US008671840B2

(12) **United States Patent**
Scheid et al.

(10) **Patent No.: US 8,671,840 B2**
(45) **Date of Patent: Mar. 18, 2014**

(54) **FLEXIBLE FRAGMENTATION SLEEVE**

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(73) Assignee: **The United States of America as Represented by the Secretary of the Navy**, Washington, DC (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 310 days.

(21) Appl. No.: **13/016,925**

(22) Filed: **Jan. 28, 2011**

(65) **Prior Publication Data**

US 2012/0192753 A1 Aug. 2, 2012

(51) **Int. Cl.**
F42B 12/22 (2006.01)
F42B 12/32 (2006.01)

(52) **U.S. Cl.**
USPC **102/495**; 86/1.1

(58) **Field of Classification Search**
USPC 102/495; 86/1.1
See application file for complete search history.

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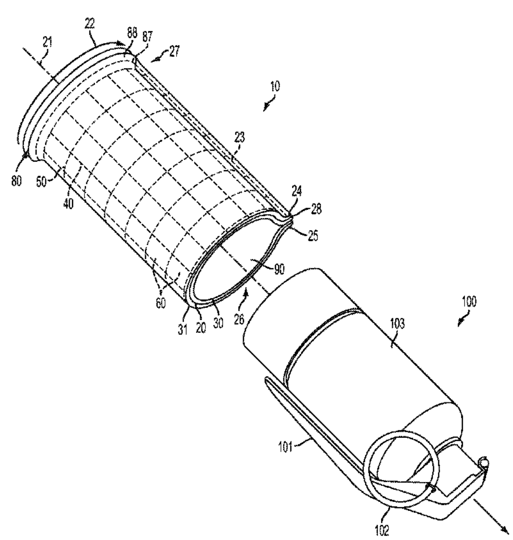
(57) **ABSTRACT**

A flexible fragmentation sleeve for use with a non-fragmenting explosive device is provided. The flexible fragmentation sleeve comprises a flexible cylindrical wall extending between opposing first and second ends along a longitudinal axis. The cylindrical wall includes an inner liner and an outer liner concentric to the inner liner. A first set of coupling elements extend parallel to the longitudinal axis of the cylindrical wall, and couple the inner liner with the outer liner. A second set of coupling elements extend circumferentially along the cylindrical wall. The second set of coupling elements is substantially perpendicular to the first set of coupling elements, and couple the inner liner with the outer liner. A plurality of pockets is defined intermediate the inner liner and the outer liner, and intermediate the first set of coupling elements and the second set of coupling elements. The flexible fragmentation sleeve of the illustrative embodiment further includes a plurality of fragmentation members. At least one fragmentation member is illustratively received within each pocket.

