July 16, 1968 H. M. PERNINI ET AL 3,392,406

FLEXIBLE ARMORED VEST

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FIG. 2.

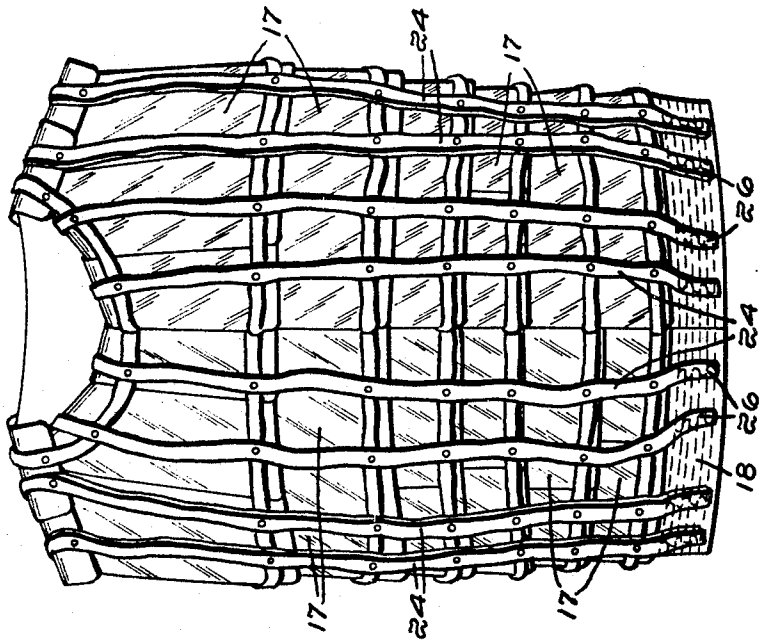
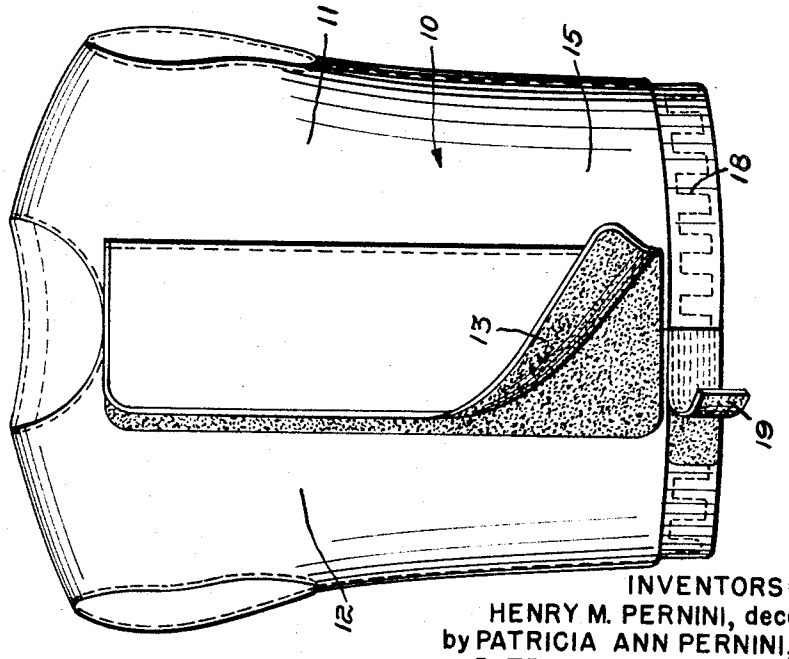


FIG. 1.



