United States Patent [19]

Hathaway et al.

[11] **3,745,938**

[45] **July 17, 1973**

[54] **COMPACTIBLE PROTECTIVE SHIELD**

[75] Inventors: **Bruce E. Hathaway; Earl W. Huffman,** both of Richwood, W. Va.; **Kevney J. O'Connor,** Newport Beach, Calif.

[73] Assignee: **R. F. Inc.,** Grantsville, W. Va.

[22] Filed: **Aug. 3, 1971**

[21] Appl. No.: **168,565**

[52] **U.S. Cl.** **109/49.5,** 2/2.5, 109/58.5

[51] **Int. Cl.** **F41h 5/08**

[58] **Field of Search** ..... 109/49.5, 58.5, 82, 109/80, 79; 89/36 R, 36 D; 5/348 R; 2/2.5; 273/55; 161/404, 138

[56] **References Cited**

UNITED STATES PATENTS

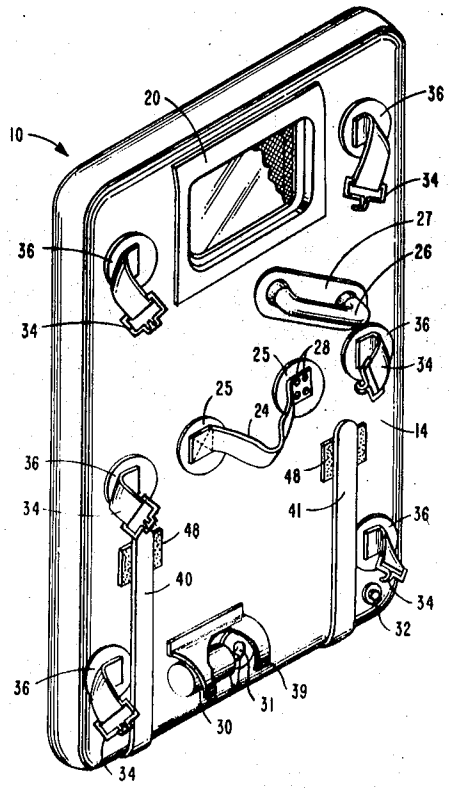
2,886,834	5/1959	Gilbertson	5/348 R
3,008,213	11/1961	Foster et al.	5/348 R X
3,310,818	3/1967	Fischer	5/348
3,526,199	9/1970	Keats	5/348 R
3,557,384	1/1971	Barron et al.	2/2.5
918,391	4/1909	Taarud	5/348 R
1,250,197	12/1917	Louppe	109/49.5 X
1,270,343	6/1918	Szmyt	109/82
1,465,767	8/1923	Krause	109/82 X
1,561,184	11/1925	Offenhauser	5/348 R
1,574,188	2/1926	Friedman	109/82 X
1,985,432	12/1934	Tucker et al.	5/348 R
2,028,060	1/1936	Gilbert	5/348 R
2,316,055	4/1943	Davey	2/2.5 X
2,466,597	4/1949	Kropscott et al.	2/2.5 UX
2,574,046	11/1951	Logan	5/348 R X

Primary Examiner—Dennis L. Taylor
Attorney—Fraser and Bogucki

[57] **ABSTRACT**

A protective shield for personnel use is provided that can be rolled into a relatively small, light weight and unobtrusive cylinder, but can be inflated to serve as a unitary shock absorbing and object deflecting shield. The inflatable structure has a generally rectangular outline, and substantially parallel front and rear broad faces of impregnated pile fabric that are relatively pliant when uninflated but substantially flat as well as stiff when inflated. A manually actuable gas cartridge device and handles are attached to the rear face of the shield, which also may include a viewing aperture covered by a foraminous member. The inflated shield provides differential distortion between the front and rear faces under impacting objects, sufficient to protect a person behind the shield by absorbing, distributing or redirecting the force of impact without significant deformation or collapse.