9 Claims, 12 Drawing Sheets



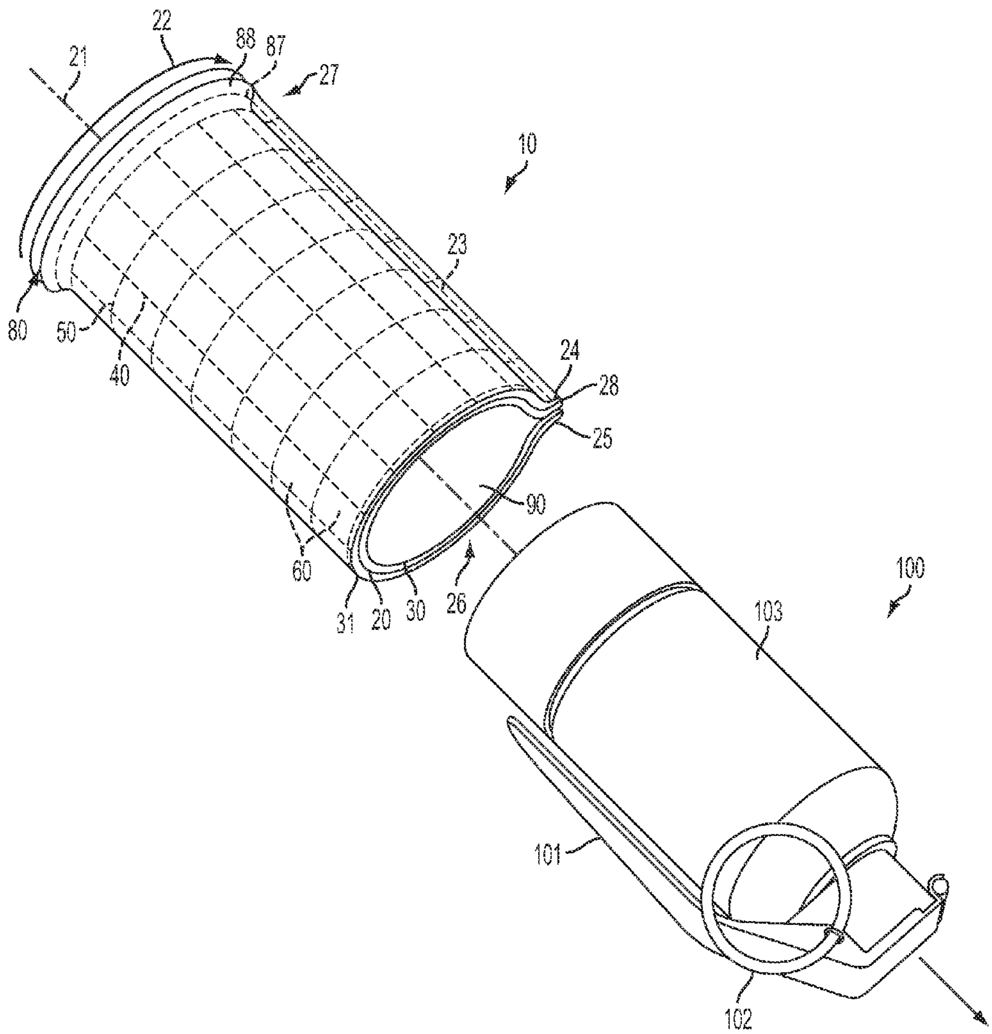

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FIG. 1

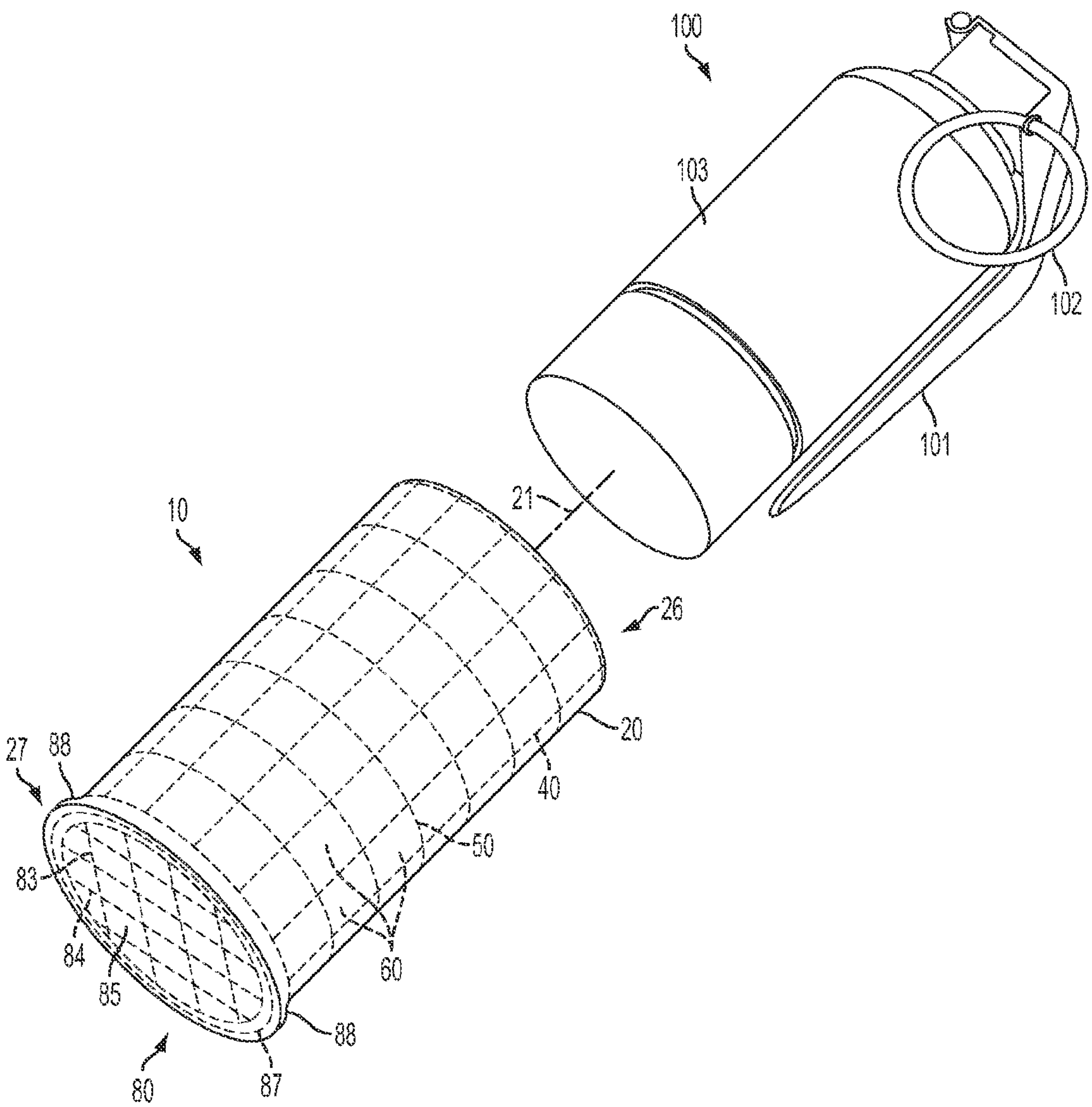

