

[54] **BULLET-PROOF PROTECTIVE ARMOR AND METHOD OF MAKING SAME**

3,061,839	11/1962	Foster.....	2/2.5
3,409,907	11/1968	Barratt.....	2/2.5
3,577,306	5/1971	Baker et al.	2/2.5 X
3,577,384	1/1971	Barron et al.....	2/2.5

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[52] **U.S. Cl.** 2/2.5

[51] **Int. Cl.** F41h 1/02

[58] **Field of Search**..... 2/2.5; 161/404

[57] **ABSTRACT**

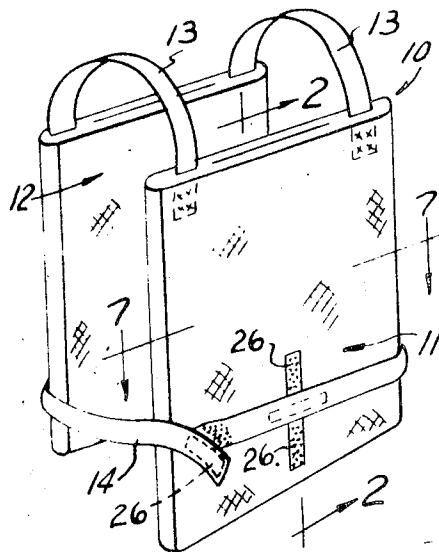
A bullet-proof armor formed of a pad made of a number of loose sheets woven of heavy gauge, linearly oriented nylon threads, the pad being enclosed within a cloth envelope, and means for holding the envelope containing the pad upon the object to be protected. The sheets are treated by subjecting them to supercooling in a cryogenic atmosphere to thereby increase their impact resistance capabilities.

