April 28, 1964 T. L. BAILEY ETAL 3,130,414

FLEXIBLE ARMORED BODY GARMENT

Filed Dec. 28, 1962 3 Sheets-Sheet 1

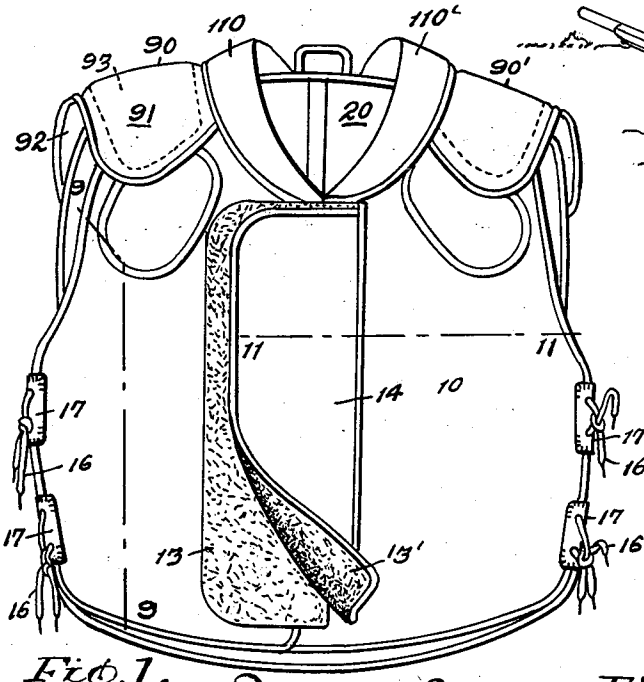


Fig. 1.

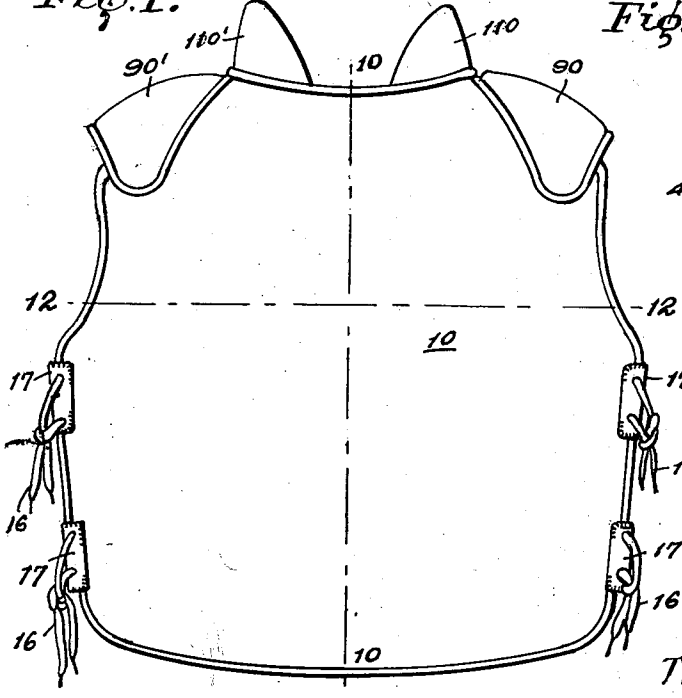


Fig. 2.

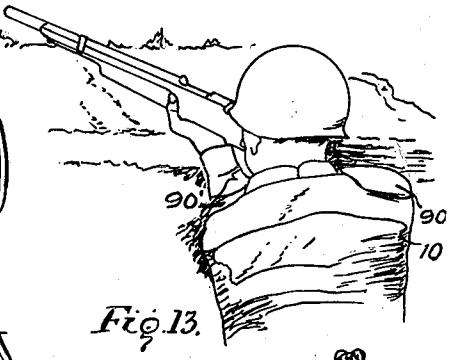


Fig. 13.