6 Claims, 8 Drawing Figures



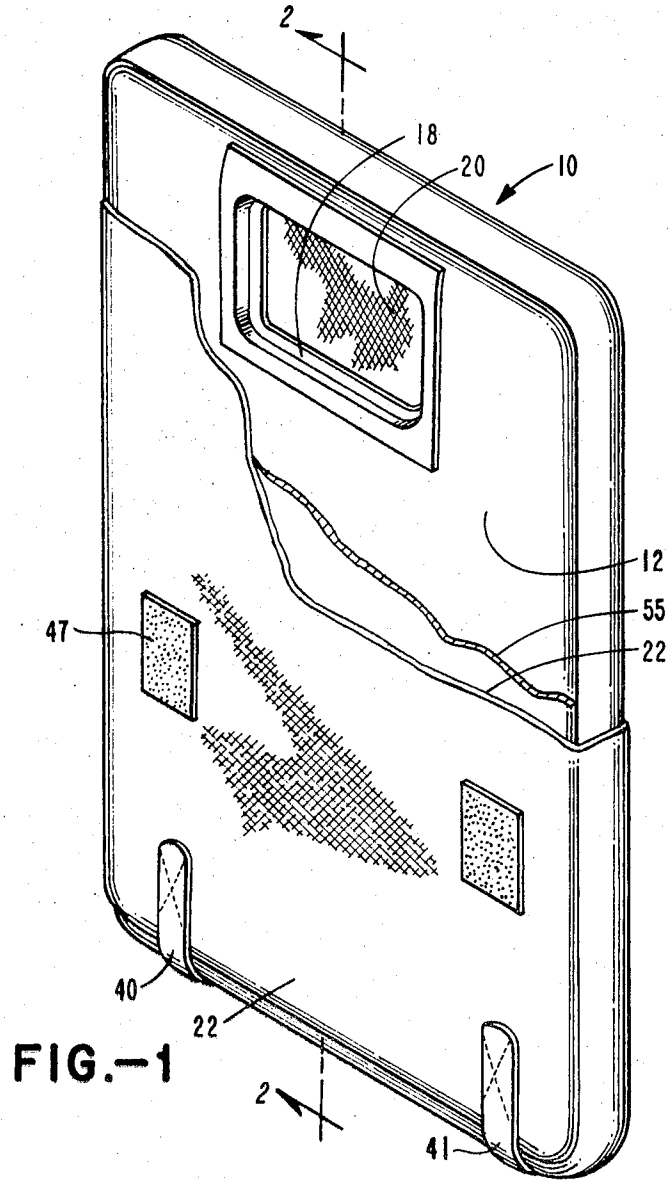
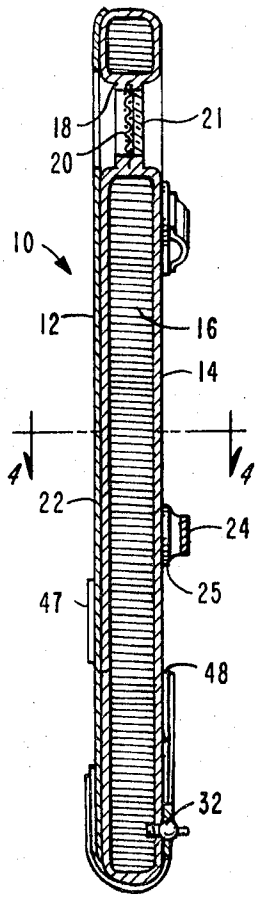