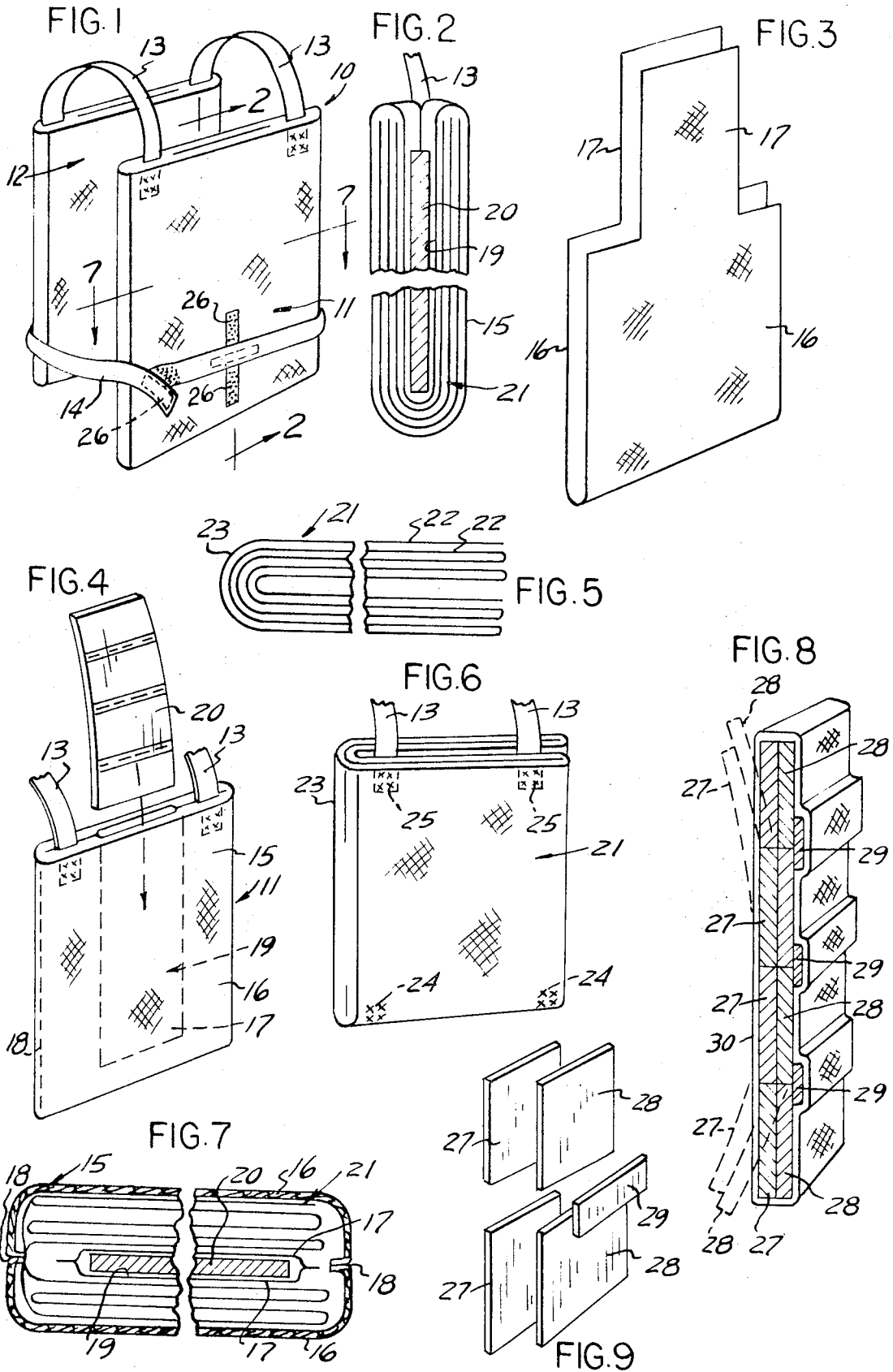
[56] **References Cited**

UNITED STATES PATENTS

2,640,987	6/1953	Ehlers.....	2/2.5
2,697,054	12/1954	Dietz et al.....	2/2.5 UX
2,778,761	1/1957	Frieder et al.....	161/404 X

4 Claims, 9 Drawing Figures





BULLET-PROOF PROTECTIVE ARMOR AND METHOD OF MAKING SAME

BACKGROUND OF INVENTION

Bullet-proof protective armor or personal use by human beings, has been made in the past out of metal plates or suitable plastic, bullet resistant, plates fastened together in some way to fit around the wearer's body, particularly his torso. Such type armor available until now, has been very heavy and stiff thus making it extremely uncomfortable for wear by persons.

In addition, the bullet stopping capabilities of such prior armor has been severely limited since, as a general rule, the bullet stopping capacity has been directly related to the thickness, and thus the weight, of such materials. Hence, a truly effective bullet-proofing material of the past available types, is much too heavy to be ordinarily worn by a person.

At best, they could have been worn only for a short time and even then, the limitations on weight have resulted in armor which in fact, will not stop high powered rifle or pistol bullets or those fired at very close range, such as point blank or virtually against the armor.

Thus, there is a need for a relatively lightweight, flexible, easily worn, body armor particularly for use by such class of persons as police officers during normal or relatively known to be dangerous duties and which are capable of stopping a high powered bullet or one fired at very close range, particularly for protection of the wearer's torso. Thus, the invention herein relates to a body protective armor, particularly useful for normal wearing by a person, although adaptable to protective use on other inanimate objects, and which fulfills the above requirements.

SUMMARY OF INVENTION

In general, the invention herein contemplates forming a bullet-proof pad made of sheets of woven, linearly oriented, nylon threads, of a heavy gauge, with the sheets being relatively loose, that is fastened, at most, along their edges, with little, if any fastening between their edges so as to permit relative flexing. Such a pad may be supported against a human torso by enclosing it within a cloth envelope and providing suitable shoulder straps and the like for fastening it to the human body.

When such a pad is made of a suitable number of layers of the woven nylon cloth, as for example about 1 to 2 dozen layers and probably optimally in the order of 18 layers or so, the pad will stop most common bullets, even at point blank range of only a few inches between the muzzle of the fire arm and the pad. For stopping the few types of extremely high powered or so-called armor piercing bullets, the device may include an additional metal plate insert, usable only when known to be necessary, to cooperate with the pad in stopping even these types of bullets.

The invention further contemplates treating the cloth cryogenically in a manner to increase its bullet stopping capacity. In the absence of such treatment, additional cloth layers, such as one-half to twice as many may be required. Thus, by means of such treatment, the number of cloth layers may be reduced, thus reducing the weight.

Hence, the invention herein contemplates providing a bullet-proof material which is sufficiently lightweight,

such as on the order of five pounds or so for complete protection, and sufficiently flexible so as to move with the wearer's body, that is may be normally worn by police officers and others who are engaged in relatively dangerous activity where bullets and similar missiles may be expected, but at unexpected times.

These and other objects and advantages of this invention will become apparent, upon reading the following description, of which the attached drawings form a part.

DESCRIPTION OF DRAWINGS

FIG. 1 illustrates a perspective view of a form of the protective armor herein which may be worn by a person for protecting the front and rear of his torso.

FIG. 2 is an enlarged, cross-sectional view, taken in the direction of arrows 2—2 of FIG. 1 and including the protective insert metal plate.