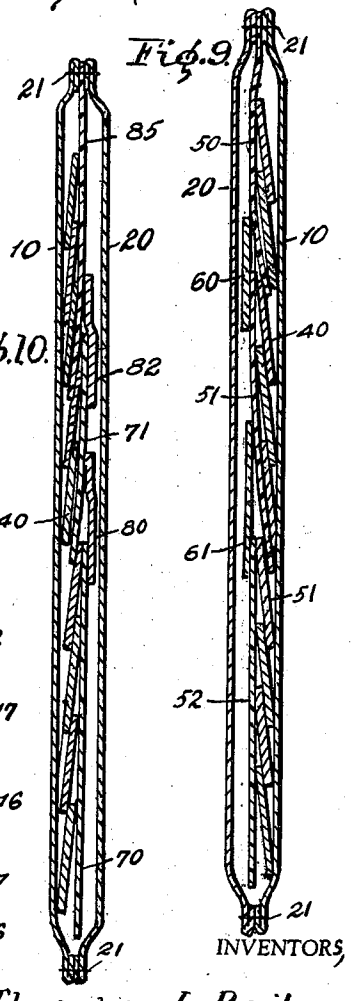


Fig. 10.

Fig. 9.

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FLEXIBLE ARMORED BODY GARMENT

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Fig. 3.

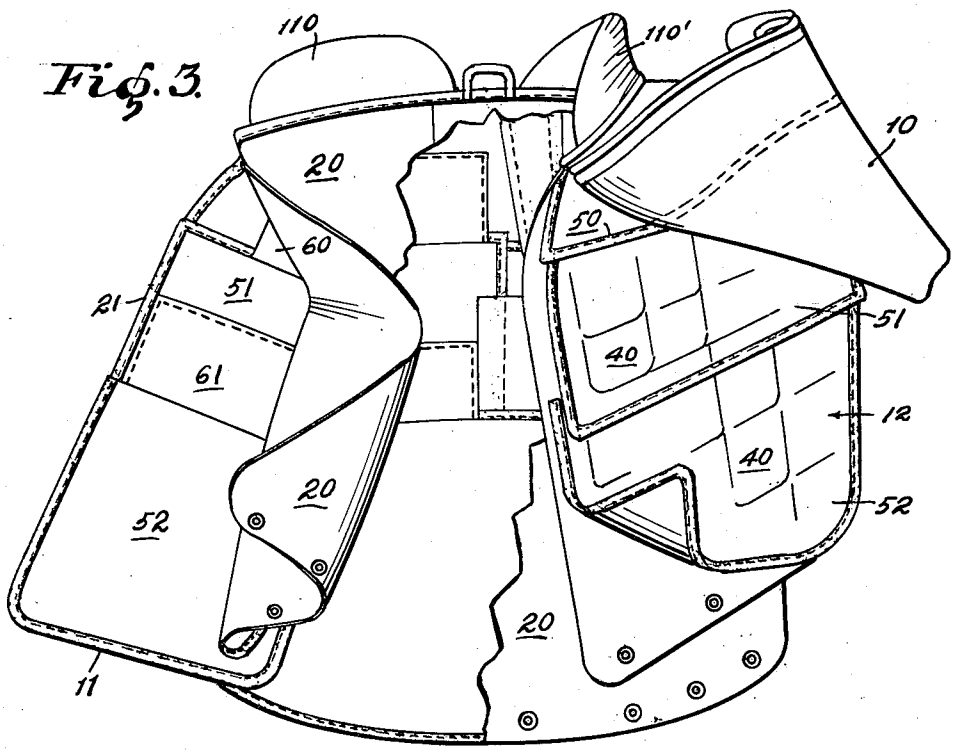
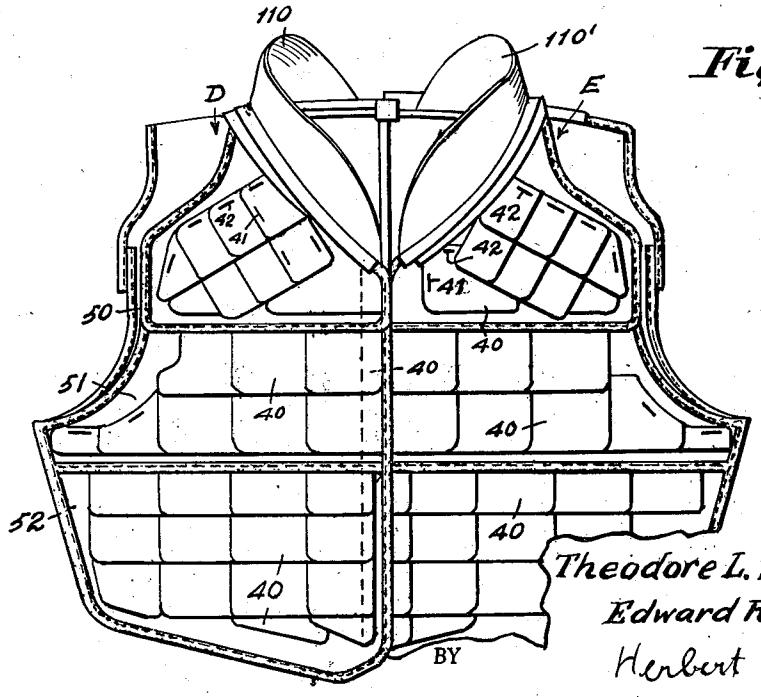