FIG. 2

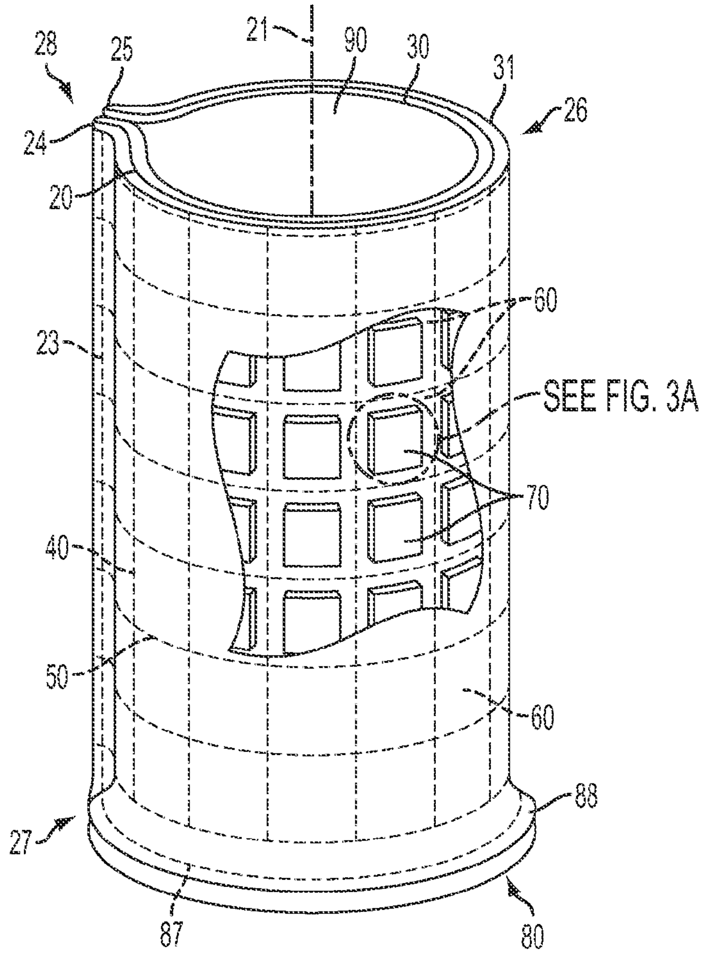

FIG. 3

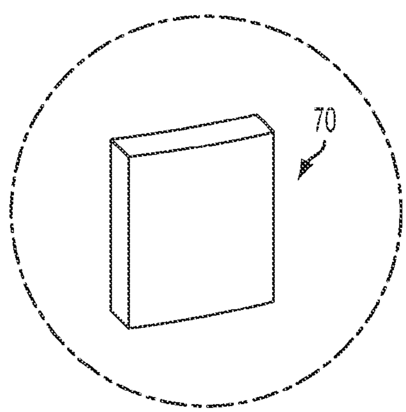

FIG. 3A

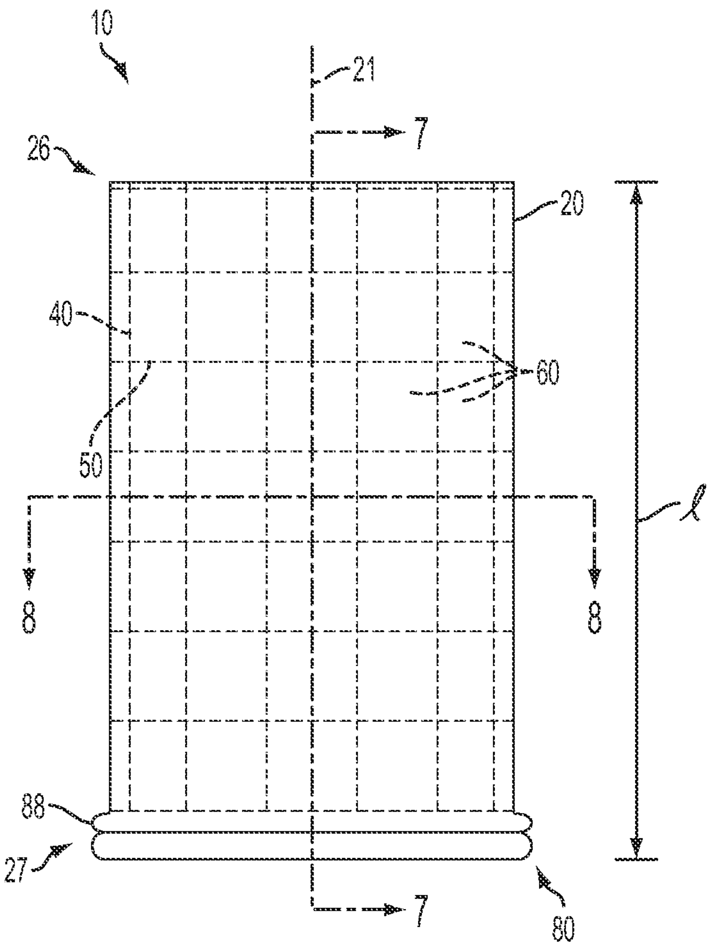

FIG. 4

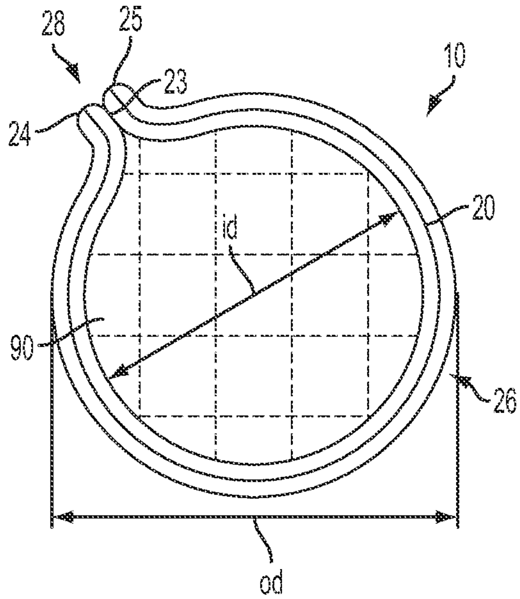

