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Nov. 12, 1968 L. A. A. BARRATT 3,409,907

ARMOUR

Filed July 2, 1965 2 Sheets-Sheet 1

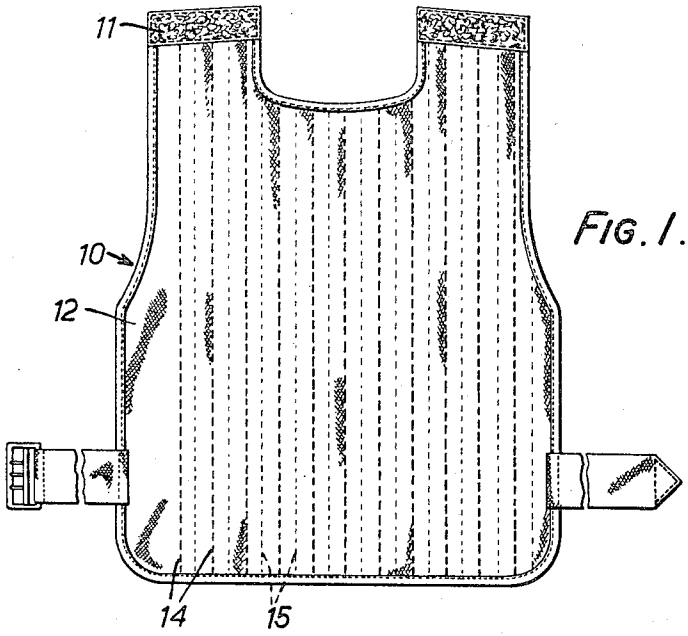

FIG. 1.

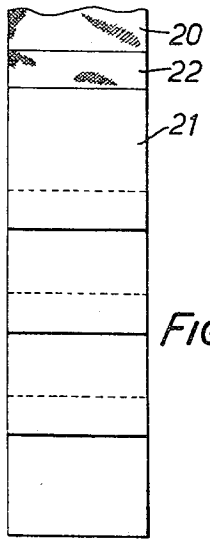

FIG. 2.

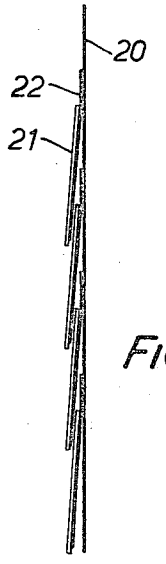

FIG. 3.

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ARMOUR

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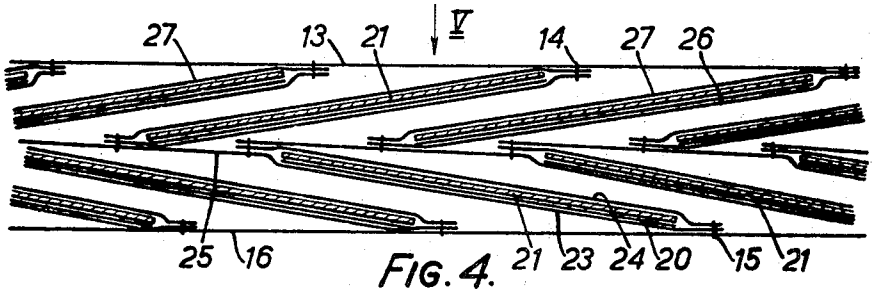

FIG. 4.