FIG. 3 is a perspective view of the cloth blank used for forming the pad containing envelope.

FIG. 4 is a perspective view of one section, including the outer envelope, of the armor and illustrates the metal plate which may optionally be used therewith.

FIG. 5 is a cross-sectional view, enlarged and fragmentary, of the bullet-proof pad.

FIG. 6 is a perspective view of the pad per se.

FIG. 7 is a cross-sectional view taken in the direction of arrows 7—7 of FIG. 1, to an enlarged scale, including showing the optionally usable metal plate.

FIG. 8 is an enlarged, cross-sectional perspective view of the metal insert.

FIG. 9 is a perspective view of a portion of the insert.

DETAILED DESCRIPTION

Referring to FIG. 1, the bullet-proof protective armor, generally designated at 10, may be made with a front body section 11 and a rear body protective section 12 connected together by means of suitable shoulder straps 13, which fit over the shoulders of the wear for suspending the sections fore and aft of his body, with a suitable body encircling belt 14 extending around the sections and the wearer's body, near the waist thereof.

In this form of armor, each protective section is made of a cloth envelope 15 (see FIGS. 2, 4 and 7) which may be made of a single piece of cloth folded in half, to form a front and rear cloth body covering portion 16, with upwardly extending portions 17. The adjacent edges of the body portion part 16 and extensions 17 may be stitched together by suitable stitching 18. Thereafter, the extensions 17 are reversely tucked into the envelope to form a central pocket 19 for removably receiving a metal insert plate 20 for increasing the protective capabilities of the armor when needed.

The envelope 15 is simply a container for the bullet-proof protective pad 21. This pad is made of layers 22 of the cloth which is woven out of heavy gauge, linearly oriented, nylon thread, with a tight weave. By either suitably folding the cloth back and forth, or else by the use of suitable stitching, the sheets or layers making up the pad are connected together along one edge 23 and are otherwise substantially free of connection so as to be relatively flexible, one sheet relative to the next. Although some stitching or fastening may be needed to keep the sheets properly together, essentially, the sheets are free to individually flex or move to a considerable extent. Thus, as illustrated in FIG. 6, the pad

forming layers or sheets may be stitched together by stitches 24 at their lower corners and also by stitches 25 at their upper corners which also connect the ends of the shoulder straps to the pad which stitches may be further extended to also connect the envelope to the pad.

While the number of layers or sheets of cloth may be varied to meet specific requirements, by way of example, 17 and 18 layers, when suitably treated as described below, formed of stretch of linearly oriented nylon of approximately 1,050 denier, will stop a 45 caliber bullet fired from a pistol with the muzzle located right at the pad surface. Within a range of a few inches up to a foot, virtually all hand gun bullets as well as rifle bullets will be stopped. This includes such relatively high powered weapons as a 357 magnum, as well as low powered 22 caliber rifle bullets, 38 caliber pistol bullets, and the like. For protection against so called high speed or armor piercing type bullets, the metal plate 20 may be inserted, as described above, giving the additional stopping ability needed for these types of missiles.

The specific type of nylon used may vary as may the degree of linear orientation, as this will affect the number of layers required, requiring the addition of one or two or more layers to be added or perhaps removed, as the case may be.

Apparently, the nylon material absorbs the energy of the bullet or similar missile in the form of a heat energy which may melt or partially melt the points of impact and the closely surrounding areas of the pad, thus stopping the bullet before actual penetration. In many cases, the bullet will simply bounce off the pad, without penetrating at all.

METHOD OF TREATING CLOTH

In order to increase the bullet stopping capacity of the pad, the cloth from which the pad is made, either before or after the pad is assembled, is treated in the following manner:

First, the cloth is annealed at a temperature below the melting point of the plastic, for a short time, to relieve a part of the molecular stresses, assuming it has not been annealed or stress relieved in the manufacture of the thread. One suitable method for providing such an annealing step is by immersing the cloth in boiling oil at about 325° F for roughly 15 minutes. A light oil such as on the order of SAE 5 has been found to be suitable for this purpose. The times and temperatures are not critical, but may vary depending upon the specific material used.

Next, the cloth material is dried out to remove moisture therefrom. Any conventional suitable drying process may be used. The object is to remove as much as possible of the moisture contained in the material, since nylon has a tendency to absorb moisture.

