June 5, 1956 F. J. LEWIS, JR., ET AL 2,748,391

MISSILE-RESISTANT GARMENT

Filed March 30, 1953 4 Sheets-Sheet 1

FIG. 1

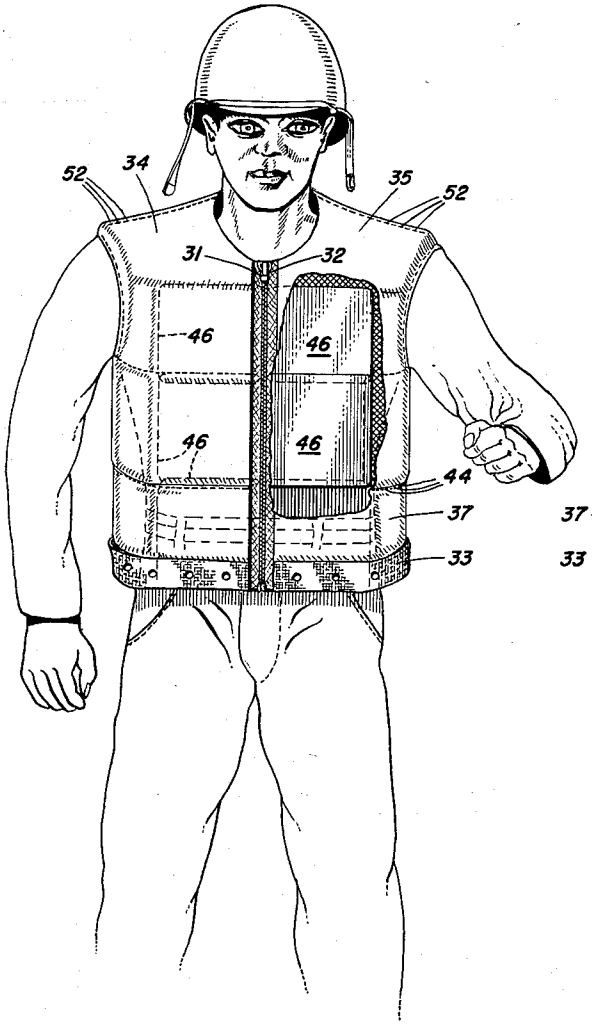
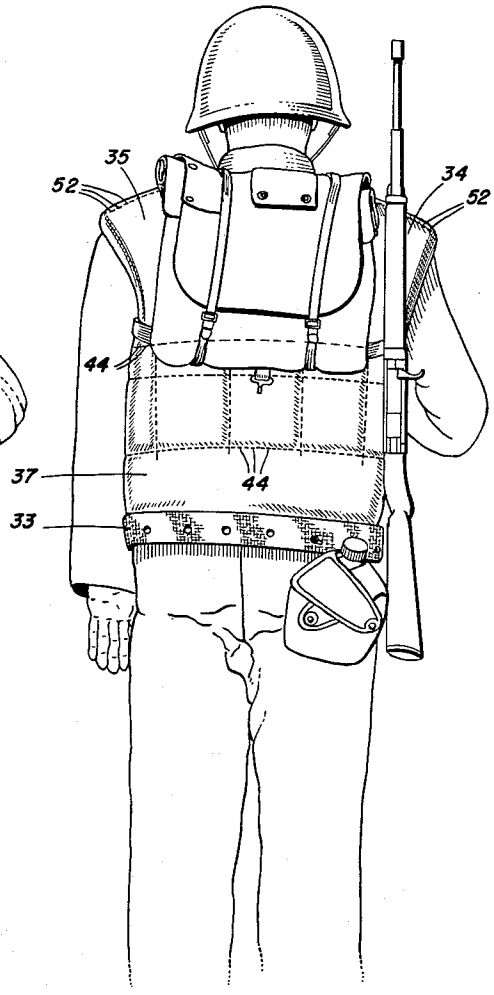


