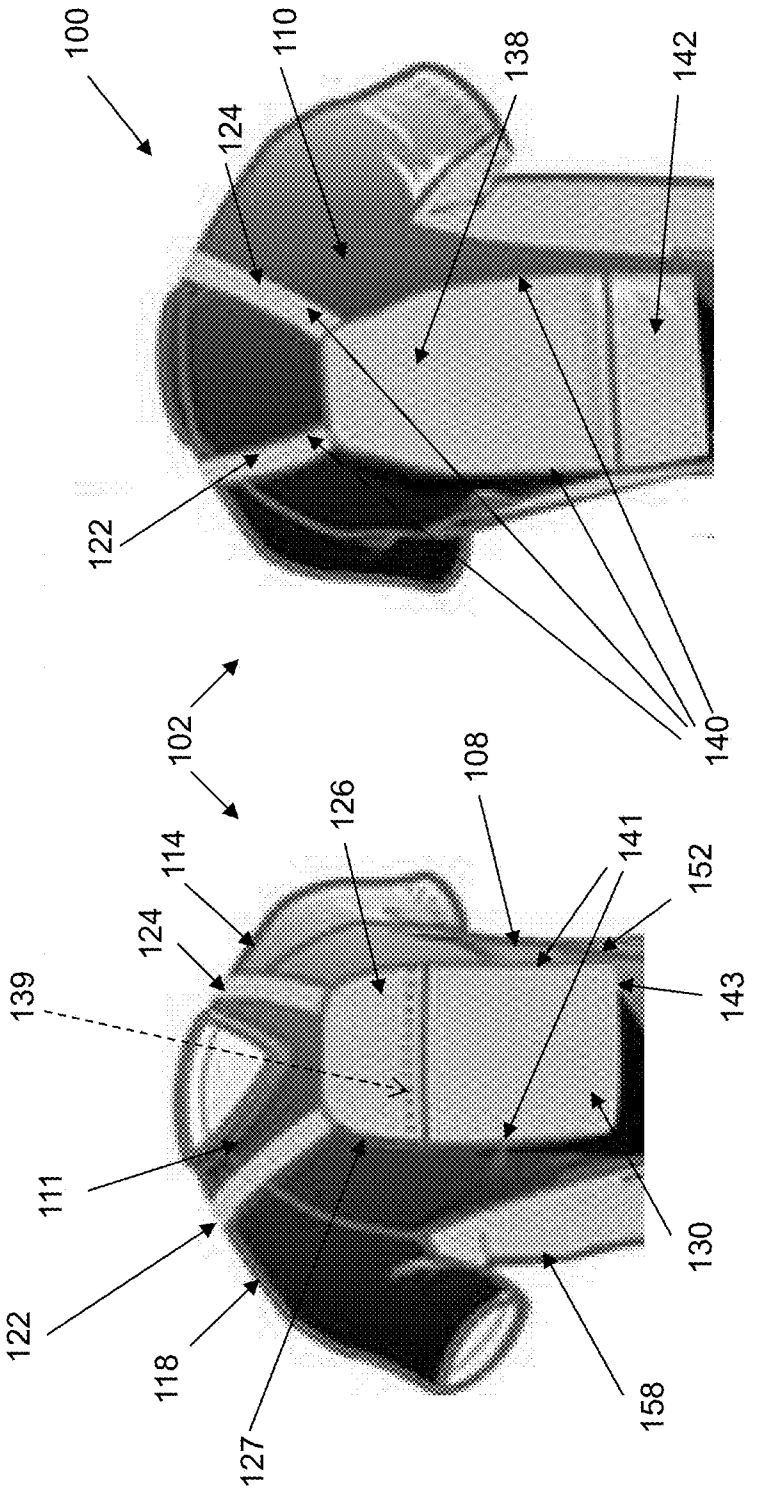
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Fig. 24