FIG.—1

FIG.—2



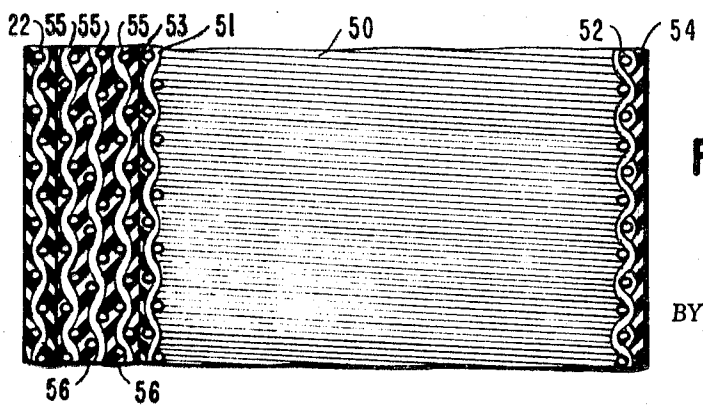


FIG.—4

INVENTORS
BRUCE E. HATHAWAY
EARL W. HUFFMAN
KEVNEY J. O'CONNOR
BY Fraser and Bogucki
ATTORNEYS

FIG.—3

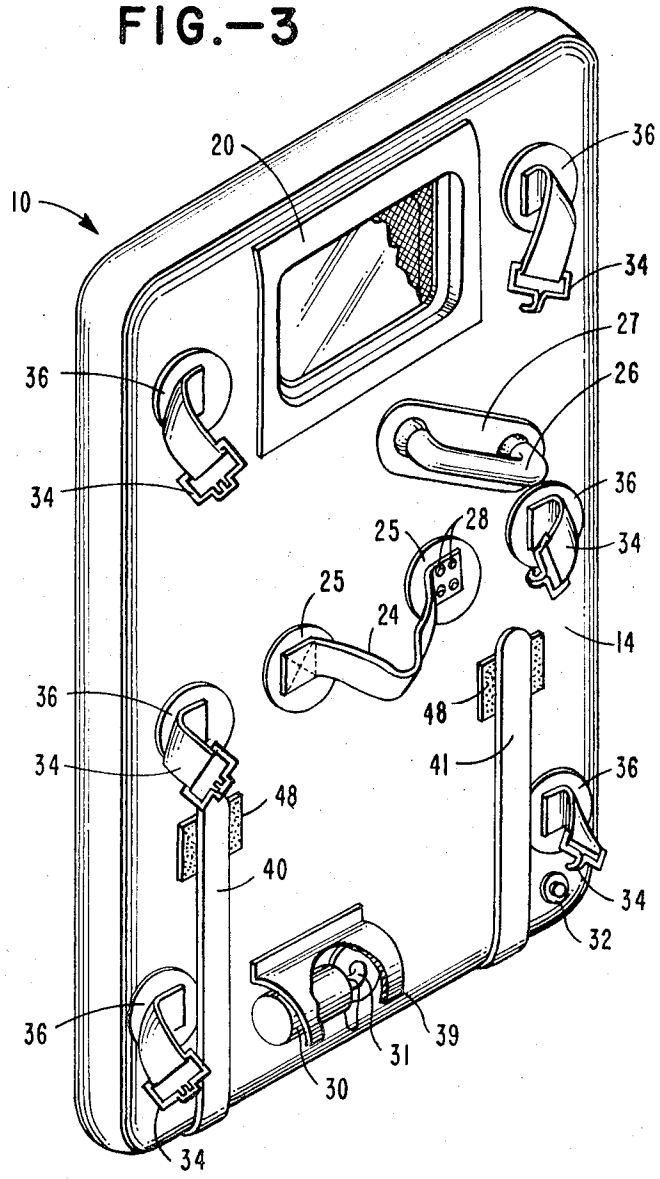
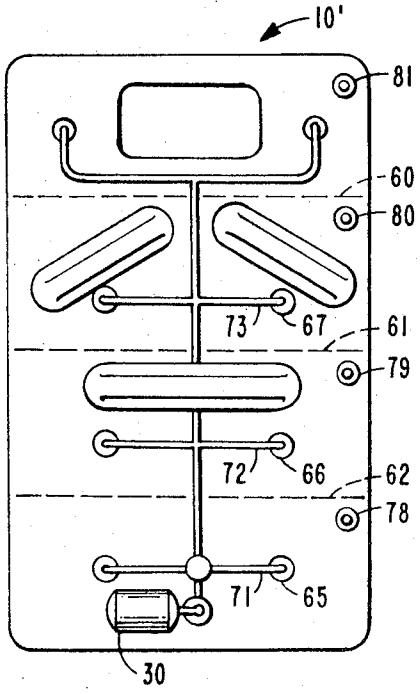