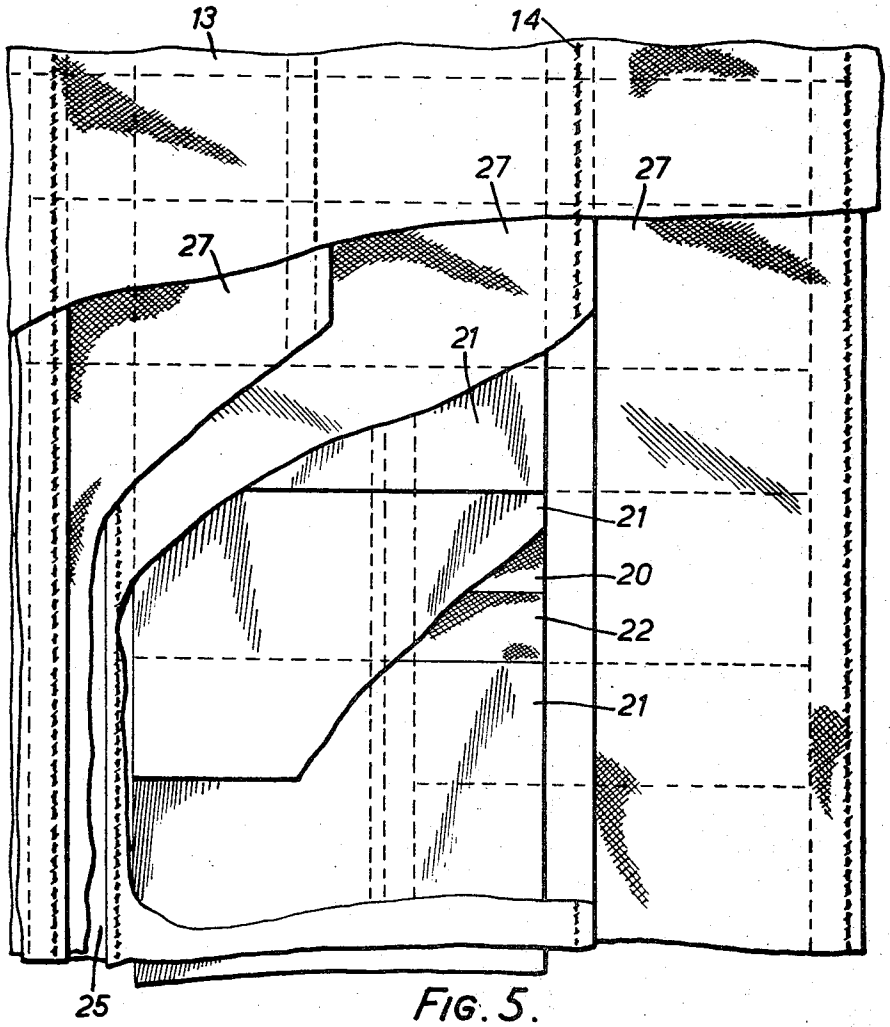

FIG. 5.

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ARMOUR

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Claims priority, application Great Britain, July 4, 1964, 27,660/64
9 Claims. (Cl. 2—2.5)

ABSTRACT OF THE DISCLOSURE

An armoured vest having a back portion and a front portion interconnected at the shoulders. Each portion of the bullet-proof vest includes a number of elongate fabric pockets so arranged that adjacent pockets overlap, and each pocket contains a fabric strip to which a series of overlapping metal plates are secured by short fabric strips with the aid of a metal-to-fabric adhesive. The provision of overlapping pockets and overlapping metal plates for each elongate strip ensures that the vest is flexible in two directions at right angles.

This invention relates to armour.

According to the present invention there is provided armour comprising, a two-sided fabric casing having, elongate pockets therein, a plurality of elongate fabric strips extending in parallel overlapping relationship within the casing, a plurality of metal plates, and a plurality of individual fabric strips each connecting one of the plates to one of the elongate strips and each elongate strip being disposed within a said pocket, each plate of each elongate strip overlapping adjacent plates of that strip and the elongate strips and plates being so connected to the casing that the degree of overlap of the elongate strips and the plates is variable.

The novel form of armour provided by the present invention may be worn as clothing to protect the wearer against injury by bullets, shell fragments, knife attacks or the like. Thus, it may be worn by members of the armed services, by police, or by civilians who are liable to attack. However, the armour need not be worn by individuals but may be used to provide protective screens, curtains, walls, sheets or mats to resist penetration by bullets, shrapnel or the like or in industrial processes or testing where there is a danger of disintegration.