Fig. 4.



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FLEXIBLE ARMORED BODY GARMENT

Filed Dec. 28, 1962 3 Sheets-Sheet 3

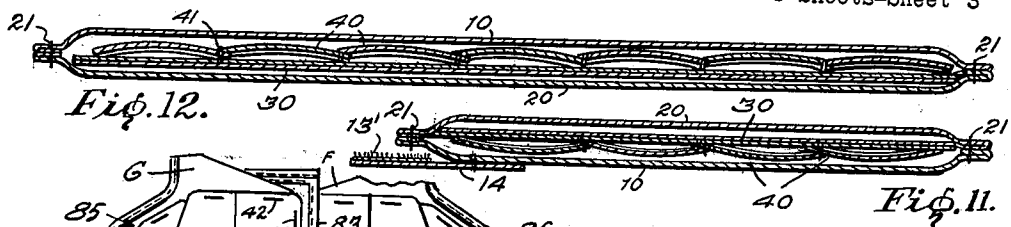


Fig. 12. Fig. 11.

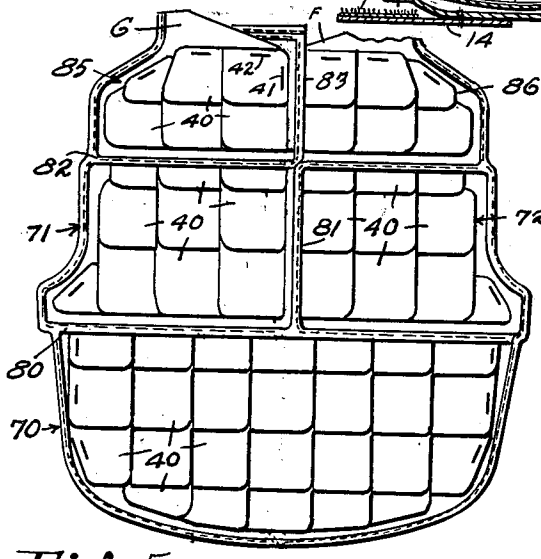


Fig. 5.

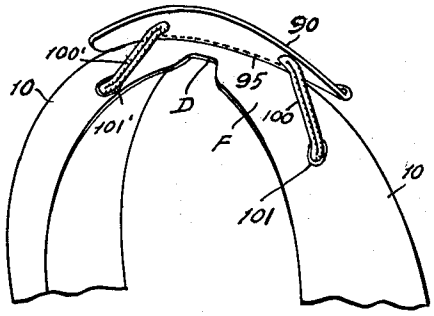


Fig. 6.

Fig. 7.