FIG. 5

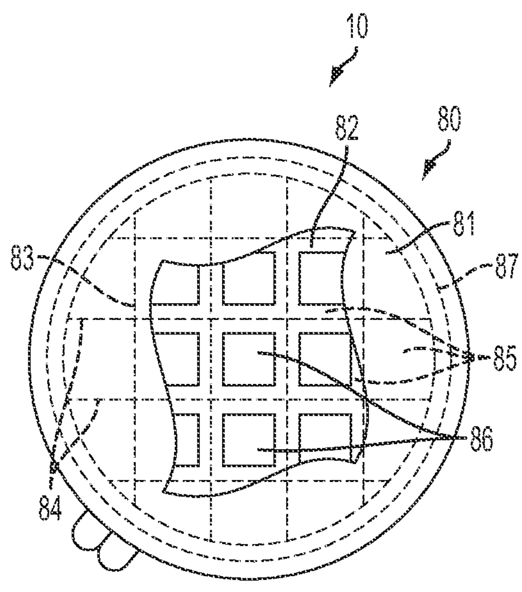

FIG. 6

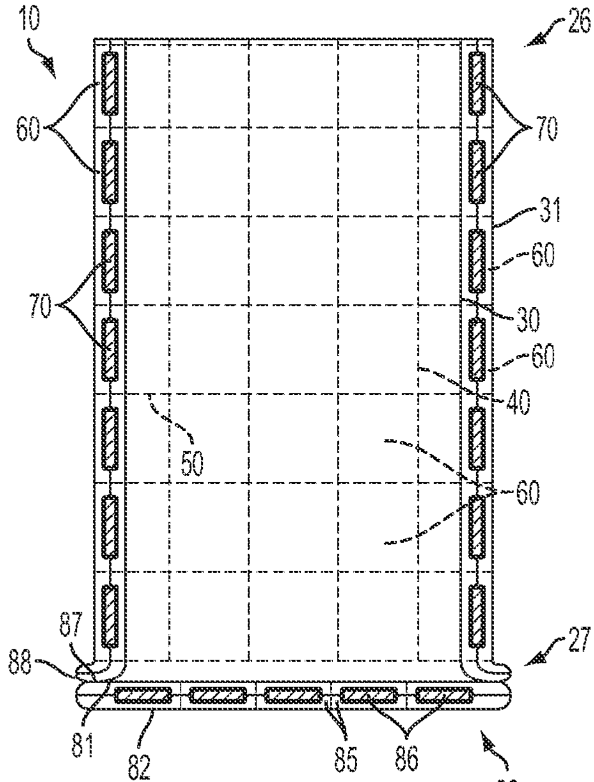
10
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FIG. 7