FIG. 2



INVENTORS
FREDERICK JAMES LEWIS, JR.
JOHN FRANCIS QUINLAN

BY G. D. O'Brien
G. Baxter Warner
ATTORNEYS

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Filed March 30, 1953 4 Sheets-Sheet 2

FIG. 4

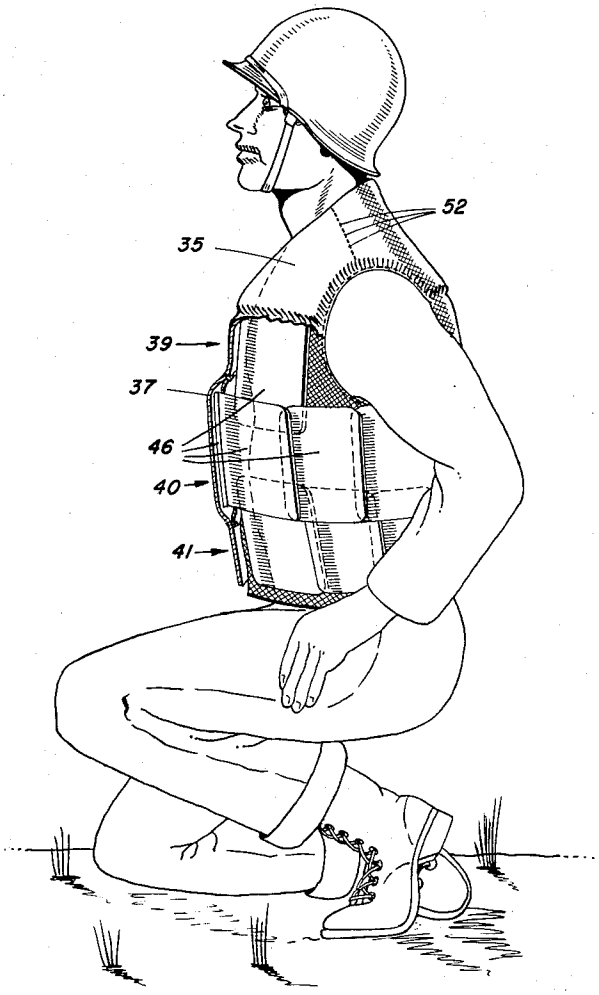
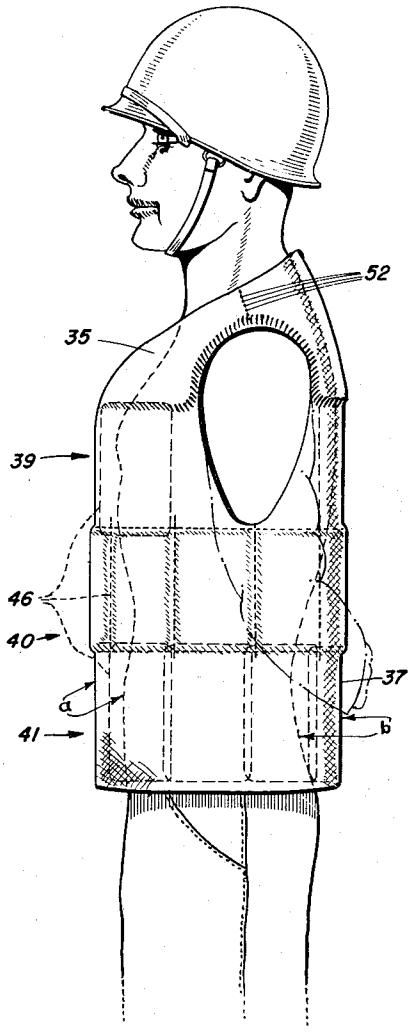


FIG. 3



INVENTORS
FREDERICK JAMES LEWIS, JR.
JOHN FRANCIS QUINLAN
BY G. D. O'Brien
ATTORNEYS

June 5, 1956 F. J. LEWIS, JR., ET AL 2,748,391

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Filed March 30, 1953 4 Sheets-Sheet 3