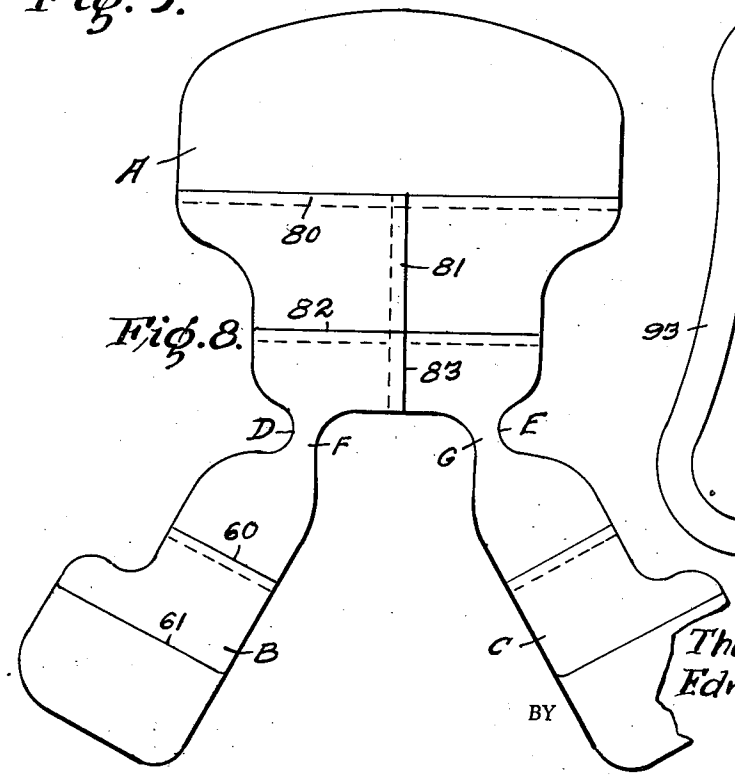
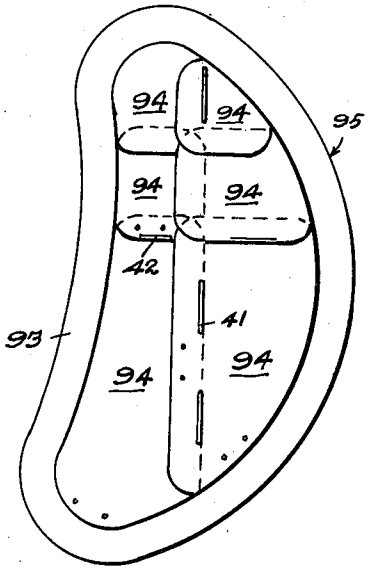


Fig. 8.



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3,130,414

FLEXIBLE ARMORED BODY GARMENT

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Filed Dec. 28, 1962, Ser. No. 248,161
10 Claims. (Cl. 2—2.5)
(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein, if patented, may be manufactured and used by or for the Government for governmental purposes, without the payment to us of any royalty thereon.

This invention relates to an armored body garment, and more particularly to a jacket or vest composed of plural layers of nylon or other high tenacity textile material, and small overlapping armor plates of titanium alloy or other metal alloy having a ballistic penetrating resistance of not less than that of steel plates of the same weight. Our garment has a special shoulder construction for added flexibility.

Such a composite body armor is especially constructed for use in combat, so as to afford maximum flexibility and ease of movement to the wearer, without excessive weight and without sacrificing ballistic protection of vital body areas above the hips. A special shoulder construction enables the combat soldier to assume any firing position required by the exigencies of the tactical combat situation, including firing from the prone position. While armored garments heretofore developed by the Armed Forces for combat personnel have provided adequate ballastic protection, they have the drawback that they ride up and bunch up in the body position required for shooting a firearm from the prone position. This handicap is overcome by the present invention without adding additional weight to the armored garment.

Further, our preferred combination of plural (preferably 3 to 4) layers of woven nylon ballistic fabric, and an overlapping arrangement of small titanium armor plates, mounted in hinged tiers, makes it possible to provide ballistic protection to the torso that is at least the equal of the all-nylon armored vest heretofore developed by the Army, and at the same time affords greater flexibility through the combination of its torso section, with a special hinged shoulder construction especially adapted for prone firing.

Thus, an armored body garment in accordance with our invention differs from the presently standardized nylon armored vest by having a much smaller number of superposed nylon layers than the 12 to 15 layers of the present nylon vest; this small number (preferably about four) of nylon layers is combined with lightweight overlapping small armor plates to provide maximum ballistic protection and flexibility. The articulated shoulder construction, likewise composed of plural layers of ballistic nylon and small overlapping titanium armor plates, protects the body surface of the wearer that is exposed to direct enemy fire even while the wearer is in the prone firing position, and enables him to execute the complex movements of loading, firing and reloading his weapon, without being hampered by the body armor and without losing the ballistic protection afforded by it.

Also, the armored body garment of the present invention is so constructed that if one armored section thereof should become damaged as the result of enemy fire, the damaged section can be replaced by the insertion of another prefabricated section in a field repair shop without extensive rebuilding.