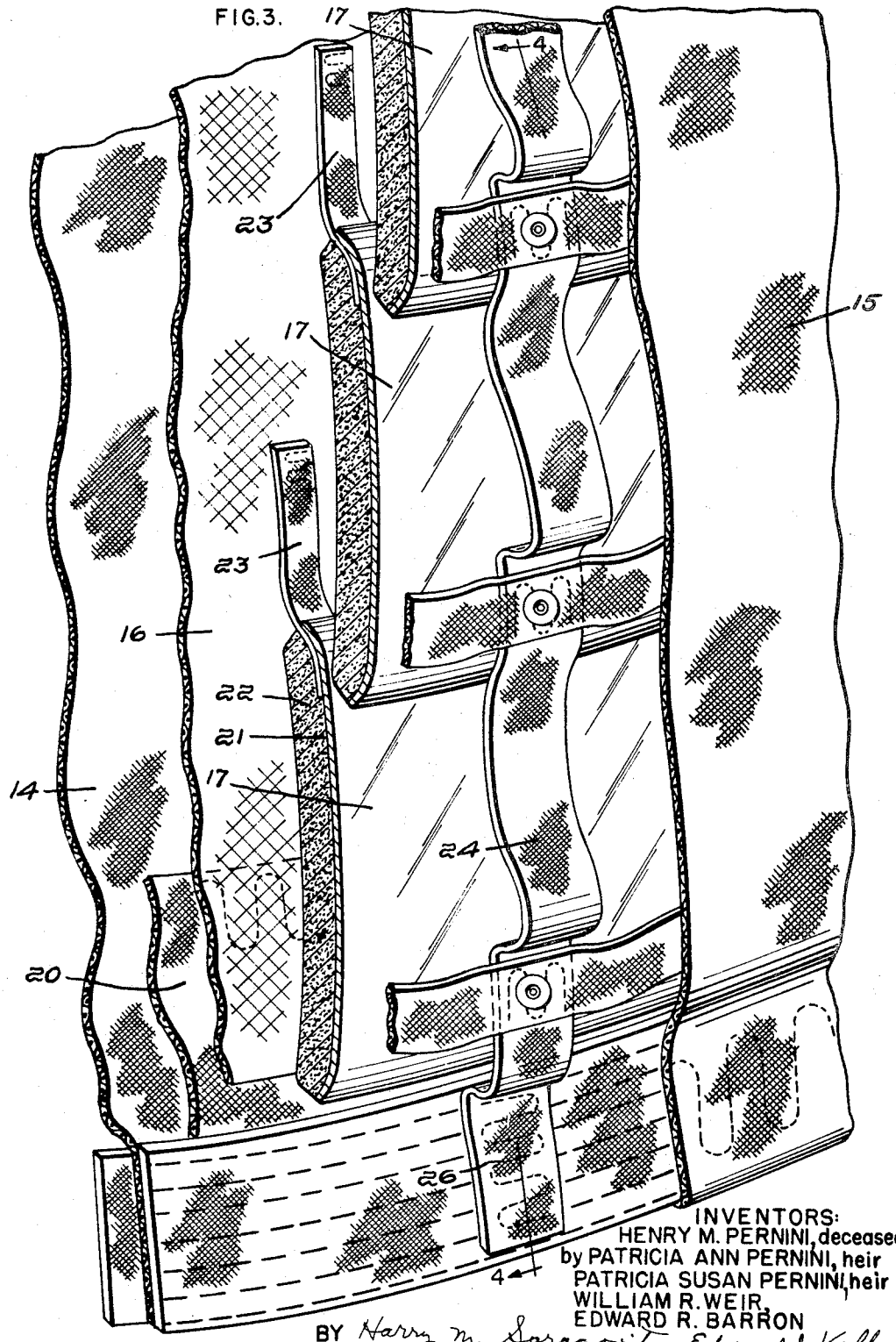
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FIG.3.



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FLEXIBLE ARMORED VEST

Filed April 17, 1967 3 Sheets-Sheet 3

FIG.4.