FIG. 5

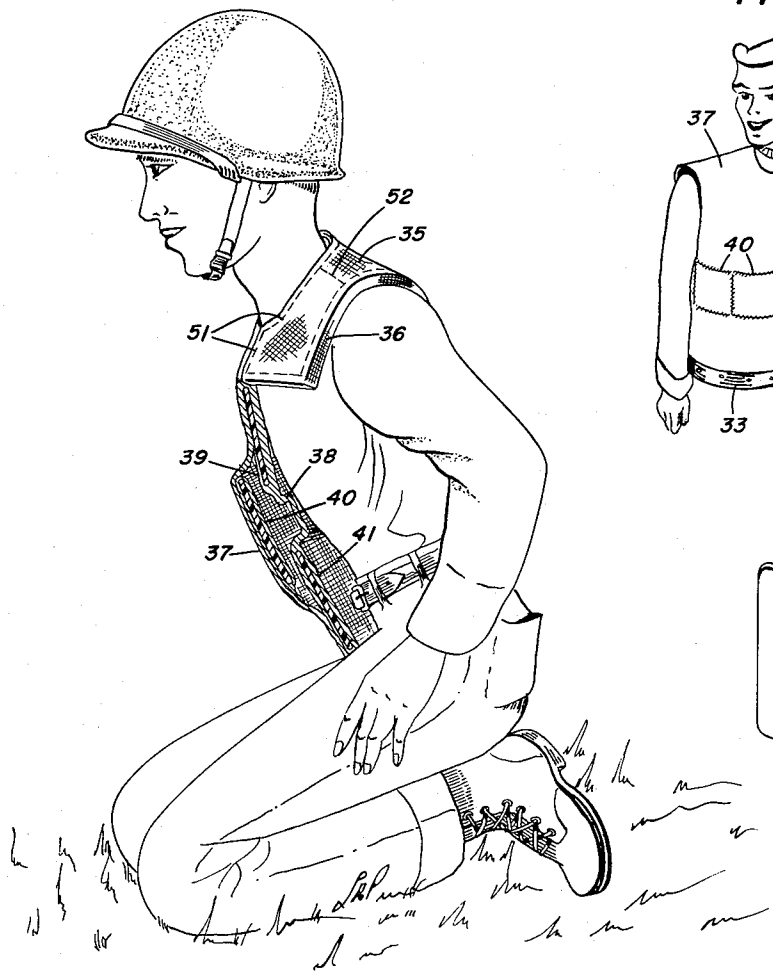


FIG. 6

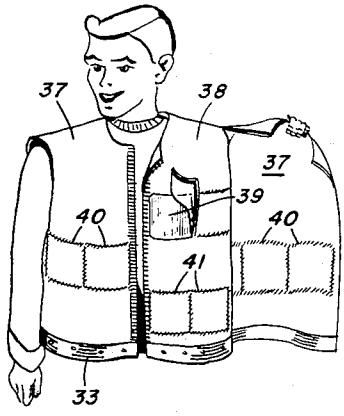


FIG. 8

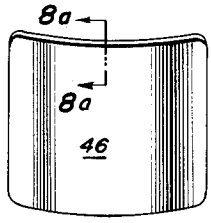


FIG. 8a

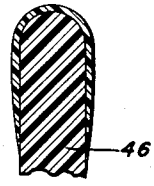


FIG. 7

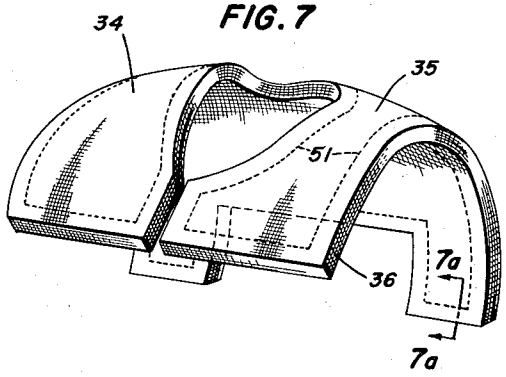
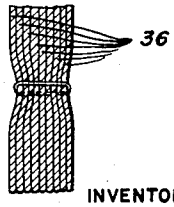


FIG. 7a



INVENTORS

FREDERICK JAMES LEWIS, JR.