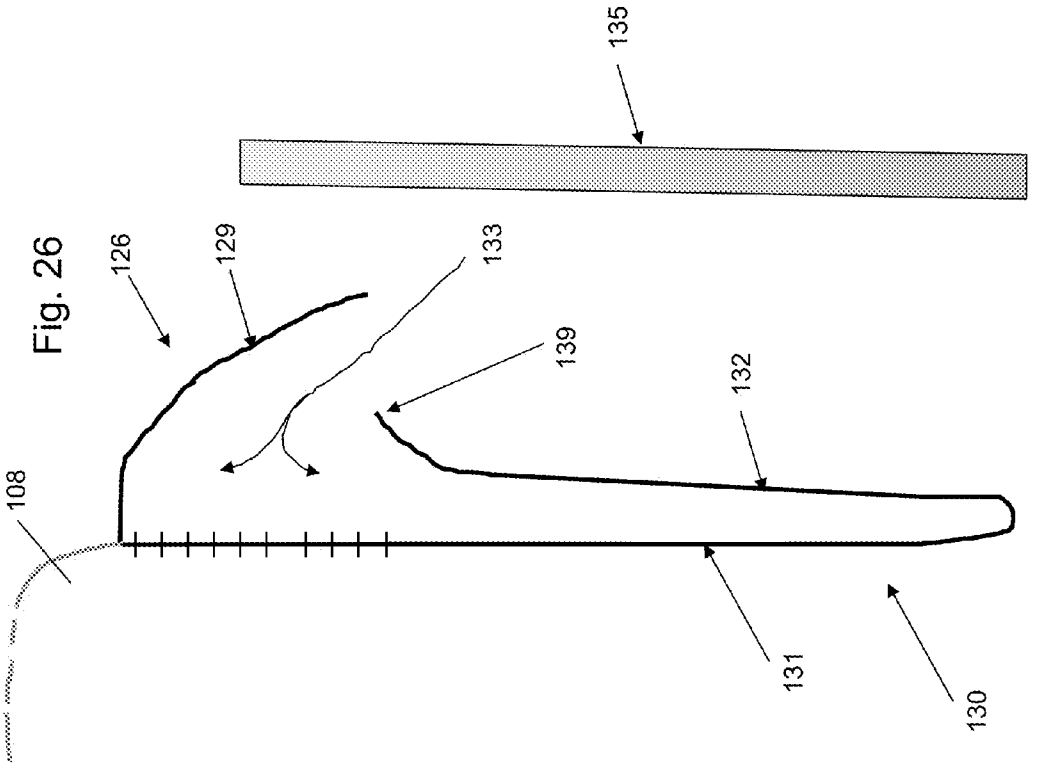
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Fig. 26

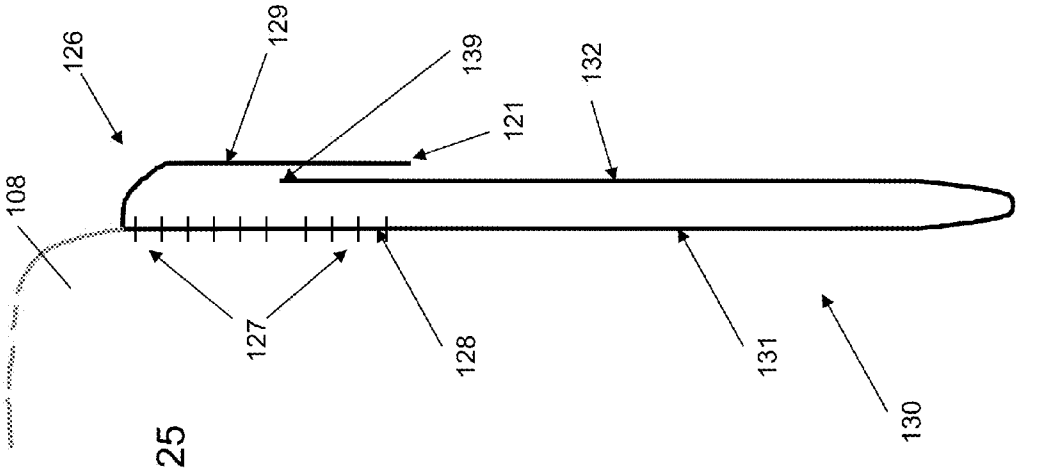
126
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Fig. 25