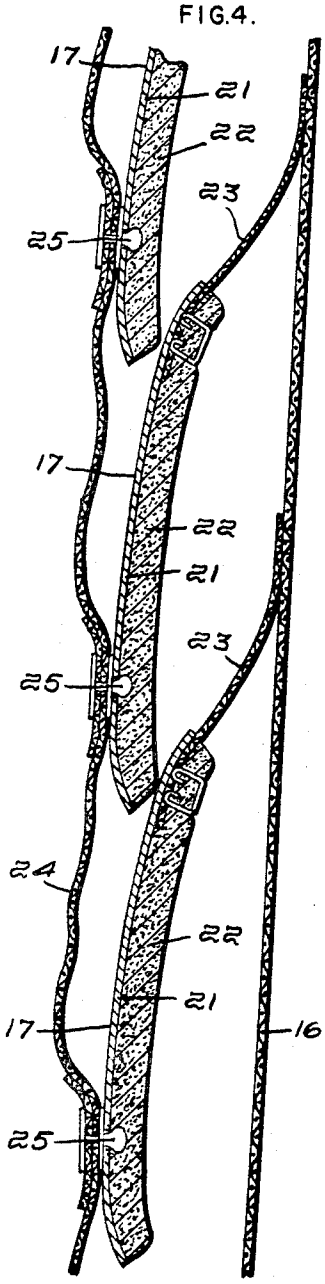
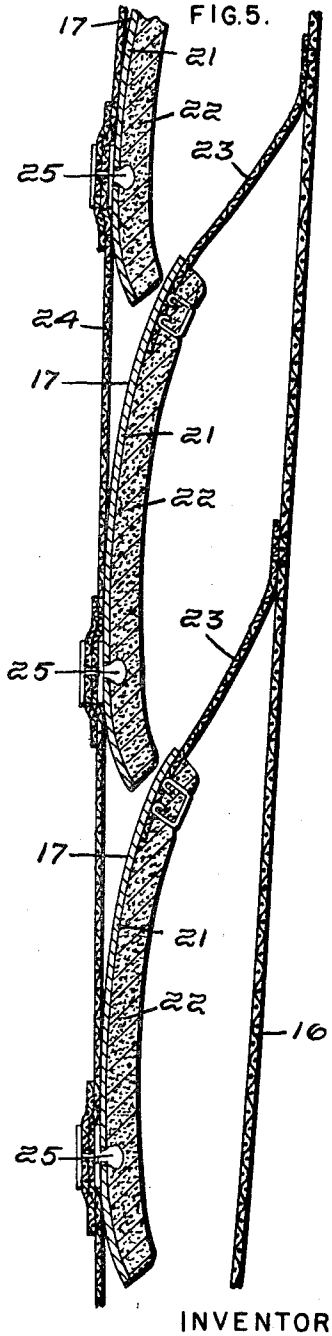


FIG.5.



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United States Patent Office

3,392,406

Patented July 16, 1968

3,392,406

FLEXIBLE ARMORED VEST

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Filed Apr. 17, 1967, Ser. No. 632,157

10 Claims. (Cl. 2—2.5)

ABSTRACT OF THE DISCLOSURE

Armored vest composed of overlapping, oversized armor plates which can be displaced to accommodate torso dimensional changes but having means to limit displacement so as not to expose the torso.

Specification

This invention relates to a flexible, armored, body garment and more particularly to a flexible, armored, vest composed of overlapping armor plates adapted to afford complete protection for the upper torso of the wearer throughout the range of motion normally available to the torso without restriction to that motion.

The armored vest of this invention is constructed so as to afford maximum flexibility as well as unrestricted motion without excessive weight and without sacrificing ballistic protection of the torso area enclosed by the vest. While flexible armored garments heretofore developed by the Armed Forces for combat personnel, such as the armored vest described in U.S. Patent No. 3,130,414 to T. L. Bailey and E. R. Barron, have provided adequate ballistic protection to those areas of the body covered, they possess certain drawbacks in that they all tend to ride up, bunch up or pull out of position when the arms are raised upwardly or when body movements cause the torso to become somewhat distorted and in so doing leave certain portions of the body unprotected. By contrast, the garment of this invention, while permitting the torso to undergo all normal movements required of a combat soldier, does not leave portions of the torso unprotected during any of these movements.

A more complete description and a better understanding of this invention may be had by referring to accompanying drawings which illustrate a preferred embodiment of our invention wherein:

FIGURE 1 of the drawing is a front elevation of the armored vest in accordance with our invention;

FIGURE 2 is a front elevation of the garment of FIGURE 1 with the outer covering removed;

FIGURE 3 is an enlarged sectional view of a portion of the vest, partly broken away, showing the relationship between the various components of the vest;

FIGURE 4 is a longitudinal section through a portion of the garment along lines 4—4 of FIGURE 3;

FIGURE 5 is a view similar to FIGURE 4 illustrating the action of the armor plates when the front of the vest is lengthened to accommodate an increase in length of the front of the torso.

More particularly, the flexible armored garment of this invention as shown in FIGURE 1 is a vest-type garment, designated generally as **10**, the front of which has a left hand portion **11** and a right hand portion **12** whose marginal side edges overlap and are held together by a fastening means **13**, e.g., a nylon hook and pile fastener of the type shown in U.S. Patent No. 2,717,437. Other fastening means, such as snap fasteners, slide fasteners, etc., may be employed in addition to or in lieu of the hook and pile fastener. The back of the garment, not shown in the drawings, is joined to the front portions as in a conventional vest and covers the back of the torso from the neck to the waist. The back embodies same construction as will be described for the front portion except that it is a single unit without the central vertical opening.