Our armored vest can be quickly donned and doffed, as the exigencies of the tactical combat situation may require. Its light weight (about 8½ to 9 lbs., depending on size) and great flexibility greatly increase the probability that the combat soldier will not discard it during a tiring march, and will actually wear it in a situation where he is likely to be exposed to enemy fire.

The accompanying drawings illustrate a preferred embodiment of our invention, but should not be deemed to limit the scope of our invention to any particular dimensions, proportions or similar details shown therein.

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

FIGURE 2 is a rear elevational view of the embodiment of FIGURE 1;

FIGURE 3 is a partly exploded view of the armored vest of FIGURES 1 and 2, unfastened and viewed frontally, and showing an exterior view of the front and back portions, partly broken away;

FIGURE 4 is another front elevational view of the embodiment of FIGURE 1, without the top fabric layer, so as to expose the arrangement of the metallic armored plates;

FIGURE 5 is another rear elevational view corresponding to FIGURE 2, without the top fabric layer, so as to expose the arrangement of the metallic armored plates;

FIGURE 6 is a detailed side view showing the articulating hinged shoulder construction of the armored vest of FIGURES 1 and 2;

FIGURE 7 is a detailed top plan view of the shoulder armor assembly of FIGURE 6, without the top fabric layer, so as to expose the arrangement of the metallic armored plates;

FIGURE 8 is a diagrammatic bottom plan view, face down, of a complete armor assembly (without fabric covers) of the armored vest of FIGURES 1 and 2;

FIGURE 9 is a longitudinal section through a front panel along lines 9—9 of FIGURE 1;

FIGURE 10 is a longitudinal section through a back panel along lines 10—10 of FIGURE 2;

FIGURE 11 is a cross-section through a front panel along lines 11—11 of FIGURE 1;

FIGURE 12 is a cross-section through a back panel along lines 12—12 of FIGURE 2; and

FIGURE 13 is a perspective view of a soldier in the prone firing position, while wearing an armored vest in accordance with the present invention.

More particularly, the armored garment in accordance with the present invention includes an outer cover 10 and an inner cover 20 (as seen, e.g., in FIGURE 3); and an armor assembly substantially in the configuration of an inverted Y (as outlined diagrammatically in FIGURE 8), wherein the strokes constitute, respectively, the back portion A and the left-hand and right-hand front portions B and C. At the junctures between back portion A and front portions B and C are deep shoulder cutouts D and E, for a purpose about to be explained in greater detail, and leaving two narrow junctures in the form of over-shoulder panels F and G between part A and parts B and C, respectively. Both outer cover 10 and inner cover 20 are made of tightly woven high tenacity elongatably nylon fabric, known in the trade as "ballistic nylon fabric"; other strong and elongatable plastic textile materials, such as strong fine regenerated cellulose fiber of the "Fortisan" or "Durafil" type are permissible though presently less preferred substitutes. A typical nylon fabric is lightweight duck cloth, having the following characteristics:

Weave, plain, two ends woven as one, two picks woven as one, weight 13–14.5 oz. per square yard;

Yarn, 210 denier, high tenacity nylon, 34 filament;

Warp, minimum 46 ends, in the loom, composed of 5 plied threads;

Filling, minimum 32 picks off the loom composed of 5 plied threads;

Breaking strength, minimum 1,000 lbs. in warp and 900 lbs. in filling (grab method);

As seen in FIGURE 1, the front portion of the garment is composed of a left-hand portion **11** (as viewed from the standpoint of the observer) and a right-hand portion **12**, corresponding, respectively, to parts B and C of the diagrammatic pattern of FIGURE 8. They meet in a fly front, which is fastened by separable fastener means **13**, **13'**, such as a nylon hook and pile fastener of the type shown in Patent No. 2,717,437, De Mestral. For ease of adjustment, the portion **13'** is preferably mounted on a flap **14**, seamed to panel **12**. If desired, other separable fastening means, such as large male and female snap fasteners (not shown) may be employed in addition to or as substitutes for the illustrated hook and pile fastener.