JOHN FRANCIS QUINLAN

BY

ATTORNEYS

June 5, 1956 F. J. LEWIS, JR., ET AL 2,748,391

MISSILE-RESISTANT GARMENT

Filed March 30, 1953 4 Sheets-Sheet 4

FIG. 9

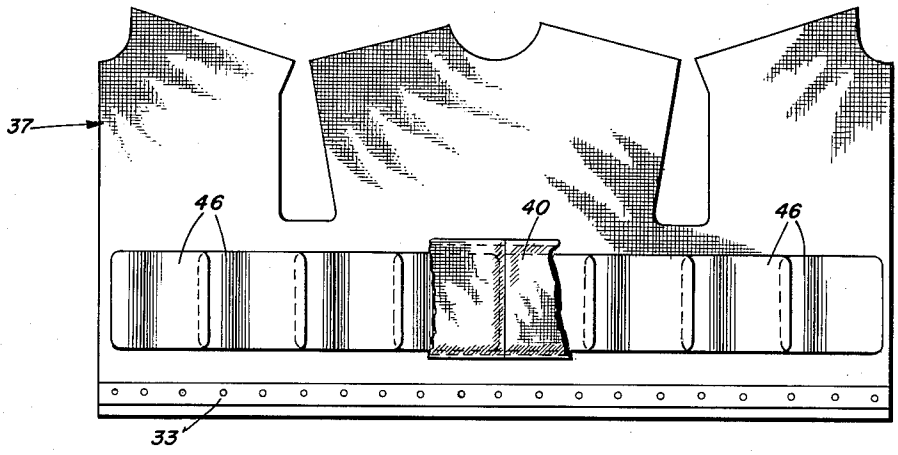


FIG. 10

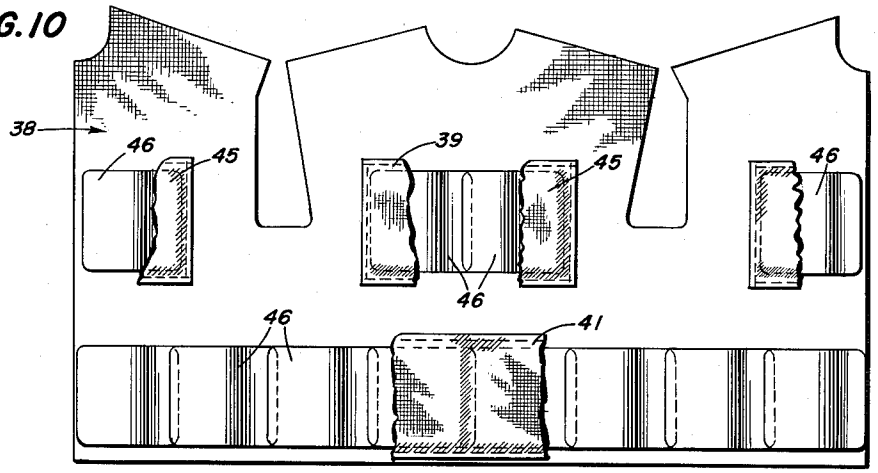


FIG. 12

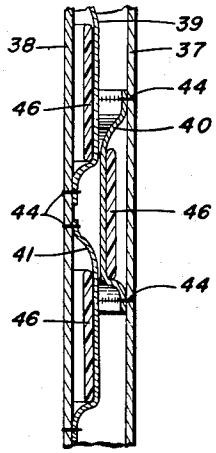
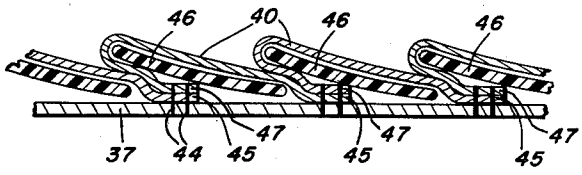