The armored garment as shown in detail in FIGURE 3 consists generally of two layers of fabric material comprising an inner **14** and an outer **15** covering with a carrier or hanger fabric **16** placed therebetween and having a plurality of small overlapping armor plates **17** suspended from and covering said carrier fabric.

The inner **14** and outer **15** covers are made of lightweight durable textile materials, such as a tightly woven, high tenacity, elongatable nylon fabric. A suitable nylon fabric is a lightweight duck cloth having the following characteristics:

Weave, basket weave, two ends woven as one, two picks woven as one, weight 14 oz. per. sq. yd.;
Yarn 1050 denier, high tenacity, continuous filament nylon;
Warp, minimum 46 yarns per inch;
Filling, minimum 42 yarns per inch;
Breaking strength, minimum 900 lbs. in the warp and 825 lbs. in the filling.

A waist belt **18** is attached to the inner and outer covers at the lower marginal edges thereof. This belt is adapted to fit snugly about the waist of the wearer to anchor the garment so that it will not ride upwardly when the arms are raised or the torso is stretched. The waist belt may be composed of any relatively heavy textile fabric, e.g., cotton or nylon web belts or belts of an elasticized fabric. The ends of the belt are adapted to be fastened together by means of suitable fastening means **19**, such as the hook and pile fastener described above or any other suitable fastening means as are well known in the art.

The carrier or hanger fabric member **16** is positioned between the inner and outer covers of the garment, and is preferably elastically attached along its lowermost marginal portion to the waist belt **18** by any lightweight elastic fabric **20**, webbing or cord. Such an elastic connection pulls the carrier into its normal position after it has been displaced by some movement or distortion of the torso. It is also possible for the carrier not to be fastened to the waist belt and still perform satisfactorily. The carrier fabric itself is constructed of a highly flexible, essentially non-elastic and lightweight textile material such as open net fabrics, e.g., a nylon, raschel knit, described in Military Specification MIL–C–8061, and having the following characteristics:

Thickness: .04 inch maximum and
Weight: 10 oz. per sq. yd. maximum with ultimate elongation in the Wales direction of 95% maximum and in the courses direction of 125% maximum and with the cloth having 65 ends (minimum) per inch, knit 6 mesh per inch in each direction.

The carrier may be constructed of other textile fibers and in other weaves but it should be lightweight, strong, flexible, essentially non-elastic and relatively inextensible.

Positioned over the carrier are a number of overlapping armor plates **17** which are arranged in tiers and extend from the base of the carrier up to the shoulders as shown in FIGURE 2. The same general arrangement of plates exists with respect to the back side of the garment. The armor plates may be any of those ballistic-resistant materials known to those skilled in the art, but the material employed in this example and the preferred armor material consists of a sheet **21** of titanium alloy backed with a nylon ballistic felt **22**. The ternary titanium alloy used herein is commercially available and contains about 5%

aluminum and 2.5% tin. The titanium plate is formed in thicknesses of the order of 0.03 to 0.04 inch. It is preferred that it have a slight curvature as is shown in FIGURE 5, but this feature is not necessary. The ballistic nylon felt has a thickness of approximately 0.3 inch and is adhesively bonded to the back side of the titanium plates. The edges of the titanium plates are somewhat rounded and the ballistic felt is skived so that the back of the plate-felt assembly results in a relatively flat surface. The rounded edges tend to prevent jamming of the plates during extreme body movements.

The ballistic felt is a needle punched nylon felt, weighing approximately 6 oz. per sq. ft. The staple nylon fibers used in the fabrication of the felt are made from continuous filament, high tenacity cord yarn, 6 denier per filament, cut to 3 inch lengths and crimped. The staple fibers are processed through a conventional single cylinder wool card with a double feed box, to make a web of approximately 1⅓ oz. per sq. ft. weight. Cross-laid batts, 4 ozs. per sq. yd. are then made by overlapping card webs at an apex angle of approximately 17°. The cross-laid batts are needled with standard barbed needles at 277 penetrations per sq. inch per pass and ½ inch penetration. After one batt is passed through the needling, additional batts are needled on until a felt of approximately 0.5 inch is formed. This felt is then condensed and set to a 0.30 inch thickness by a flat bed press.