PROTECTIVE UNDER-CLOTHING APPARATUS, SYSTEM AND METHOD

FIELD OF THE INVENTION

[0001] The present invention pertains to armor-enhanced under-clothing, and more particularly to armor-enhanced under-clothing that is comfortable, easy to customize and ergonomically superior over prior devices.

BACKGROUND AND SUMMARY OF THE INVENTION

[0002] Military and law enforcement personnel have employed armor-enhanced under-clothing in order to protect their bodies from gunfire, shrapnel, explosive devices and other harmful ballistic objects. Even when such under-clothing is sized according to individual specifications (for example, small, medium and large), the armor-enhanced under-clothing does not generally fit well, gets bunched up, prohibits smooth movement, results in undesirable gaps between body and under-clothing, has limited contact points with the body, and even hinders the withdrawal of firearms. Such disadvantages often result in poor performance and can encourage mis-use or even non-use of these protective devices.

[0003] The present invention overcomes the current shortcomings and more. The present invention provides a customizable, scalable, armor-enhanced under-clothing system that conforms more substantially to the user's body, providing better protection over every critical body area in different stages as selected by the user. In this way, the user can employ as much or as little of the system of the present invention as desired or needed for a given anticipated threat level, incorporating suitable armor to protect the wearer against anything from light ballistics (e.g., sand) all the way up to the heaviest ballistic weaponry and fragments that might be encountered. The present invention employs compression fabric as a base material in the top (e.g., shirt) and bottom (e.g., shorts) system elements, and further can include a static fabric material harness in the top system element. The material can be provided in different forms depending upon desired characteristics (e.g., wicking, fire resistance, temperature management, anti-microbial, etc.). Anti-ballistic panels of suitable material and thickness can be inserted into the static fabric material harness designed to carry the panels while preventing any undesirable bouncing effect. In one embodiment of the present invention, the top and bottom elements are adapted to be secured to one another using hook-and-loop fasteners or similar fasteners to facilitate comfort, intended purpose and overall fit. The present invention also provides full body contact as opposed to selected point contact associated with prior devices. The present invention can be provided in sleeveless, short sleeve and long sleeve shirts, shorts and pants, for example.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] FIGS. **1** and **2** show front and back views of one embodiment of a top element as provided by the system of the present invention, with the top element being inverted so as to show the interior surface thereof.

[0005] FIGS. **3** and **4** show front and back views of an alternative embodiment of a top element as provided by the system of the present invention.

[0006] FIGS. **5** and **6** show front and back views of an alternative embodiment of a top element as provided by the system of the present invention.

[0007] FIGS. **7** and **8** show front and back views of an alternative embodiment of a top element as provided by the system of the present invention.

[0008] FIGS. **9** and **10** show front and back views of one embodiment of a bottom element as provided by the system of the present invention.

[0009] FIGS. **11** and **12** show front and back views of an alternative embodiment of a bottom element as provided by the system of the present invention.

[0010] FIGS. **13** and **14** show front and back views of an alternative embodiment of a bottom element as provided by the system of the present invention.

[0011] FIGS. **15** and **16** show front and back views of an alternative embodiment of a bottom element as provided by the system of the present invention.

[0012] FIGS. **17** and **18** show front and back views of an alternative embodiment of a bottom element as provided by the system of the present invention.

[0013] FIGS. **19** and **20** show front and back views of an alternative embodiment of a top element as provided by the system of the present invention.