FIG. 11



INVENTORS
FREDERICK JAMES LEWIS, JR.
JOHN FRANCIS QUINLAN

BY G. D. O'Brien
D. Baxter Warner
ATTORNEYS

United States Patent Office

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MISSILE-RESISTANT GARMENT

Frederick J. Lewis, Jr., Norfolk, Va., and John F. Quinlan, Jacksonville, N. C., assignors to the United States of America as represented by the Secretary of the Navy

Application March 30, 1953, Serial No. 345,746

8 Claims. (Cl. 2—2.5)

(Granted under Title 35, U. S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates to wearing apparel, and particularly to a garment having a capacity to resist penetration by relatively low-energy missiles and thus protect a wearer while engaged in a combat area.

An object of the invention is to provide a missile-resistant garment adapted to be draped over the shoulders and fastened in the manner of a vest, to provide virtually complete protection for the body of the wearer, from neck to waist.

Prior methods of armoring an infantry soldier have usually involved the use of metal breast plates which were lacking in sufficient flexibility, were uncomfortably heavy, prevented body breathing by cutting off air circulation, and failed to protect the body against transient deformation effects generated when the armor was struck but not penetrated. Moreover, emphasis was placed upon the resistance of the armor to bullets and controlled missiles rather than fragment type missiles from grenades, mortars, and artillery. In present-day warfare approximately 70% of all combat casualties are caused by uncontrolled missiles, that is, fragments.

A second object of the present invention is to provide a garment directed primarily to the purpose of protecting a soldier or other wearer against this fragmentary type of missile.

A third object of the invention is to provide a missile-resistant garment protecting the upper torso, and constructed of light-weight materials, including rigid nonmetallic panels serving the same purpose as the heavier metallic armor-plates heretofore employed.

A fourth object is to provide a paneled garment in which individual rigid panels are flexibly interconnected, to provide relative motion and telescopic action between panels, and complete overall flexibility.

A fifth object is to provide a garment of the character described, adapted to drape over the shoulders snugly but hang free of the body below the shoulders, thus affording maximum ventilation to the body and permitting a degree of air pumping action as the wearer moves his body in relation to the surrounding freely-hanging garment.

A sixth object is to provide a missile-resistant garment in which the weight is evenly distributed about the body, and divided equally upon the two supporting shoulders.

A seventh object is to provide a garment possessing complete flexibility about the shoulder area, yet providing missile resisting protection in the shoulder area, to substantially the same degree as is provided by the flexibility interconnected rigid panels of the lower area.

An eighth object is to provide a garment in which the component parts are so constructed and assembled as to insure maximum interchange of momentum between such parts, on the one hand, and a missile striking thereagainst

on the other, thereby reducing the possibility of wounding effects behind the armor materials.

A ninth object is to provide a garment in which the component armor materials are nonmetallic products that are readily obtainable, yet are sufficiently rugged to withstand long periods of combat use, or storage, without deterioration and without creating an infection hazard.

A tenth object is to provide a garment in which the individual component armor elements are adapted to lie in overlapping relationship in all areas of the garment, and to cooperate, one with another, in all areas of the garment, to produce continuous armor protection throughout the limits of the garment.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

Figs. 1, 2 and 3 are, respectively, front, rear and side views of a garment embodying the invention, as it appears when being worn;

Fig. 4 is a view of the garment as it appears when individual armor panels move telescopically, as when the wearer crouches;

Fig. 5 is another view of the telescoping action;

Fig. 6 is a front view of the garment, with one front outer jacket section lying in normal draped relationship to the inner jacket section and to the body, while the other front outer jacket section is extended to reveal the inner jacket section, and the inner surface appearance of the outer jacket;