FIG.—6



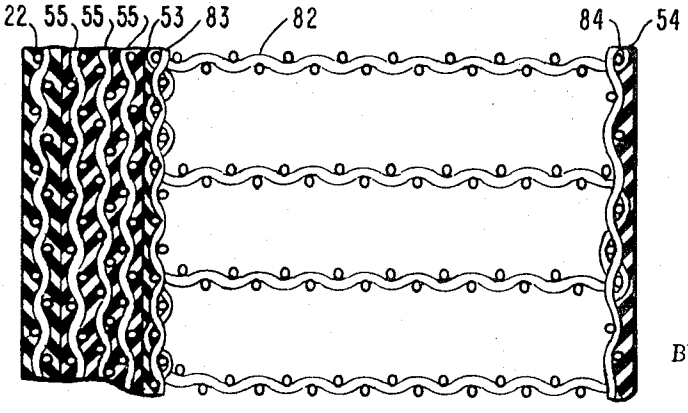


FIG.—7

INVENTORS
BRUCE E. HATHAWAY
EARL W. HUFFMAN
KEVNEY J. O'CONNOR
BY Fraser and Bogucki
ATTORNEYS

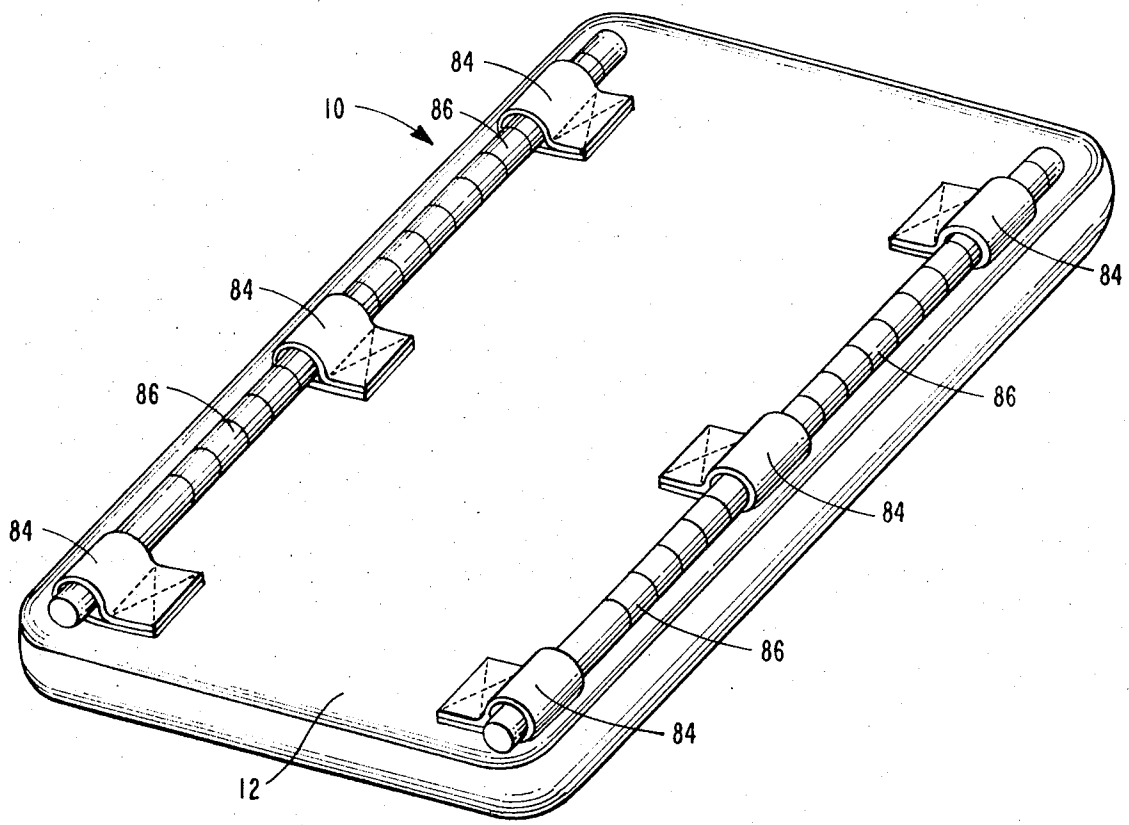


FIG.—8

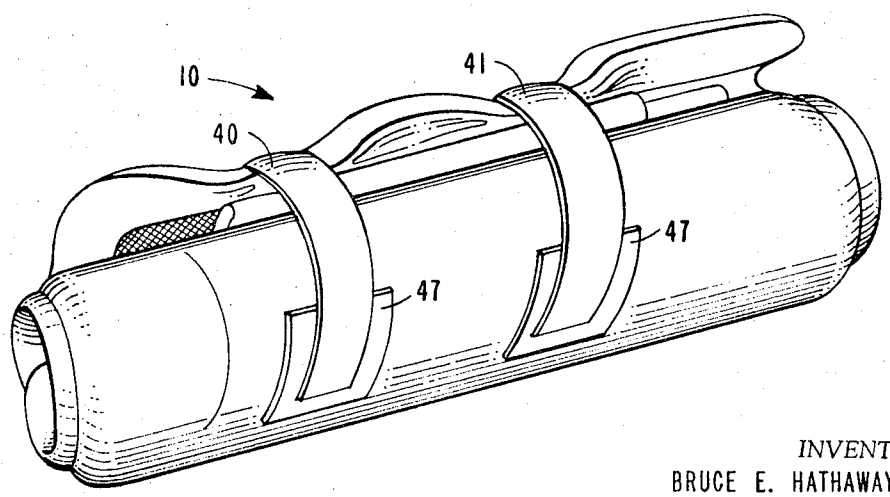


FIG.—5

INVENTORS
BRUCE E. HATHAWAY
EARL W. HUFFMAN
KEVNEY J. O'CONNOR
BY Fraser and Boguecki
ATTORNEYS

COMPACTIBLE PROTECTIVE SHIELD

BACKGROUND OF THE INVENTION

This invention relates to protective structures for personnel, and particularly to unobtrusive protective shields that may be readily deployed for use.

A need exists for a protective structure that can be carried or stored unobtrusively and conveniently under normal circumstances, and readily deployed when needed to provide protection against flying, falling or impacting objects. Protective shields heretofore used have generally been of rigid construction, and therefore both relatively heavy and comparatively cumbersome. It is of course known to provide inflatable chest protectors, and other protective structures that can be worn, but these generally provide only limited area protection and are not readily manipulable or deployable. Inflatable protective elements must have a combination of resiliency, in order to absorb an impacting shock, and rigidity, in order to deflect an impacting object without significant deformation or partial collapse. The walls must also have sufficient structural integrity to absorb the impacts of relatively sharp pointed objects without being subject to puncturing while at the same time having sufficient pliability so that the structure can be compacted into an unobtrusive, readily stored shape.

SUMMARY OF THE INVENTION

The objects and purposes of the present invention are achieved by an inflatable structure having substantially parallel front and back broad faces joined around a substantially rectangular peripheral margin and interiorly connected by gas permeable means. Rubber impregnated pile fabric having spaced apart front and back walls serves as the base structure, and may include additional impact and puncture resistant layers of flexible, pliant material. A manually actuated gas cartridge and handles are mounted on the rear broad face. When the gas cartridge is actuated, the interior gas flow is substantially unobstructed and when the interior is pressurized the walls are firm, flat and impact resistant. The shield may include an internal margin defining a viewing aperture, across which is mounted a foraminous viewing element. Such structures may be carried as a cylindrical roll, and substantially immediately extended to the deployed condition. When deployed, the exposed broad face resiliently yields over a limited area under an impacting force, cushioning and absorbing the shock or deflecting the impacting object to the side.