Back portion **15** (corresponding to part A) is laced along its sides to the left-hand front panel **11** and to the right-hand front panel **12** by elastic laces **16**. To avoid undesirable multiple perforations of the nylon cloth of the front and back portion, it is desirable to equip them with small eyeletted tabs **17** for laces **16**. This arrangement facilitates size adjustability. However, it is also possible to join the back panel to the front panel by conventional side seams, although this arrangement is presently less preferred because it does not permit size adjustment.

Inner layer **20** is constructed in the same manner as outer layer **10**, except that it does not carry the fly front fastening means and side fastening means of the outer layer. It is connected to outer layer **10** by seamed edge bindings **21**, as shown, e.g., in FIGURE 3.

As is well understood by those skilled in the art, the two ballistic plies provided by the just-described outer and inner layer provide some protection against a low-velocity nearly spent projectile, but are insufficient to protect the wearer against wounds from shell fragments, ricocheting bullets, and similar battlefield perils. It is therefore necessary to provide armored inserts between outer layer **10** and inner layer **20**, which are of a special construction about to be described in greater detail. Generally, these inserts are composed of one, or preferably two (as shown in detailed FIGURES 11 and 12), plies of ballistic textile material (nylon or other suitable high-tenacity textile materials, generally of the same type used for the outer layer **10** and inner layer **20**). This single or (preferably) double layer **30** of ballistic textile material carries a number of small metal plates **40**, preferably of titanium alloy, in mutually overlapping relationship, so as to provide the desired high degree of ballistic penetration resistance in combination with the supplemental resistance of the inner and outer ballistic fabric layers of the garment. Thus, in the preferred embodiment of our invention, the wearer has the combined protection of four layers of ballistic fabric layers (outer layer **10**, inner layer **20** and two-ply ballistic textile insert **30**) and metal plates **40**. This combined protection is sufficient to ward off small shell fragments and most small arms fire (other than rifle bullets fired at point blank range or machine gun bullets of comparable momentum).

Metal plates **40** are preferably of titanium alloy. A commercially produced ternary titanium alloy containing about 5% aluminum and 2.5% tin, has been found suitable to produce thin armor plates (e.g., of .03–.04" thickness). We prefer that the individual plates have a slight curvature as shown in FIGURE 12; however, this feature is not indispensable for the ballistic performance of our armored garment. Other highly penetration resistant alloys having ballistic properties not less favorable than those of steel plate of the same weight may be substituted for the titanium alloy; for instance, a high strength manganese steel alloy known in the trade as "Hadfield Steel" may be used in lieu of the titanium alloy, but such a substitution is less preferred because of the superior ballistic qualities (penetration resistance to weight ratio) of titanium alloy. The outline of the plates is generally quadrangular.

In order to provide all-around ballistic protection, it is of course necessary that there be no gaps between vertically or horizontally adjacent metallic armor plates, a principle well known to armorers since classical times. We have constructed the armored garment in such a way that the front fastener **13**, **13'** permits the metallic armor plates nearest the fly front of either left or right-hand front panel to overlap each other, as is shown perspectively in FIGURE 1 and diagrammatically in FIGURE 4.

As is shown in FIGURE 3, each front panel **11**, **12** is provided with multiple (preferably three) tiers of vertically overlapping inserts **50**, **51**, **52**, each tier being composed of several overlapping horizontal and vertical rows of metal armor plates **40** (the majority having preferably a dimension of about 3 x 3"). As shown in FIGURE 4, each metal plate **40** is stapled to the nylon textile layer of the insert by means of a lateral staple **41** and top staple **42**, so as to overlap, respectively, the adjacent lower and laterally adjacent metal plate. Each successive lower tier of the insert is hinged to the corresponding higher tier by a hinge strip **60**, so arranged that the metal plates of the lowermost horizontal plate row of the higher tier overlap the highest horizontal plate row of the next lower tier. This arrangement is illustrated in detail in FIGURE 9, which shows hinge strips **60**, connecting the backs of nylon fabric layers of tiers **50** and **51**, and hinge strips **61**, connecting the backs of nylon fabric layers of tiers **51** and **52**. The hinge strips are of elongated strong thin textile material, e.g., 3 oz. nylon oxford cloth, and do not of themselves possess ballistic penetration resistance.