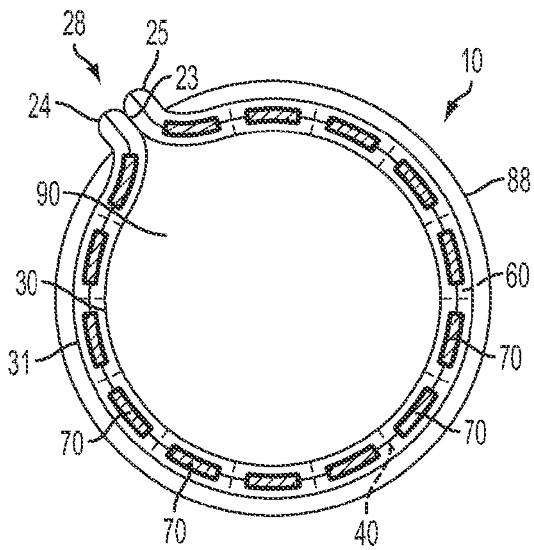
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FIG. 8

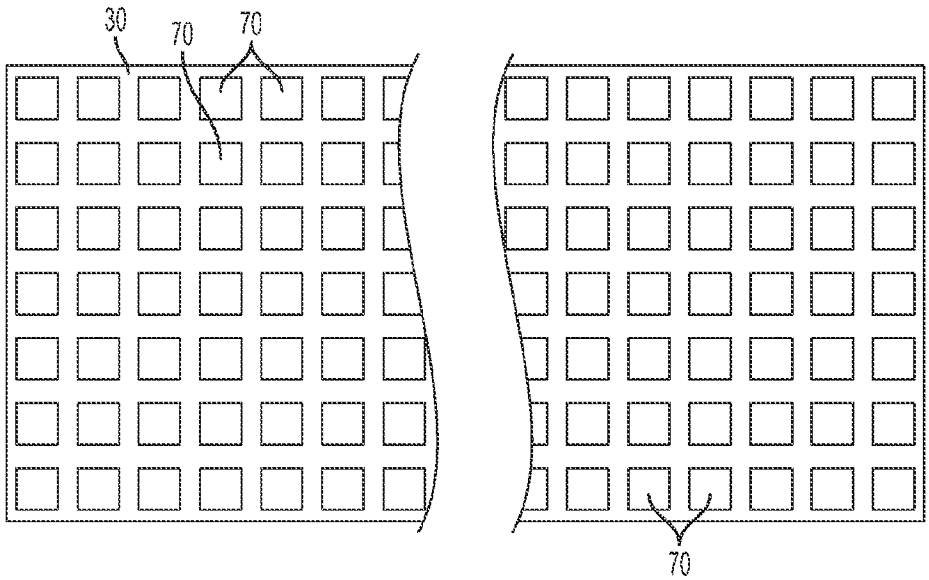

FIG. 9A

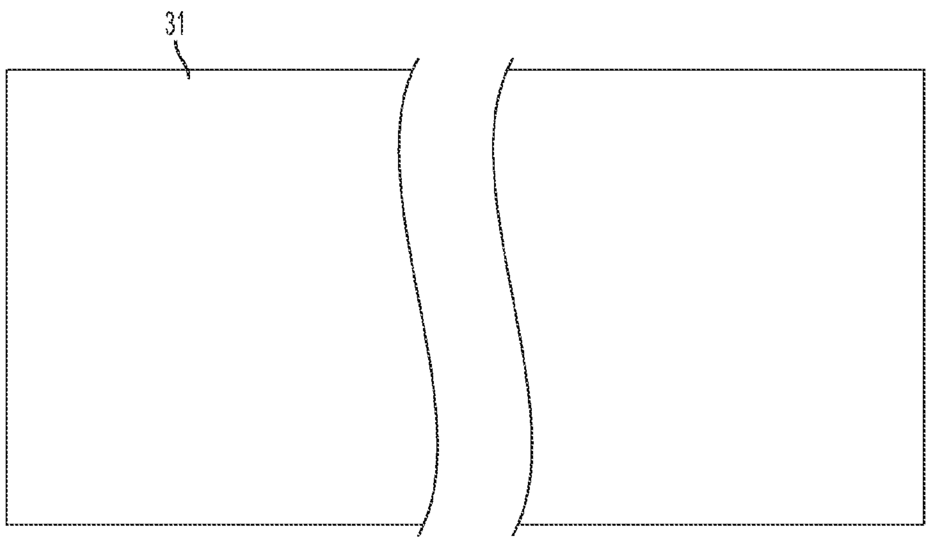

FIG. 9B

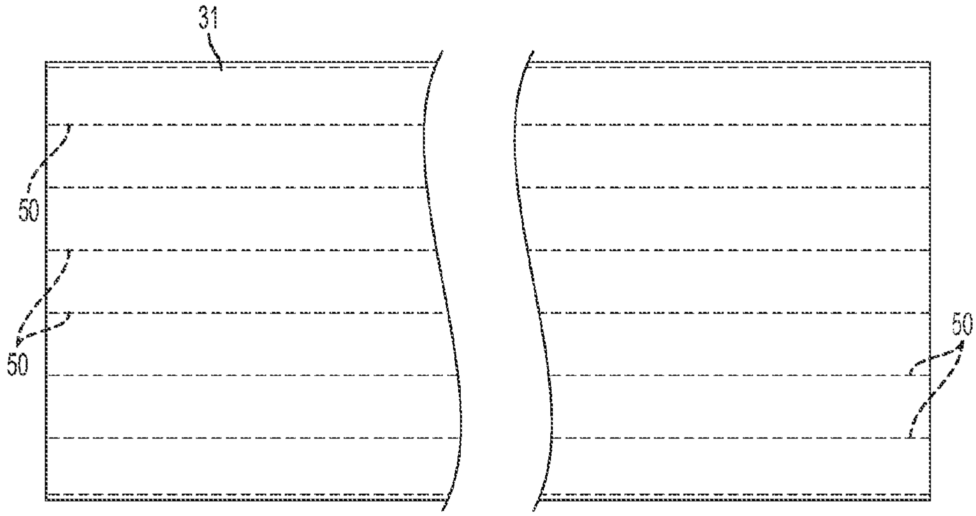

FIG. 9C

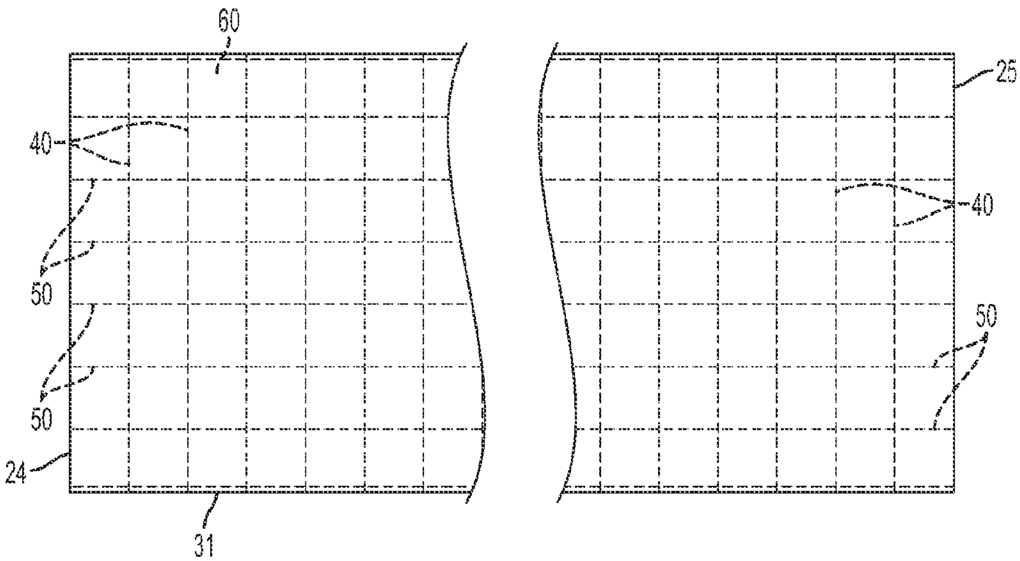

FIG. 9D

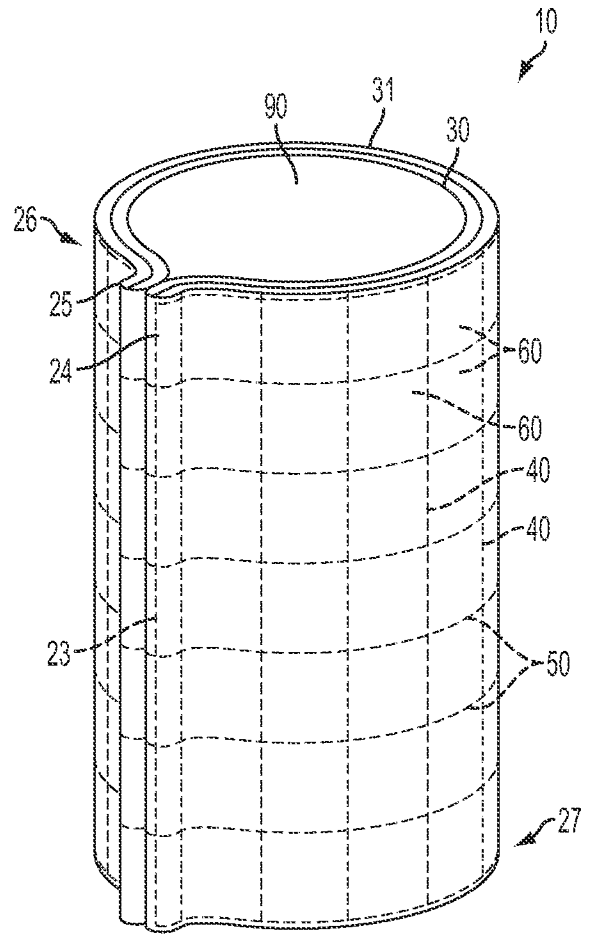

FIG. 9E

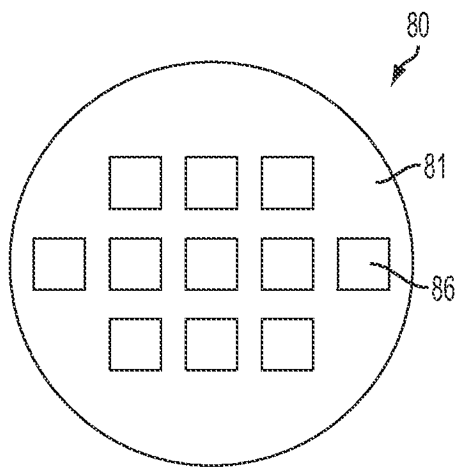

FIG. 10A

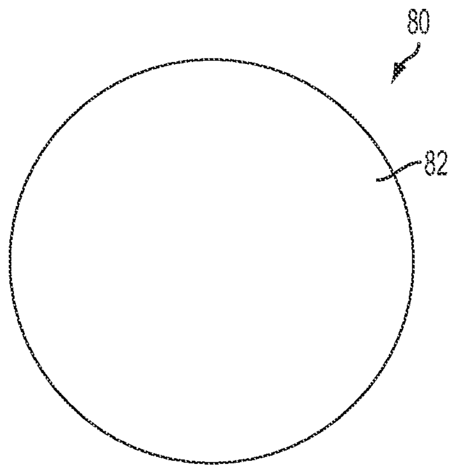

FIG. 10B

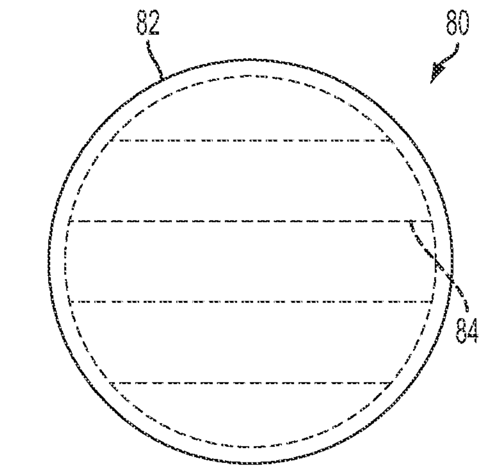

FIG. 10C

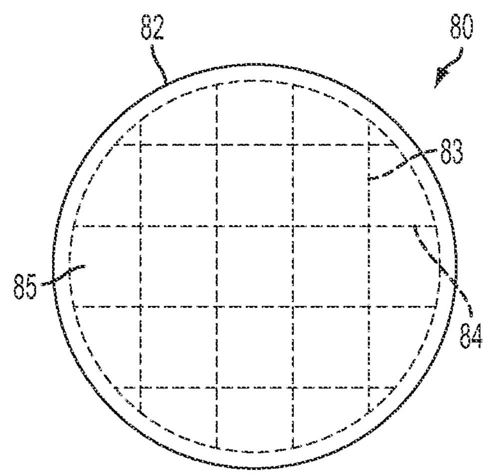

FIG. 10D

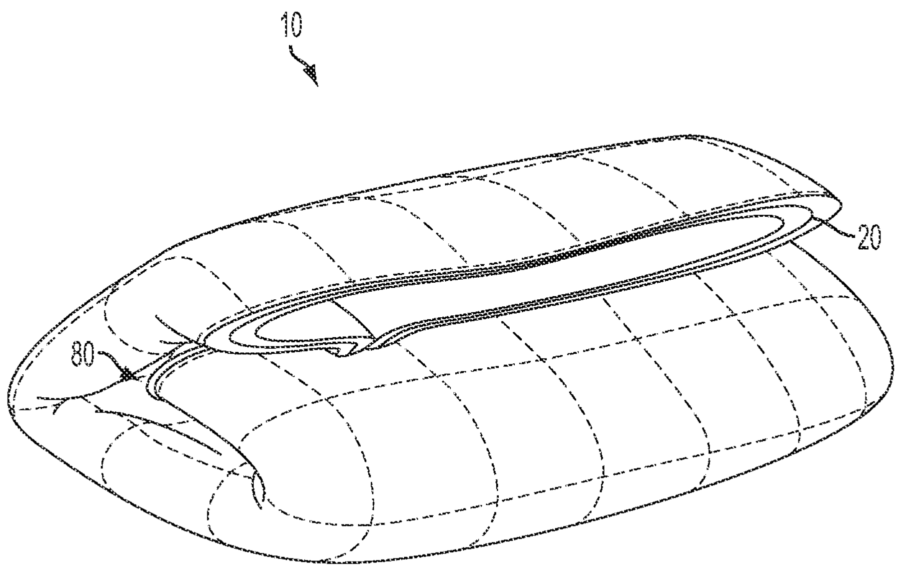

FIG. 11

FLEXIBLE FRAGMENTATION SLEEVE

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

The invention described herein was made in the performance of official duties by employees of the Department of the Navy and may be manufactured, used, licensed by or for the United States Government for any governmental purpose without payment of any royalties thereon.