Alternatively or additionally, in accordance with the invention, roll fasteners may be provided in the form of straps attached to the front and bottom margins, preferably including fasteners of the Velcro type and arranged so that the shield can be rolled along its length in any disposition, and then secured adequately but in a readily releasable manner. The shield may also incorporate fasteners positioned near the edges thereof for interconnecting two or more adjacent shields together to form a protective wall. As another feature, the shield may include loops for receiving night sticks or other rigid members forming handles to permit use of the shield as a stretcher in a horizontal position.

In another arrangement in accordance with the invention, means are provided for dividing the shield internally into a number of compartments, with a gas cartridge device being coupled to each of these compartments through separate conduits and one-way valves, so that the high velocity impact of a sharp object that may puncture one of the compartments does not cause deflation of the remainder of the shield.

BRIEF DESCRIPTION OF THE DRAWINGS

A better understanding of the invention may be had by reference to the following description, taken in conjunction with the accompanying drawings, in which:

FIG. **1** is a perspective view, partially broken away, of a deployable protective shield in accordance with the invention;

FIG. **2** is a side cross-sectional view of the shield of FIG. **1**, taken along the lines **2—2** therein and looking in the direction of the appended arrows;

FIG. **3** is a perspective rear view of the arrangement of FIGS. **1** and **2**;

FIG. **4** is an enlarged cross-sectional view of a fragment of the arrangement of FIGS. **1–3**;

FIG. **5** is a perspective view of the shield of FIGS. **1–4**, showing the shield in the compacted position;

FIG. **6** is a rear view of a different arrangement in accordance with the invention;

FIG. **7** is an enlarged cross-sectional view of a fragment of an alternative wall construction for the arrangement of FIGS. **1–3**; and

FIG. **8** is a perspective view of an alternative form of deployable shield in accordance with the invention.