[0014] FIGS. **21** and **22** show front and back views of one embodiment of a top element as provided by the system of the present invention.

[0015] FIG. **23** shows front and back views of a top element in accordance with one embodiment of the present invention.

[0016] FIG. **24** shows front and back views of an inverted top element in accordance with another embodiment of the present invention.

[0017] FIGS. **25** and **26** are schematic left-side view diagrams illustrating one embodiment of the chest portion and first pocket bag in accordance with the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE PRESENT INVENTION

[0018] FIGS. **1** through **26** illustrate different embodiments of the present invention. As shown in the embodiment of FIG. **1**, the front side **14** of one embodiment of a top element **12** of the system of the present invention includes a suitably-sized interior pocket **16** within a base material **17** for receiving a suitably-sized front torso ballistic panel **18**. In this embodiment, the base material **17** comprises a compression fabric designed to snugly fit the wearer with 100% body contact. As such, the base material **17** provides a material with high tenacity stretch which provides muscles with a firm compression fit that lessons vibrations, reduces fatigue, and keeps muscles energized. The fabric can be formed in a knit construction, for example, using a series of gradient fibers with an open knit inner surface to create a moisture transfer environment.

[0019] The arm elements **20** also include respective suitably-sized interior pockets **22** for receiving respective suitably-sized forearm ballistic panels **24**. The pockets **16**, **22** generally include an opening through with panels can be inserted and removed. This facilitates customization of the anti-ballistic properties of the present invention, as heavier and thicker panels may be needed for some engagements, while lighter and thinner panels may be needed for other engagements. In another embodiment of the present invention, the pockets **16**, **22** are constructed with panels retained therein, and then sealed so that the panels remain permanently

part of the top element. The pockets can comprise a variety of materials, including compression fabric, or alternatively a static fabric material retaining greater strength and resisting movement more than compression fabric.

[0020] As shown in the embodiment of FIG. **2**, the back side **15** of the top element **12** includes a suitably-sized interior pocket **26** for receiving a suitably-sized back torso ballistic panel **28**. As FIGS. **1** and **2** show the interior surface **13** of the top element, it will be appreciated that the pockets **16**, **22** and **26** are on the interior and are not generally accessible from the exterior of the top element, which assists in the concealability and comfort of the present invention.

[0021] As shown in the embodiment of the present invention in FIGS. **3** and **4**, the top element can include epaulets **30** over the shoulder area, wherein the epaulets **30** are formed with an interior surface that forms a channel through which strap members **32** and clip members **34** can extend. The strap **32** and clip **34** members can be used to retain additional panels **36** within or over the surface of the base material **17**.

[0022] FIGS. **5** and **6** show additional front **14** and back **15** sides of a top element **12** of the system of the present invention, similar to those shown in FIGS. **1** and **2**, respectively, with like numbers representing like elements therein. FIGS. **5** and **6** further show custom-sized interior hip-side pockets **40** within the base material for receiving a custom-sized side ballistic panel **42**. Such panels **42** protect the user's side and hip areas and, similar to the front and back panels described above, provide for a snug fit which engages the wearer's body and does not, for example, protrude so far as to hinder the wearer's ability to quickly access firearms or other materials that may be attached somewhere on the wearer's outerwear.

[0023] FIGS. **7** and **8** show front **14** and back **15** sides of a sleeveless top element **12** with elements corresponding to those shown and described in connection with FIGS. **1-6**.

[0024] FIGS. **9** through **18** represent different embodiments of a bottom element **50** of the present invention, with FIGS. **9**, **11**, **13**, **15** and **17** representing the front side **52** of the bottom element **50** and FIGS. **10**, **12**, **14**, **16** and **18** representing the back side **54** of the bottom element **50**. The base material **55** of bottom element **50** comprises a similar material and/or the same material as the compression fabric described above with regard to base material **17** of top element **12**. As represented in FIGS. **9** and **10**, leg pockets **56** are provided to receive custom-sized leg protective ballistic panels **58**. The panels **58** protect at least the wearer's femoral artery. The pockets **56** can comprise static material similar to that described above in connection with pockets **16**, **22** in FIGS. **1-2**.