An embodiment of an armoured vest in accordance with the invention will now be described, by way of example, with reference to the accompanying drawing, in which:

FIGURE 1 is a front view of a front assembly of the vest;

FIGURE 2 is a fragmentary view of a strip forming part of the vest;

FIGURE 3 is a side view of the strip shown in FIGURE 2;

FIGURE 4 is a fragmentary diagrammatic end view of the vest with a peripheral seam removed and shown opened up though will normally lie flat; and

FIGURE 5 is a fragmentary plan view with certain parts removed.

Referring now to the drawing, the vest front assembly **10** includes shoulder parts **11**, and a main body part **12**. It will be appreciated that the vest includes a rear assembly, which is substantially the same as the front assembly and will not therefore be further described. The main body part **12** has an outer casing **13** (see FIGURE 4) of suitable light fabric, for example nylon. One of the synthetic material fabrics is chosen because of high strength, good weaving properties and the fact that it

can easily be cleaned by washing. A number of longitudinally-extending lines of stitches **14** (heavy broken lines in FIGURE 1) are visible on the outer face of the outer casing **13**. Further longitudinally-extending lines of stitches **15** (light broken lines in FIGURE 1) appear on the outer face of an inner casing **16** (see FIGURE 4) of the front assembly of the vest. The purpose of the lines of stitches **14**, **15** will appear hereinafter. The inner casing **16** is of a strong nylon webbing.

The interior of the vest contains a plurality of ribbons or elongate fabric strips **20** carrying metal plates **21**, preferably of titanium or a titanium alloy, each plate **21** overlapping an adjacent plate. Titanium or a titanium alloy is selected for the plates because of the high strength-weight ratio.

As can be seen in FIGURE 3, each plate **21** is secured to a piece of fabric **22**, preferably of a synthetic material, for example nylon, by means of an adhesive, for example "Bostik I" (registered trade mark) and this piece **22** is secured, again by adhesive, to the elongate strip or ribbon **20**. The pieces **22** act as hinges and do not prevent relative movement between adjacent plates **21**. Both the strips **20** and the pieces of fabric **22** act as reinforcements for the plates **21** when a bullet or other projectile strikes the vest.

Referring now to FIGURES 4 and 5, each plate-carrying strip **20** is secured at one end in a pocket **23**, **24** (shown in broken lines) and each pocket is secured by means of the line of stitches **15**. One piece of material which goes to form each pocket is extended by an extension piece **25** which enables it to be secured to the free edge of one of the next adjacent pockets and also, on a line midway between the edges of the two pockets and the inner casing to a pocket **26**, **27** attached to the outer casing **13**. These extension pieces **25** serve to hold the pockets in their correct relationship but do not impair the flexibility of the vest. The pockets **26**, **27** of the outer casing **13** are secured by the lines of stitches **14** as can be seen from FIGURES 1 and 4. When the vest is lying flat each line of stitches **15** lies midway between two lines of stitches **14**.

It will be appreciated that in use, the degree of overlap of the strips of plates **21** can be materially increased, thus making a corresponding reduction in the width dimensions of the vest. There is also a degree of flexibility in the longitudinal direction of each strip facilitated by the hinged connection of the plates **21** to the elongate ribbons **20**. The fact that the individual plates **21** can move relatively to one another in two directions gives the garment considerable flexibility and allows the wearer to move relatively freely, for example, allows him to bend. Moreover, these possible movements of the plates and strips of plates can assist in cushioning the shock of the projectile. At the same time, the fact that the plates can only move in a direction such that the overlap is increased, prevents any risk of the projectile penetrating between adjacent plates. The flexibility also aids in the folding-up of garments of armour in other forms, for storage purposes. Although, in the embodiment described, at any given part of the vest there are three plate thicknesses in the extended condition, it will be appreciated that the vest in accordance with the invention can be made with either fewer or with a larger number of thicknesses of plates.

The degree of protection which is required determines the thickness of the plates **21** which is necessary and, for example titanium plates may be used having a thickness of twenty to thirty-six thousandths of an inch, using titanium alloy sold by Imperial Metal Industries Ltd. as No. 115, the plates being two inches by two inches. The degree of resistance can also be increased by increasing the extent of overlap so that at any given position

there are a number of thicknesses of plate or a number of layers of armour.