DETAILED DESCRIPTION

Referring now to FIGS. **1–3**, a protective shield **10** for personnel use comprises an inflatable, resilient body having a front broad face member **12** and a rear broad face member **14**, with a generally rectangular outline, the longer sides being the vertical sides as seen in FIGS. **1–3**. Although the shield **10** can be used in any attitude, it will normally be in the orientation shown, and consequently for convenience the upper and lower edges as seen in the Figures will be referred to hereafter as the top and bottom of the structure.

The core structure, as best seen in the fragmentary sectional view of FIG. **4**, comprises a neoprene, rubber or other elastomer impregnated pile fabric having internal threads **16** joining the front and rear face members **12, 14**, as also seen in FIG. **2**. The internal transverse threads **16** prevent the face members **12, 14** from tending to separate under the internal pressure and thus distort from the desired essentially flat configuration. The flat surfaces are maintained at 6 psi normal inflation pressures.

The peripheral edges of the two face members **12, 14** are joined together along a continuous peripheral seam so that the outer edge of the shield **10** is slightly rounded.

An internal viewing aperture near the top of the shield **10** is defined by an internal rectangular margin **18** provided by joining the front and rear face members **12, 14** along an appropriate area, and then cutting out or otherwise excising the included material, this internal viewing aperture being covered by a transverse foraminous member such as a screen **20**. If greater protection is desired, the viewing aperture may be covered with glass or transparent plastic **21** in place of or in addition to the screen **20**. In this example, the front member **12** of the shield **10** is covered by an attached thickness of material comprising a puncture resistant and force distributing cover layer **22**. A number of inter-

posed protective layers may also be used for greater protection against puncturing, as described below. As is well known, internal puncture sealants may alternatively or additionally be used.

On the back member **14**, as best seen in FIGS. 2 and 3, means are provided for holding and manipulating the shield **10**, comprising an arm loop **24** affixed to the back face by mounting pads **25**, and a spaced apart handle **26** and associated mounting disk **27**. Snap fasteners **28** are used to detachably secure the arm loop **24** to at least one of the mounting pads **25**. Near the bottom of the rear member **14** is mounted a manually actuable gas cartridge device **30** of standard commercial type of which many are available. Although only one cartridge is shown for simplicity, a dual or other multiple device may be used, in any event including an actuating device, such as a pull string (not shown in detail), which when pulled releases gas from the cartridge **30** through a conduit **31** into the interior of the shield **10**. An oral or pump inflatable valve **32** mounted near the bottom of the shield **10** also couples to the interior of the shield for separate inflation. Three sets of detachable coupling fasteners **34** are mounted on disks **36** on each side of the shield. The fasteners are chosen to pair with mating fasteners at the edges of adjacent shields to permit two or more shields to be fastened together to form a wall. A cloth cover **39** is disposed over the gas cartridge to protect against inadvertent actuation and damage.

To provide the desired combination of resiliency, physical strength and toughness, and resistance to puncturing, shock and abrasion in the deployed **153**, it has been found advantageous to employ a commercially available pile fabric known as drop stitch fabric as the core structure for the shield, as best seen in enlarged fragmentary view in FIG. **4**. Referring to that view, a unidirectionally extending mass of transverse pile fibers **50** connects opposing parallel face layers **51, 52** which are impregnated with a synthetic rubber neoprene compound **43, 54**, shown enlarged for greater clarity. One or more layers of neoprene coated ripstop nylon ballistic material **55** (three layers are illustrated) are affixed to the front face member **12**. These nylon cloth layers **55** are secured by a neoprene base cement **56** which fills between the warp and fill of the fibers. A cover layer **22** of ripstop nylon fabric coated on both sides with neoprene is cemented to the nylon ballistic layers **55** on the front face member **12** of the shield **10** and wraps around partially to the rear of the shield **10**. This type of wall structure, with or without the cover layer **22**, has sufficient body and rigidity when inflated, but is also suitably flexible and pliant when uninflated.