[0025] FIGS. **11** and **12** show the embodiments of the present invention with protective elements **58** on the front **52** and back **54** sides of the bottom element **50**. FIGS. **13** and **14** show the embodiments of the present invention similar to FIGS. **11** and **12**, with the same reference elements, and with an additional crotch protective element **60** retained within a suitably-sized pocket **62** therearound.

[0026] FIGS. **15** and **16** show further enhanced embodiments of the bottom element **50** of the present invention, with the front side **52** showing hip guards **66** within hip pockets **64**, in addition to crotch protective element **60** and leg protective panels **58** as illustrated and described above. Further, FIG. **16** shows tailbone protective element **72** within tailbone pocket **70** and gluteal protective elements **74** within gluteal pockets **76**.

[0027] FIGS. **17** and **18** show embodiments of the bottom element **50** of the present invention in long pants-like form. Similar reference numbers apply as labeled and described above.

[0028] FIGS. **19-22** show additional embodiments of the top element **12** of the present invention. Outer arm internal pockets containing ballistic inserts **80**, waistline internal pockets containing ballistic inserts **82** and upper torso under arm pockets containing ballistic inserts **84** are shown therein with respect to a long sleeve embodiment **85** in FIGS. **19-20** and a short sleeve embodiment **88** in FIGS. **21-22**.

[0029] In operation, a wearer of the present invention may select a previously installed version, where ballistic panels are already selected and sewn in, or where ballistic panels are already inserted into the top and bottom elements of the present invention. The selection can be made according to the wearer's size (e.g., small, medium and large). Alternatively, the wearer may select the top and bottom elements without any ballistic panels installed, put on the top and bottom elements, and then install appropriate ballistic elements in the available pockets as desired for an anticipated engagement. It will be appreciated that the pockets can be openable and sealable using hook and loop type fasteners, or other appropriate fasteners to enable quick assembly and dis-assembly. Accordingly, one aspect of the present invention provides a protective clothing system with a standardized set of pockets which may or may not be fully employed for a given engagement, but which do not reduce the ergonomic design and comfortable fit, regardless of whether the pockets are filled with suitable ballistic material.

[0030] The ballistic material can comprise, for example, layers of fibers that may comprise a high molecular weight polyethylene material, an aramid fiber, a combination of high performance fibers, or a non-woven thermoplastic composite. Commercially available embodiments of the ballistic material are known as Dyneema™ and Spectrashield™, for example.

[0031] The present invention allows for ballistic or other fabric inserts (e.g., as assessed by potential threat) to be sewn into or placed in a pocket or sleeve, for example. The present invention also protects the end user from sand, ballistic fragments, etc., as a secondary layer. In one embodiment of the present invention, the tops or bottoms in any configuration will cover areas that traditional body armor does not. As such, an end user can wear the top of bottoms of the present invention under their traditional body armor and the tops and bottoms would have extra protection in the areas that the body armor does not cover. Optionally, there may be additional protection for the lower abdominal area, arms, under arms, upper legs, etc.

[0032] As such, the present invention can conceal the armor, keep the armor or protection in the correct place, allow it to fit a great range of people, allow for multiple overlap points for extreme comfort, provide interchangeable armor components in order to adjust for size, and allow the tops and bottoms in one size to adjust within the pocket or sleeve so that the same component can permit different thickness inserts to be employed.