The nylon webbing forming the inner casing **16** ensures that there is no danger, on impact of a projectile, of the plates being broken away and entering the body of the wearer.

To facilitate putting-on or taking-off the garment, it may be provided with fasteners and for this purpose it is preferred to use a non-metallic one such as that sold under the trademark "Velcro."

It will be understood that such garments may be of various extent and may even include or consist of a collar piece for protecting the neck of the wearer. The garments have particular application to the protection of pilots of aircraft, such as helicopters, which are engaged in low flying against hostile elements and for which the aircrew need protection against small arms fire. In such craft the armour may also be used to cover the flooring or form a circular enclosure around the crew compartment, the armour being easily removed when the helicopter, or other aircraft, is not engaged on missions where such protection is required.

I claim:

1. Armour comprising,
a two-sided fabric casing having elongated overlapping pockets therein,
a plurality of elongate fabric strips extending in parallel overlapping relationship within the casing,
a plurality of metal plates, and
a plurality of individual fabric strips each connecting one of the plates to one of the elongate strips and each elongate strip being disposed within a said pocket,
each plate of each elongate strip overlapping adjacent plates of that strip and the elongate strips and plates being so connected to the casing that the degree of overlap of the elongate strips and the plates is variable.

2. Armour according to claim **1**, wherein said plates are of titanium.

3. Armour according to claim **1**, wherein said plates are of titanium alloy.

4. Armour according to claim **1**, wherein said fabric is nylon.

5. Armour according to claim **1**, wherein said metal plates are connected to the respective individual fabric strips by a metal-to-fabric adhesive.

6. Armour comprising,
a two-sided fabric casing,
a set of elongate fabric pockets each having two longitudinal edges, one longitudinal edge of each pocket being secured to one side of the fabric casing and the other longitudinal edge being attached to the corresponding edge of one of the next adjacent pockets in such a manner that the pockets overlap,
a plurality of elongate fabric strips,
a plurality of metal plates, and
a plurality of fabric strips each securing one of the metal plates to one of the elongate strips, the plates on each elongate strip being in overlapping relationship,
each one of the elongate strips being secured in one of the pockets.

7. Armour according to claim **6**, comprising
a further set of elongate fabric pockets each having two longitudinal edges and each accommodating one of said elongate strips, and
an extension strip on each pocket of the first mentioned set of pockets,
one longitudinal edge of each pocket being secured to the other side of the casing and the other longitudinal edge being attached to one of the extension strips of the first-mentioned set of pockets.

8. A bullet-proof vest comprising,
a back assembly,
a front assembly, each said assembly comprising,
an inwardly-facing casing member of a synthetic material webbing fabric,
an outwardly-facing casing member of a synthetic material fabric, the casing members being sewn together at their peripheries,
a set of longitudinally-extending pockets of a synthetic material fabric, each having two longitudinal edges and each pocket being secured along one longitudinal edge to the inwardly-facing casing member and along the other longitudinal edge to the corresponding edge of one of the adjacent pockets, the adjacent pockets overlapping one another,
a plurality of ribbons,
a plurality of metal plates, and
a plurality of strips of synthetic material fabric, each metal plate being secured by a metal-to-fabric adhesive to one of the strips and each said strip being secured to one of the ribbons, the plates of any one ribbon being in overlapping relationship and each ribbon and the plates thereof being secured within one of the pockets, and the arrangement of pockets and plate-carrying ribbons of each assembly being such that adjacent plate-carrying ribbons overlap to a degree which is variable according to the size and movements of the wearer.

9. A bullet-proof vest according to claim **8**, comprising
a further set of longitudinally-extending pockets, each pocket having two longitudinal edges, and
an extension strip on each pocket of the first-mentioned set of pockets,
each pocket of the further set being secured along one longitudinal edge to the outwardly-facing casing member and along the other longitudinal edge to one of the extension strips, and
the longitudinal edges of the one set of pockets secured to the inwardly-facing casing member being staggered in relation to the corresponding edges of the further set of pockets secured to the outwardly-facing casing member.

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