The back panel inserts are constructed in a manner analogous to the front panels. Thus, the armored inserts of the back panels are composed of a lower tier **70** which is hinged by a hinge strip **80**, to upper left-hand and right-hand tiers **71**, **72**, as shown in detail in FIGURE 10 and perspectively in FIGURE 5. Upper tiers **71** and **72** are joined to each other by a vertical hinge strip **81**, which joins the inner edge of the inner ply of tier **71** to the proximate inner edge of the inner ply of tier **72** so as to overlap the respect armor plates, as shown in FIGURE 5. Horizontal hinge strip **82**, join tiers **71**, **72** to the topmost tiers **85**, **86** of the upper front panels F, G, which extend over the shoulder of the wearer, as shown at FIGURE 8, and are in joined overlapping relationship to each other by vertical hinge strip **83** below the nape of the neck. Metallic armor plates **40** are also carried in the back portions of the body armor inserts, preferably by means of a staple attachment **41**, **42** corresponding to that of the front panels.

The staples **41**, **42** which hold metallic plates **40** to their respective textile inserts preferably pass through the ballistic fabric insert and through predrilled holes at the top and one side of each metal plate and are clenched (see FIGURE 12).

The over-shoulder panels F, G which extend to the shoulder blade region of the back are each provided with a deep cut-out (D, E) in the collarbone region and do not carry armor plates in the collarbone region, because the shoulder is protected by a pair of special articulated armor shoulder plates of generally lunar shape, about to be described in greater detail, and illustrated in FIGURES 6 and 7.

One such shoulder plate **90** is composed of an outer cover **91** and inner cover **92** of nylon or other high-tenacity penetration resistant textile material of the same type as covers **10** and **20**. Between covers **91** and **92**, there is provided an insert **93** of at least one and preferably two plies of the same ballistic textile material as the body inserts (preferably nylon), and carrying a number, preferably about six, of overlapping titanium alloy or other high strength metallic armor plates **94** stapled thereto by staples **41'**, **42'** in articulated mutually overlapping relationship, as shown in FIGURE 7. Shoulder

plate **90** is seamed at **95** to the inner edge of over-shoulder panel F, as shown in FIGURE 6, so as to provide a hinge. The outer edge of shoulder plate **90** is yieldingly connected to over-shoulder front panel F by elastic straps **100, 100'** which extend respectively from the outer front and rear corners of the shoulder plate, pass through apertures **101, 101'** in outer cover **10** of the garment, and are anchored to tiers **50, 86** of the armored insert panel F. Thus, shoulder plate **90** bridges the shoulder cut-out D and provides armor protection to the shoulder region of the wearer, regardless of the relative position of his arms to the torso.

The other shoulder plate **90'** is constructed, and connected in the same manner as shoulder plate **90**.

An upstanding collar is provided for added neck protection, preferably a ¾ collar generally resembling a clerical collar, but open in front and back to avoid chafing. This collar consists of left and right lunar collar pieces **110, 110'**, each consisting of about six to ten layers of ballistic nylon or other high-tenacity textile material in an outer envelope which is joined to the neck seams of outer cover **10** and inner cover **20**, as shown in FIGURES 1 and 3.

The ballistic protection afforded by this armored garment is at least equal to that of the presently standardized all-nylon armored vest covered by United States Patents Nos. 2,640,987, Ehlers, and 2,773,791, MacIver (both assigned to the Government of the United States as represented by the Secretary of the Army), but constitutes a marked improvement thereover by reason of its greater flexibility and special shoulder construction which enables the combat soldier to assume the basic firing position in the prone.

Field repair of our armored vest, when damaged by the impact of a projectile, is easily effected by removing edge binding **21** from the damaged section, removing the damaged armored insert and replacing it with a new or reconditioned one from stock, repairing the damaged portion of outer cover **10** (and of inner cover **20** is needed), and finally replacing edge binding **21**. If the shoulder plate **90** or **90'** needs replacement because of impact damage, it is removed by severing hinge seam **95** and detaching elastic cords **100, 100'**, and replacing the old plate with a new or reconditioned plate from stock.

The flexibility of our armored vest is not only useful in the prone firing position, but also in other situations that necessitate raising one or both arms above the shoulder; e.g., in controlling the parachute shroud lines during a descent by parachute in an airborne assault.