Fig. 7 illustrates the contour of the flexible armor pads;

Fig. 7*a* is an enlarged cross-sectional view of a portion of one of the flexible armor pads showing stiffening means applied thereto;

Fig. 8 illustrates the general contour of the rigid armor elements;

Fig. 8*a* is an enlarged cross-sectional view of an edge portion of one of the rigid armor elements showing a rounded or beveled edge with protective coating thereon;

Figs. 9 and 10, respectively, are views of the outer and inner fabric coverings or jackets, constituting the shell, or foundation, to which both the flexible and rigid armor components are attached; the rigid armor components being also shown in these views, together with a fragmentary showing of the armor receiving pockets;

Fig. 11 is a sectional view showing the manner of holding successive rigid panels in overlapping relationship, horizontally; and

Fig. 12 is a vertical sectional view showing the vertically overlapping retention means.

Referring first to Figs. 1 through 6, the garment is shown as taking the form of a sleeveless coat, or vest, having "zipper" type slide fasteners **31**, **32** attached to its vertical edges, and holes to receive the arms of the wearer, with a horizontal strip **33** (see Fig. 9) of reinforcing webbing extending along the lower portion, to provide a support for weapons, tools, etc., which the wearer may carry. Extending along the two shoulder areas are two built-up missile-resistant pads **34**, **35**, each pad consisting of a plurality of layers **36** of woven textile material such as nylon, silk, or equivalent; the superimposed layers being sewn together along their edges, to prevent ravelling, and the pad thus formed being in turn sewn into position upon the inner surface of the outer fabric covering **37**, or the inner surface of the inner covering or lining **38**, so that the pads **34**, **35** (constituting what is referred to herein as "flexible armor") lie between the two coverings **37**, **38** at the shoulder areas of the garment. These coverings **37**, **38**, are hereinafter referred to as the "outer jacket" and "inner jacket," respectively.

Immediately below, and slightly overlapping, the lower edges of the flexible armor shoulder pads **34, 35**, at both the front and rear, are the pocket bearing portions of the garment, including the left and right front sections and the entire back section of the garment, from the horizontally aligned lower edges of the armor pads **34, 35**, to the base line below webbing **33**. These portions have three horizontally extending rows (**39, 40**, and **41**) of pockets sewn thereto; the central row **40** of pockets being sewn to the outer jacket **37**, and the top and bottom rows of pockets (**39** and **41**) being sewn to the inner jacket **38**, as shown in Figs. 9, 10 and 12. Each row of pockets has a vertical depth of slightly more than one-third of the total vertical distance between shoulder pads **34, 35** and webbing **33**, in order to provide some vertical overlap, as shown.

The fabric forming the pockets is considerably wider in extent, horizontally, between successive securing margins **45, 47** (see Fig. 11) as compared with the horizontal width of the rigid armor panels **46**, per se, so that surplus material is present to fold over itself and permit the horizontal overlapping of successive panels, and the retention thereof (as by stitching **44**) in this overlapping relation, as shown clearly in Fig. 11; vertical overlapping being also provided for by the retention arrangement illustrated in Fig. 12, and above-described. Increased vertical overlapping may occur under certain body actions, as illustrated in Figs. 4 and 5.

Each individual panel **46** consists of a molded slab of laminated plastic material, preferably with some curvature about a vertical axis, so that each panel is in effect a section of a hollow cylinder of large radius; the resultant bowing of the panels (see Fig. 8) being useful in providing a further margin of safety against inward deflection of the armor to a degree that might cause abrasion or laceration of the skin of the wearer's body. The panels **46**, as well as the pockets into which they are inserted, are substantially square in contour, and preferably about ⅛ inch in thickness, with the peripheral edges beveled or rounded off, as by grinding, and then coated with resin or plastic material, and the four corners also beveled and rounded on a small radius, and coated, all of which reduces the likelihood of their tearing the pocket fabric. There are preferably from twelve to twenty layers of woven glass cloth ("fiberglas" or its counterpart) in each panel, with each lamina of glass fibers preimpregnated with liquid resin (natural or synthetic) after which the stacked assembly is inserted in a mold or die, along with additional bonding agents, if desired, and the assembly compressed to the final dimensions, with application of heat and pressure sufficient to cause hardening into a unitary plastic slab or panel.