[0033] In the embodiment of the invention as shown in FIGS. **23** and **24**, for example, the present invention provides an article **100** of under-clothing, comprising a top element **102** comprising compression fabric material, with the top element **102** having front **104** and back **106** exterior surfaces, and front **108** and back **110** interior surfaces. The article **100**

further includes a harness element **112** comprising, for example, a non-compression, static material secured to and extending from the front interior surface **108** to the back interior surface **110** of the top element **102**. The top element **102** further includes a neck area **111** forming an opening indicated at **113**, left shoulder interior **114** and exterior **116** surfaces, and right shoulder interior **118** and exterior **120** surfaces. The harness element **112** includes a first strap element **122** secured to the right shoulder interior surface **118**, and a second strap element **124** secured to the left shoulder interior surface **114**.

[0034] The first strap element **122** has a first strap length and is secured to the right shoulder interior surface along substantially the entire first strap length. Similarly, the second strap element **124** has a second strap length and is secured to the right shoulder interior surface along substantially the entire second strap length.

[0035] The harness element **112** further includes a chest portion **126** secured at least in part to the first **122** and second **124** strap elements and further secured to the front interior surface **108** of the top element **102**. As illustrated in FIG. **23** and in the schematic drawing of FIG. **25**, the chest portion **126** can be secured by sewing a seam **127** that connects the chest portion **126** to the front interior surface **108** of the top element **102**. In one embodiment of the present invention, the chest portion is secured to the front interior surface **108** along the upper perimeter boundary of the chest portion, which is shown along seam **127** in FIG. **23** as a substantially inverted U-shaped seam. Further, the chest portion **126** can comprise a two-ply static fabric element that provides a durable and strong material for the purposes of securely retaining ballistic-resistant material as described hereinafter. In one embodiment of the present invention, the harness element comprises a static material that does not stretch. Such a material can be considered a "jersey mesh" material in accordance with one embodiment of the invention. By not stretching, any armor inserted into the pocket bag portions described herein will not be permitted to bounce around. The bouncing of armor inserts is undesirable because it can reduce effectiveness, comfort and desire for the user to employ armor. The first or back ply **128** of the chest portion **126** is retained against the top element **102** via seam **127**, while the second or front ply **129** of the chest portion otherwise hangs freely over a first pocket bag portion **130** provided as part of the harness element **112**.

[0036] The first pocket bag **130** includes a back ply portion **131** and a front ply portion **132**, and can accommodate the insertion or removal of ballistic inserts. In one embodiment of the present invention, the back ply portion **131** of the first pocket bag **130** is integrally formed with the back ply **128** of the chest portion, but is generally not secured to the top element **102** (except optionally at attachment points **145**) and hangs freely from the chest portion. The front ply portion **132** similarly hangs freely but is not integrally formed with the front ply portion **129** of the chest portion **126** of the harness element. Rather, the front ply portion **132** of the first pocket bag **130** includes a rim **139** (illustrated by dashed arrow in FIG. **23**, and in FIG. **26**), and the rim **139** of the front ply portion, as well as the outer side edges **141** and bottom edge **143** of the first pocket bag **130** are generally not secured to the top element **102**, except optionally at attachment points **145** shown in FIG. **23**, which can correspond to the points of intersection of the rim **139** and outer side edges **141** of the front ply portion **132** of the first pocket bag. As shown in FIG. **26**, for example, the front ply **129** of the chest portion **126** can be lifted (e.g., by hand), and the rim **139** and/or front ply **132** of the first pocket bag **130** can be pulled away from the back ply **131** so as to create an opening **133** to insert or remove a ballistic insert **135**. As illustrated in FIG. **25**, the rim **139** of the front ply portion **132** of the pocket bag **130** can extend above the bottom edge **121** of the front ply **129** of the chest portion **126** when both ply portions **129**, **132** are in the rested position, which results in the front ply **129** of the chest portion **126** overlapping the front ply **132** of the pocket bag **130**, which can thereby assist in securely retaining the ballistic insert within the open area inside the pocket bag and the chest portion. It will be appreciated that the pocket bag **130** can be a separable component that is not integrated with the chest portion of the harness element **112**, but is rather connectable and disconnectable using a zipper-type connection, hook-and-loop type connection or other type of temporary connection.