The configuration of the shield **10** when it is compacted in cylindrical form is shown in FIG. **5**. As seen in FIG. **5**, and also in FIGS. **1–3**, a convenient, readily detachable but secure, fastening means is provided in the form of a pair of straps **40, 41** fastened to the front face member **12** near the bottom edge of the shield **10**. Pairs of fastener pads **47, 48** are disposed on the front and rear face members **12, 14**, respectively, of the shield, in the region of the free end of each strap (e.g., the strap **41**) when it is on the corresponding side of face members **12** or **14**. The facing surfaces of these pads **47, 48** and the associated straps **40, 41** may be of a suitably adherent but nevertheless removable material such as that sold under the trademark Velcro. Thus, when the shield **10** is deployed, the straps **40** and **41** are secured neatly to an adjacent pad **48**. When the shield **10** is in the compacted position, it may be rolled into a cylinder and the exposed straps **40** and **41** may then be turned around the cylinder and affixed to an aligned Velcro pad **47**, as shown in FIG. **5**.

In the operation of the system of FIGS. **1–5**, the shield **10** is carried in the compacted position of FIG. **5** until a need for its use arises, at which point the straps **40, 41** are removed from the Velcro pads **47** and the shield is rolled outwardly. Then the manually actuable cartridge device **30** is operated, quickly inflating the shield **10** to the deployed condition, the inflation time being of the order of three seconds. In such state, the shield is instantaneously ready for use. At an internal pressure of **6** psi the shield has flat surfaces, resists bending and distortion against direct and twisting forces, and can easily be manipulated.

When in use, the shield **10** has a combination of energy absorption and deflection properties that provide a high degree of security for the user. The combination of these properties, in a relatively light weight, compactible structure, is achieved for the first time in known systems by the present invention. A shield that has faces that are excessively rigid would tend both to have to be excessively bulky and heavy and subject to fracture under impacting force. In addition, such structure would inherently present greater difficulty with respect to compaction. The face members of shields in accordance with the invention, however, differentially deform or distort in response to the impact of an object, distributing the force of the object over substantially greater exposed areas without transmitting the shock to the rear wall or the user, so that the user receives only a cushioned impact. The structural rigidity of the shield **10** as a whole is such that objects impinging near the top, bottom, or sides of the shield do not cause bending or collapsing of the side of the shield, but instead deflect the objects away from the user. The toughness of the material of the broad face members **12, 14** is sufficient for the great majority of instances of use. It is not intended to stop or deflect high velocity penetrating objects such as bullets or shrapnel with this structure.

The fasteners **34** attached along the sides may be interconnected to mate fasteners on adjacent shields **10** to form an emergency barrier. The snap fastener **28** for the handle **24** provides a safety factor for the user, in that an excessive external twisting movement will cause the fastener **28** to release, preventing harm to the user.

Shields in accordance with the invention may be of the order of 1-¼ inches thick in the above example, and although size may be varied at will the given example is of a shield 24 inches wide and approximately 42 inches high. In this size, the shield weighs only approximately 7 pounds, but withstands punctures from virtually any thrown object, as well as manually applied forces with virtually no distortion. At the same time, the shield when inflated has sufficient buoyancy and stiffness to support the average sized man when floated.

In a separate example of a shield **10'** in accordance with the invention, referring now to FIG. **6**, the principal operative elements are as previously described. In this arrangement, however, the interior of the shield **10'** is divided into distinct and separate interior chambers by internal dividing walls **60, 61** and **62**. The charging system for inflating the structure utilizes a cartridge device **30**, as previously described, but also em-

ploys a plurality of one-way valves **65, 66, 67, 68** at least one of which is disposed in association with each of the interior chambers. A conduit system from the cartridge includes a principal branch **70** and side branches **71, 72, 73** and **74,** each of which goes to a different one of the one-way valves **65–68,** respectively. Similar conduit and valve arrangements may be used in pairs, as shown, although the arrangement need not be further described. Separate combination oral and pump valves **78–81** may also be employed for each of the internal chambers.

In this arrangement, actuation of the gas cartridge device **30** causes the chambers to be filled separately, although virtually simultaneously, and then in the event that any one of the chambers is punctured, the remainder of the chambers remain inflated, giving the user such protection as they afford.