By utilizing twelve to twenty layers of the woven glass, in the individual panels **46**, and ten to fifteen layers of a nylon-rayon combination in the shoulder pads **34, 35**, both these complementary regions of the garment will have substantially the same ballistic resistance to fragmentary missiles. Thus the flexible armor **34, 35** protecting the shoulder area cooperates with the telescopic, relatively shiftable armor panels **46** to provide complete armor protection from neck to waist; the panels **46** being adapted to overlap each other horizontally and vertically and the upper row of panels **46** being adapted to overlap slightly with the pads **34, 35**.

The maintenance of the panels **46** in horizontally overlapping relationship, as shown best in Fig. 11 (by reason of the above-described method of arranging and securing the pocket forming fabric) is an important feature of the invention, as is also the capacity of the panels to telescope vertically; the latter being particularly important when the wearer crouches or kneels, with a result as shown in Figs. 4 and 5. In this position the wearer has double protection in an important central area. This capacity for relative vertical displacement follows from the attachment of pockets **39, 40, 41** to the two separate jacket elements **37, 38** in alternate fashion, as described.

Reference to Fig. 3 shows that the garment may fit quite loosely over the torso, with a definite "offset" or clearance between the garment and the body, as indicated at "*a*" and "*b*" in Fig. 3. This clearance is achieved by proper balance of the garment fore and aft, and by suspending the fore and aft areas from the reinforced and armored region covering the upper surface of each shoulder. The flexible shoulder armor **34, 35** may be quilted in certain areas by sewing completely through, as indicated at **51** in Fig. 7, thereby stiffening these areas. This is also desirable immediately over each shoulder ridge, as indicated at **52** in Figs. 4 and 5, and aids in assuring proper "offset" of the garment as illustrated in Fig. 3. This offset is important, as it assures maintenance of air flow in the resultant space as the wearer's walking or running motion produces swinging of the garment in pendulum fashion; the pendulous swinging serving to "pump" air in and out of the space inside the garment. The garment offset also affords better opportunity to cushion the force of missile impact and thereby lessen the likelihood of a missile's deforming the panels **46** to a degree that could cause pressure against the body of the wearer.

In the fabrication of the garment, the shoulder armor is preferably first sewed in place, between the inner and outer jackets **38, 37**. Top and bottom pocket rows **39, 41** are then (or previously) sewed to inner packet **38**, and the middle pocket row **40** is sewed to the outer jacket **37**. The panels **46** are then inserted in the individual pockets of each row, and the pockets are then sewed up on the remaining open edges to prevent release or loss of the armor panels thereafter. The garment is then complete, assuming base belt **33** and fastener strips **31, 32** have been previously attached.

The manner in which the rigid armor panels **46** are held in overlapping relationship, as illustrated in Figs. 11 and 12, and the attachment of successive rows of panel pockets to the inner and outer jackets, alternately, constitute important features of the invention, as both these features contribute to the attainment of complete and continuous armor coverage, as well as a desirable degree of telescopic flexibility. Of coures, the provision of the flexible armor pads **34, 35** is also essential to the completeness of the armor coverage.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A missile-resistant garment comprising complementary sections one of which sections is adapted to cover the shoulders of the wearer and the second section being adapted to envelope the portion of the torso immediately below the shoulders, flexible armor elements attached to said shoulder covering section and adapted to drape snugly over the shoulders of the wearer, rigid armor elements comprising a part of the torso covering section, certain of said rigid armor elements being disposed in overlapping suspended relationship to the lower edges of said flexible armor elements, inner and outer jacket elements joined at the shoulder and waist lines, and a plurality of horizontally disposed rows of pockets secured to said jacket elements and adapted to receive said rigid armor elements, alternate rows of pockets being secured to one of said jacket elements, and the intervening pockets being secured to the other of said jacket elements thereby facilitating relative vertical displacement of said rows of pockets and the armor elements received therein.