[0037] As further shown in FIGS. **23** and **24**, the harness element **112** includes a back portion **138** secured to the first **122** and second **124** strap elements and further secured to the back interior surface **110** of the top element **102**. In one embodiment of the present invention, the back portion is secured to the strap elements and the interior surface **110** of the top element **102**, and the strap elements **122**, **124** are secured to the interior surface **110** of the top element **102**, such as by sewing a seam **140**, for example. The harness element **112** further includes a second pocket bag **142**. In one embodiment of the present invention, the back portion **138** and the pocket bag **142** each comprise separate two-ply constructions similar to the chest portion **126** and pocket bag **130**, respectively, described above. In one embodiment of the present invention, and similar to the arrangement described above for the front pocket bag **130**, the back ply portion of the second pocket bag **142** is integrally formed with the back ply of the back portion **138**, but the second pocket bag **142** is generally not secured to the top element **102** (except optionally at attachment points **151** shown in FIG. **23**) and hangs freely from the chest portion. The front ply portion of the second pocket bag **142** similarly hangs freely but is not integrally formed with the front ply portion of the back portion **138** of the harness element **112**. Rather, the front ply portion of the second pocket bag **142** includes a rim similar to that shown at **139** for first pocket bag **130**, and the rim of the front ply and the outer perimeter (including a bottom edge and side edges) of the second pocket bag **142** are generally not secured to the top element **102**, except optionally at attachment points **151** shown in FIG. **23**, which can correspond to the intersection points of the second pocket bag side edges and the rim of the front ply of the second pocket bag.

[0038] One or more ballistic inserts can be inserted into and removed from the second pocket bag **142** and the opening created by the two plies of the back portion **138**, similar to the process described and shown in connection with the first pocket bag **130** and chest portion **126** in FIG. **26**, for example. It will be appreciated that the pocket bag **142** can be a separable component that is not integrated with the chest portion of the harness element **112**, but is rather connectable and disconnectable using a zipper-type connection, hook-and-loop type connection or other type of temporary connection.

[0039] As further shown in FIGS. **23** and **24**, the top element **102** further includes a left side portion **150** comprising left side interior **152** and exterior **154** surfaces, and a right side portion **156** comprising right side interior **158** and exterior **160** surfaces, and further including a front portion **162** com-

prising the front interior **108** and exterior **104** surfaces. The front portion **162** of the top element **102** is releasably secured to the left side portion **150** using a left side securing element **170** and is further releasably secured to the right side portion **156** using a right side securing element **172**. In one embodiment of the present invention, the left side **170** and right side **172** securing elements comprise slide fastener (i.e., Zipper™) elements, allowing the user to zip and unzip the front portion **162** from the side portions **150**, **156** to allow easy access to the front pocket element **132** of the present invention.

[0040] It will be appreciated that the protective clothing system of the present invention thus provides a customizable, scalable, armor-enhanced clothing system that conforms more substantially to the user's body, with a thinner armor profile, and with better protection over every critical body area in different stages as selected by the user. The present invention further provides such an article whereby the top element comprises an outer compression fabric layer with an inner non-compression fabric harness element.

[0041] The present disclosure describes numerous embodiments of the present invention, and these embodiments are presented for illustrative purposes only. These embodiments are described in sufficient detail to enable those skilled in the art to practice the invention, and it will be appreciated that other embodiments may be employed and that structural, and other changes may be made without departing from the scope or spirit of the present invention. Accordingly, those skilled in the art will recognize that the present invention may be practiced with various modifications and alterations. Although particular features of the present invention can be described with reference to one or more particular embodiments or figures that form a part of the present disclosure, and in which are shown, by way of illustration, specific embodiments of the invention, it will be appreciated that such features are not limited to usage in the one or more particular embodiments or figures with reference to which they are described. The present disclosure is thus neither a literal description of all embodiments of the invention nor a listing of features of the invention that must be present in all embodiments.