Each individual armor plate is attached to the underlying carrier by its own individual elastic tape **23** as is shown in detail in FIGURE 3. In the case of larger plates, more than one elastic tape may be used. One end of the elastic tape is fastened to the armor plate by stapling to the ballistic felt backing and the other end is stitched or stapled to the carrier. The elastic tape may be formed of elasticized fabrics as are well known in the art or may be formed of strips of solid elastomeric substances, e.g., rubber.

The basic shape, size and locations of the armor plates can be readily determined by those skilled in the art by taking into consideration body displacements which occur at the torso. The relatively rigid areas of the torso, such as the mid-thoracic region permit the use of relatively large armor plates whereas the more flexible abdominal-lumbo-sacral regions require relatively smaller plates. The plates are oversized only to the extent necessary to provide complete protective cover for the torso when the torso undergoes dimensional changes produced by body movements thereby causing the armor plates to be displaced.

In order to limit the relative displacement of the plates so as to prevent the exposure of the underlying torso, a restraint harness **24** is placed over the plates to provide restraint to movement in the vertical and horizontal modes. The restraint harness consists of an integral, inextensible network or grid of interconnected fabric tapes which is placed over the armor plate assemblage. The tapes are connected to each plate by means of snap fasteners **25** having the male portion on the tape and the mating portion on the plate. The restraint harness is slack in the normal position as shown in FIGURES 3 and 4 but when the body is distorted, the harness limits the degree of displacement of the armor plates as shown in FIGURE 5. The harness is non-elastically attached to the waist belt at **26** and holds the lowermost tier of plates in position above the belt to prevent their upward displacement. Instead of tapes the harness can be constructed of a cord network.

While the changes in the arrangement, proportions, dimensions, and shape of the flexible armored garment disclosed in the specification will occur to those skilled in the art without departing from the spirit of our invention, it is our desire to encompass such variations within the scope of such invention. It is, for example, contemplated that the inner **14** and outer **15** coverings may be eliminated if the armored vest is to be worn beneath some available outer garment or covering.

We claim:

1. A flexible armored body garment adapted to protect the upper torso of a human body comprising:

(a) a flexible carrier member extending over substantially the entire portion of the body of the wearer to be protected by said garment,

(b) a plurality of armor plates individually suspended by elastic means from said carrier in overlapping relation to each other to cover the entire area of the body of the wearer to be protected by said garment, and

(c) a restraint harness of substantially inextensible material attached to each of said armor plates and including a portion at the lower extremity of said harness adapted to snugly engage the body of the wearer to anchor the lower extremity of said harness against upward movement relative to the body of the wearer, the remaining portions of said harness embodying sufficient slack between points of attachment to individual armor plates to permit limited relative movement between said armor plates during movement of the body of the wearer while preventing movement of said plates out of overlapping relation,

whereby the area of the body of the wearer to be protested by said garment remains completely covered by said overlapping armor plates during body movement.

2. A flexible armored body garment according to claim **1** wherein said restraint harness is a network of flexible fabric tapes.

3. A flexible armored body garment according to claim **2** wherein the portion at the lower extremity of said harness adapted to snugly engage the body of the wearer comprises a waist belt.

4. A flexible armored body garment according to claim **3** wherein the lower marginal edges of said flexible carrier member are elastically attached to said waist belt.

5. A flexible armored body garment according to claim **4** wherein the front of said garment adapted to cover the front of said wearer is divided along its longitudinal mid-line into right and left sides and having fastening means to hold the right and left sides together in position about the torso of the wearer.

6. A flexible armored body garment according to claim **5** having an outer covering of a flexible textile material.

7. A flexible armored body garment according to claim **6** wherein said carrier member is a flexible, non-elastic textile net.

8. A flexible armored body garment according to claim **6** having an inner liner of flexible material.

9. A flexible armored body garment according to claim **6** wherein said armor plates are formed of titanium backed with ballistic nylon felt.

10. A flexible armored body garment according to claim **6** wherein said restraint harness is an interconnected grid of fabric tapes extending vertically and horizontally over the surface of the garment.

References Cited

UNITED STATES PATENTS

1,465,767	8/1923	Krause	2—2.5 X
2,747,190	5/1956	Foster	2—2.5
2,748,391	6/1956	Lewis et al.	2—2.5
3,061,839	11/1962	Foster	2—2.5
3,130,414	4/1964	Bailey et al.	2—2.5

FOREIGN PATENTS

762,463	1/1934	France.

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