Thereafter, the cloth either in sheet form or after assembly into pads, is treated cryogenically for a period of time. For example, the cloth is immersed in a cryogenic atmosphere, as near as can be practically obtained in commercial production to absolute zero, for a few hours. Thus, in commercial production, it may be placed at a temperature of roughly about minus 400° F and kept there for anywhere from 3 to 6 hours until it molecularly stabilizes. Thereafter, the cloth is removed from the cryogenic atmosphere and permitted to gradually return to room temperature.

The chemical and physical effects upon the material do to this cryogenic immersion is not known. Nor is the specific temperature or time apparently critical, the same being variable within rather wide degrees.

However, the net result is that the material, apparently the molecular structure of the material, is in some way altered so as to substantially increase its ability to resist the impact and penetration of bullets and similar missiles. With this treatment, the number of sheets used in a pad for almost all bullet stopping purposes, may be kept on an order of 18 layers, give or take a few layers. Without it, the number of sheets required is about half again to twice as many layers.

After the super-cooling treatment of the material, it is desirable to replace moisture in the material and this can be accomplished simply by means of immersing the material, after it has returned to approximately room temperature, in boiling water for about 15 minutes or a little longer. This saturates the material with moisture again.

The next step, after replacing the moisture, is to dry the material to a point where it is suitable to handle and use, and then assemble the pad into the envelope described above.

There are relatively wide variances in the times and temperatures of the foregoing treatment which seem to be related to the specific chemical composition of the particular nylon used. Thus, some trial and error is required to obtain optimum times and temperatures and even then, variations within reason, seem not to affect the characteristics of the material in stopping bullets, in any substantial manner.

The pad when assembled into the bullet-proof armor, in a size suitable to protect the torso of a human being, may be on the order of about 9¾ inches by 14½ inches in size, with a thickness of approximately one-half inch, giving a weight of approximately 2½ pounds per armor section. Thus, the entire armor may weigh something on the order of less than five pounds.

Of course, the size of the armor may be increased substantially to cover more of the body of the wearer, in which case there will be some slight additional weight. Also, the armor may be so shaped as to protect inanimate objects.

The armor itself is sufficiently lightweight and flexible that it may be comfortably worn by such persons as police officers during even normal, as well as dangerous assignments, for protecting the wearer at all times.

Preferably the envelope is made of the same cloth material as is the pad, thus providing two additional layers to the pad. Also the belt 14 may be secured to the envelope and the ends of the belt secured together by stitching "Velcro" type cloth patches 26 in the appropriate places. This conventional cloth is formed with napped fibers which interengage to secure opposing patches together.

To make the insert place flexible enough to bend and conform to the curvature of the wearer's body, it is formed of a number of edge to edge aligned pairs of thin steel plate sections 27-28 (e.g., one-eighth inch thick), with the joints between the pairs overlapped by a narrower cover plate 29 and all of the plates enclosed with a flexible cloth cover material 30 adhesively secured to the plates. Preferably such cloth cover is formed of wide plastic adhesive tape (e.g., about 3 inch wide tape), wound around and adhered to the plates. Thus the overlapped, aligned plate sections may flex or

move relative to the original flat plain of the insert as indicated in dotted lines in FIG. 8. The insert is thereby relatively flexible in the direction transverse to the joints.

Having fully described an operative embodiment of this invention, I now claim:

- 1. A bullet-proof protective armor comprising:
 - a relatively flexible pad formed of a number of sheets, such as one to two dozen sheets, of cloth arranged in face to face relationship and secured together along one edge, with the sheets being substantially free of positive securement together between their opposite edge portions for relative flexing of each of the sheets;
 - said cloth being of a tightly woven material formed of heavy, nylon thread, such as roughly on the order of 1,050 denier;
 - and means for positioning and holding the pad upon an object to be protected, for stopping bullets and the like missiles impacted against said pad.
- 2. An armor as defined in claim 1, and wherein the nylon material has a molecular structure resulting from linearly orienting the molecules and then subjecting the

material to a cryogenic, super-cold temperature, relatively near absolute zero for a relatively short period of time, such as on the order of roughly a few hours.

3. An armor as defined in claim 1, and said pad being encased within a flat, cloth-like envelope having attached straps for fastening the pad upon the body of a wearer of the armor;

and including a pocket formed within the envelope and opening at one edge thereof, the pocket being arranged within the pad, between the sheets thereof, and a metal insert plate, arranged within and being removable from said pocket, so that the plate is arranged between the sheets forming the pad and may be removed and replaced as desired.

4. A construction as defined in claim 1, and comprising:
said pad being encased within a flat, clothlike envelope; and
a pocket formed within the envelope and opening at one edge thereof, the pocket being arranged within the pad, between the sheets thereof, and a metal insert plate removably arranged within said pocket.

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