1. An article of under-clothing, comprising:

a top element comprising compression fabric material, with the top element having front and back exterior surfaces, and front and back interior surfaces; and

a harness element comprising a static material secured to and extending from the front interior surface to the back interior surface of the top element.

2. The article of claim **1** wherein the top element includes a neck portion forming an opening, left shoulder interior and exterior surfaces, and right shoulder interior and exterior surfaces, and wherein the harness element includes a first strap element secured to the right shoulder interior surface, and a second strap element secured to the left shoulder interior surface.

3. The article of claim **2** wherein the first strap element has a first strap length and is secured to the right shoulder interior surface along substantially the entire first strap length, and further wherein the second strap element has a second strap length and is secured to the right shoulder interior surface along substantially the entire second strap length.

4. The article of claim **1** wherein the harness element includes a chest portion secured to the first and second strap elements and further secured to the front interior surface of the top element.

5. The article of claim **4** wherein the harness element further includes a first pocket bag extending from the chest portion, wherein the first pocket bag has side edges and a bottom edge, and wherein at least the bottom edge of the first pocket bag is not secured to the top element.

6. The article of claim **1** wherein the harness element includes an upper back portion secured to the first and second strap elements and further secured to the back interior surface of the top element.

7. The article of claim **6** wherein the harness element further includes a second pocket bag secured to the upper back portion, wherein the second pocket bag has side edges and a bottom edge, and wherein at least the bottom edge of the second pocket bag is not secured to the top element.

8. The article of claim **5**, further including a ballistic insert maintained within the first pocket bag.

9. The article of claim **8**, wherein the chest portion comprises a two-ply material secured to the front interior surface so as to form an opening between the two plies, and wherein the ballistic insert is further maintained within the opening between the two plies of the chest portion.

10. The article of claim **1** wherein the top element further includes a left side portion comprising left side interior and exterior surfaces, and a right side portion comprising right side interior and exterior surfaces, and further including a front portion comprising the front interior and exterior surfaces.

11. The article of claim **10** wherein the front portion of the top element is releasably secured to the left side portion using a left side securing element and is further releasably secured to the right side portion using a right side securing element.

12. The article of claim **11** wherein the left side and right side securing elements comprise slide fastener elements.

13. A method, comprising:

providing a top element of an article of under-clothing comprising a compression fabric, with the top element having front and back exterior surfaces, and front and back interior surfaces; and

securing a harness element comprising a static material to the top element such that the harness element extends from the front interior surface to the back interior surface of the top element.

14. The method of claim **13** wherein the top element includes a neck portion forming an opening, left shoulder interior and exterior surfaces, and right shoulder interior and exterior surfaces, and wherein the harness element includes a first strap element secured to the right shoulder interior surface, and a second strap element secured to the left shoulder interior surface.

15. The method of claim **13** wherein the harness element includes a chest portion secured to the first and second strap elements and further secured to the front interior surface of the top element.

16. The method of claim **15** wherein the harness element further includes a first pocket bag extending from the chest portion, wherein the first pocket bag has side edges and a bottom edge, and wherein at least the bottom edge of the first pocket bag is not secured to the top element.

17. The method of claim **13** wherein the harness element includes an upper back portion secured to the first and second strap elements and further secured to the back interior surface of the top element.

18. The method of claim **17**, wherein the second pocket bag has side edges and a bottom edge, and wherein at least the bottom edge of the second pocket bag is not secured to the top element.

19. The method of claim **13** wherein the top element further includes a left side portion comprising left side interior and exterior surfaces, and a right side portion comprising right side interior and exterior surfaces, and further including a front portion comprising the front interior and exterior surfaces.

20. The method of claim **19** wherein the front portion of the top element is releasably secured to the left side portion using a left side securing element and is further releasably secured to the right side portion using a right side securing element.

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