While changes in the arrangement, proportions, dimensions and shape of the armored garment and component parts thereof, disclosed in this specification will readily occur to the expert without departing from the spirit of our invention, it is our desire to encompass such variations within the scope of such invention.

We claim:

1. A flexible armored body garment composed of plural layers of woven high tenacity elongatable plastic textile material and small metal plates having ballistic penetration resistance not less than that of steel plates of the same weight; said armored body garment comprising:

(*a*) an outer cover of said textile material in the shape of said garment and having a pair of deep cut-outs in the shoulder region;

an inner cover of said textile material in the shape of said garment and having a pair of deep cut-outs in the shoulder region;

articulated front and back assemblies of hinged inserts affixed to one of said covers, each of said inserts comprising at least one layer of said textile material and a plurality of said metal plates carried by said last-mentioned layer in overlapping relationship; and

(*b*) a pair of articulated armored shoulder plates bridging said cut-outs, each of said shoulder plates being hinged to one of said covers along the closed ends of said cut-outs and yieldingly connected to the body portion of said garment along the open ends of said cut-outs, and each of said shoulder plates comprising at least one layer of said textile material and a plurality of said small metal plates hingedly affixed thereto in overlapping relationship;

whereby said armored body garment is rendered so highly flexible as to enable the wearer to shoot a firearm from the prone position unhampered, with his torso protected by said garment.

2. A flexible armored body garment according to claim 1, wherein said metal plates are titanium alloy.

3. A flexible armored body garment according to claim 1, wherein said woven high tenacity textile material is nylon.

4. A flexible armored body garment according to claim 1, said garment having a fly front, and wherein said front assemblies are a plurality of hinged overlapping tiers of inserts on either side of said fly front, and wherein said back assembly is a plurality of hinged overlapping tiers of inserts; said fly front having releasable closure means for holding said front assemblies in overlapping relationship.

5. A flexible armored body garment according to claim 4, wherein said tiers of said back assembly are overlapping left and right pairs, and wherein an additional lowermost tier is hinged to a said left and right pair of tiers in overlapping relation therewith.

6. A flexible armored body garment composed of plural layers of woven nylon textile material and small titanium alloy metal plates having high ballistic penetration resistance; said armored body garment having a fly front, and comprising:

(*a*) an outer cover of said textile material in the shape of said garment and having a pair of deep cut-outs in the shoulder region;

an inner cover of said textile material in the shape of said garment and having a pair of deep cut-outs in the shoulder region;

a pair of front assemblies to either side of said fly front and a back assembly of articulated inserts affixed to one of said covers, each of said inserts comprising a double layer of said nylon textile material and a plurality of said metal plates hingedly affixed to said last-mentioned layer in overlapping relationship;

(*b*) a pair of articulated armored shoulder plates bridging said cut-outs, each of said shoulder plates being hinged to one of said covers along the closed ends of said cut-outs and yieldingly connected to the body portion of said garment along the open ends of said cut-outs, and each of said shoulder plates comprising a double layer of said nylon textile material and a plurality of said small metal plates hingedly affixed thereto in overlapping relationship; and

(*c*) releasable closure means for said fly front for holding said pair of front assemblies in overlapping relationship;

whereby said armored body garment is rendered so highly flexible as to enable the wearer to shoot a firearm from the prone position unhampered, with his torso protected by said garment.

7. A flexible armored body garment according to claim 1, wherein said metal plates are quadrangular and are stapled to said textile material along the top edge and a side edge of said plates.

8. A flexible armored body garment according to claim 6, wherein said metal plates are quadrangular and are stapled to said textile material along the top edge and a side edge of said plates.

9. Flexible armored body garment according to claim

4, having a pair of lunar-shaped stand-up collar pieces of multiple layers of said woven high tenacity textile material extending from the nape of the neck to the top of said fly front.

10. Flexible armored body garment according to claim 6, having a pair of lunar-shaped stand-up collar pieces of multiple layers of said woven nylon textile material extending from the nape of the neck to the top of said fly front.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,130,414 April 28, 1964

Theodore L. Bailey et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 3, after line 4, add the following paragraph:

Elongation of finished cloth, minimum 25% in warp and 20% in filling.

Signed and sealed this 15th day of September 1964.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents

UNITED STATES PATENT OFFICE

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