In lieu of the pile fabric **50, 51, 52** used in the example shown in FIG. **4,** and as illustrated in FIG. **7,** a commercially available woven three dimensional cloth may be used. In this arrangement, loosely woven layers **82** are interwoven with and extend between spaced apart woven panels **83, 84** in the fashion taught by Koppelman U.S. Pat. No. 3,048,198. The interconnecting layers **82** are of a loose porous weave but maintain the panels **83, 84** at a uniformly spaced distance when the shield is inflated, but allow them to readily collapse when the shield is not inflated. Because the layers **82** are loosely woven, gas can readily pass through them during inflation and deflation. As in the example shown in FIG. **4,** the layers **83, 84** may be impregnated with a synthetic rubber neoprene compound **53, 54** and the front surface of the shield supports a puncture resistant barrier comprising three layers of cemented nylon **55, 56** and a cover layer **22.**

As illustrated in FIG. **8,** a shield **10** may alternatively or additionally be fitted with appropriately placed tabs or loops **84** along opposite long sides of the front broad surface face member **12** (or the rear broad surface **14** face member). Three spaced apart loops **83** are shown adjacent each margin of the shield **10.** The loops **84** define apertures for receiving night sticks **86** or other suitable implements which when placed between adjacent pairs of the loops **83** serve as handles to permit individuals on each side to carry the shield **10** in a horizontal orientation. When carried in this manner, the shield **10** is used as a stretcher or personnel support. Alternatively, an individual may be strapped to the inflated shield.

Although there have been described various modifications and variations in accordance with the invention, it will be appreciated that other modifications and exemplifications may be utilized within the scope of the appended claims.

What is claimed is:

1. A compactible shield comprising:

an inflatable body of flexible, gas impervious material, said material comprising elastomeric impregnated fabric, said body when inflated having a front face member substantially parallel to a rear face member, and including internal members joining said front face member and said rear face member, said front face member having a covering of at least one layer of flexible impact and puncture resistant material;

inflating means mounted on said rear face member of said body and operatively coupled to the interior of said body, said internal members being nonobstructive to the flow of an inflating gas in said bag for inflating the regions between said front and rear face members on opposite sides of said internal members; and

holding means mounted on said rear face member for manually holding and manipulating the shield.

2. The invention as set forth in claim **1** above, wherein said covering comprises at least two layers of elastomer impregnated fabric.

3. The invention as set forth in claim **2** above, wherein said covering comprises three layers of neoprene coated nylon fabric, and adhesive means joining said layers, and further comprises cover layer means of ripstop nylon fabric coated on both sides with neoprene.

4. The invention as set forth in claim **1** above, including in addition binder strap means secured to at least one end thereof, and spaced apart detachable coupling means for the free end of said binder strap means attached to at least one of the face members of said body.

5. The invention as set forth in claim **11** above, wherein said binder strap means comprises a pair of spaced apart straps attached in the region of one end of said body, and said detachable coupling means comprises a pair of pads on each of the front and rear face members at regions spaced from the attachment points of said straps for detachably securing the free ends of the straps when the body is compacted and deployed respectively, the detachable couplings comprising coacting fasteners of the Velcro type.

6. A compactible protective shield comprising:

an inflatable body of flexible, gas impervious material, said material comprising pile fabric and having a substantially rectangular outline when inflated, said body when inflated having a front face member substantially parallel to a rear face member, and including a mass of pile fibres joining said front and rear face members, said body further including an interior margin joining said front and rear face members;

inflating means mounted on said rear face member of said body and operatively coupled to the interior of said body; and

handle means mounted on said rear face member of said body.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,745,938 Dated July 17, 1973

Inventor(s) BRUCE E. HATHAWAY ET AL

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 65, after "front" insert ---face---.

Column 3, line 5, after "back" insert ---face---.

Column 3, line 12, after "rear" insert ---face---.

Column 3, line 32, "153" should read ---condition---.

Column 3, line 40, "43" should read ---53---.

Column 5, line 38, delete "broad".

Column 5, line 39, cancel "surface" (first occurrence); same line, cancel " broad surface 14".

Column 5, line 40, after "member" insert ---14---; same line "83" should read ---84---.

Column 5, line 44, the numeral "83" should read ---84---.

Column 6, line 32, "claim 11" should read ---claim 4---.

Signed and sealed this 8th day of January 1974.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

RENE D. TEGTMEYER
Acting Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334

71