2. A missile-resistant garment comprising complementary sections one of which sections is adapted to cover the shoulders and the upper from and the upper back body portions of the wearer and the second section being adapted to envelope the portion of the torso immediately below

that portion covered by the first section, flexible armor elements attached to said first section and adapted to drape snugly over the shoulders and cover the upper front and upper back body portions of the wearer, rigid armor elements comprising a part of the torso covering section, certain of said rigid armor elements being disposed in overlapping suspended relationship to the lower edges of said flexible armor elements, a portion of said flexible armor elements being stiffened to cause the edges of the upper front and upper back body covering portions to stand out from the body such that the second section of the garment will hang in laterally off-set relationship to the torso throughout the circumference of the garment.

3. A missile-resistant garment providing full protection over the upper half of the human torso comprising, an upper flexible shoulder engaging armor pad of substantial thickness, said shoulder engaging pad having an upper front body covering portion and an upper back body covering portion, a lower garment portion including a plurality of uniformly arranged overlapping rigid armor plates, means applied to the shoulder engaging pad for projecting the edges thereof outwardly from the body of the wearer, said lower portion being draped from the edges of the pad so as to normally be spaced from the body of the wearer to permit freedom for ease of bodily movement therewithin.

4. A missile-resistant garment providing full protection over the upper half of the human torso comprising, an upper flexible shoulder engaging armor pad of substantial thickness, said shoulder engaging pad having an upper front body covering portion and an upper back body covering portion, a lower garment portion including a plurality of uniformly arranged overlapping rigid plates, inner and outer jacket elements, and a plurality of horizontally disposed rows of pockets secured to said jacket elements and adapted to receive said rigid armor elements, alternate rows of pockets being secured to one of said jacket elements, and the intervening pockets being secured to the other of said jacket elements, said lower portion being draped from the edges of the pad, means associated with the upper flexible shoulder engaging armor pad for causing the edges thereof to be laterally offset from the body of the wearer whereby the lower portion normally will be spaced from the body of the wearer to provide freedom of movement therewithin.

5. A garment as defined in claim 4 wherein said flexible armor pad includes multiple layers of textile material and said rigid armor plates comprise molded layers of woven inorganic material.

6. A garment as defined in claim 4 wherein each rigid armor plate includes beveled coated peripheral edges to reduce abrasive tendencies at the regions of contact between said armor plates and said pockets.

7. A missile-resistant garment providing full protection over the upper half of the human torso comprising an upper flexible shoulder engaging armor pad, portions of said pad forming upper front and upper back body covering sections, a lower garment portion including a plurality of uniformly arranged overlapping rigid armor plates, means for stiffening a portion of said flexible shoulder armor pad such that the edges thereof stand out from the body of the wearer, said lower garment portion being draped from the edges of the flexible shoulder pad in lateral off-set relationship to the torso.

8. A missile-resistant garment comprising an inner and outer jacket, a flexible shoulder engaging armor pad positioned between the two jackets at the shoulder portions thereof and forming upper front and upper back body covering sections, a portion of said armor pad being stiffened to cause the edges thereof to stand out from the body of the wearer such that the jackets will hang in lateral off-set relationship to the torso, a plurality of horizontally disposed rows of armor plate receiving pockets secured to the jackets, alternate rows of pockets being secured to one of said jackets, and the intervening pockets being secured to the other of said jackets, one of said rows positioned in overlapping relationship with the shoulder pad and each of the pockets being disposed in overlapping relationship with its horizontal and vertical adjacent pocket, rigid armor plates secured within said pockets, each of said armor plates including beveled and coated peripheral edges to thereby reduce abrasive tendencies at the regions of contact between said armor plates and said pockets.

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