BACKGROUND AND SUMMARY OF THE DISCLOSURE

The present invention relates generally to fragmentation sleeves and, more particularly, to field-installed flexible fragmentation sleeves. Illustratively, a removable fragmentation sleeve for use with a hand deployable explosive device is disclosed. The fragmentation sleeve may be used with an offensive hand grenade or concussion grenade, but is not limited thereto.

Hand deployable explosive devices may be fragmenting or non-fragmenting. Upon detonation, fragmenting explosive devices, such as fragmentation grenades, are configured to propel a plurality of fragmentation members toward a target. While non-fragmenting explosive devices, such as concussion grenades, are not configured to produce fragmentation members (e.g., flechettes, shrapnel) upon detonation, these explosive devices may produce greater shock waves than fragmenting explosive devices. An explosive device capable of producing enhanced shock waves (as with concussion grenades) selectively with fragmentation members (as with fragmentation grenades) may increase versatility in the field.

The flexible fragmentation sleeve of the present disclosure is configured to be easily stowed and quickly assembled in the field. The flexible fragmentation sleeve increases versatility in field applications. More particularly, a removable, flexible fragmentation sleeve provides the option to add fragmentation members to a non-fragmenting explosive device. As such, enhanced shock waves of the non-fragmenting explosive device may be combined with the fragmentation members of a fragmenting explosive device. Furthermore, a flexible fragmentation sleeve is lightweight, stowable, and easy to transport.

According to an illustrative embodiment of the present disclosure, a flexible fragmentation sleeve is used with a non-fragmenting explosive device. The flexible fragmentation sleeve comprises a flexible cylindrical wall extending between opposing first and second ends along a longitudinal axis. The cylindrical wall includes an inner liner and an outer liner concentric to the inner liner. A first set of coupling elements extend parallel to the longitudinal axis of the cylindrical wall, and couple the inner liner with the outer liner. A second set of coupling elements extend circumferentially along the cylindrical wall. The second set of coupling elements is substantially perpendicular to the first set of coupling elements, and couple the inner liner with the outer liner. A plurality of pockets is defined intermediate the inner liner and the outer liner, and intermediate the first set of coupling elements and the second set of coupling elements. The flexible fragmentation sleeve of the illustrative embodiment further includes a plurality of fragmentation members. At least one fragmentation member is illustratively received within each pocket.

A further illustrative embodiment includes a hand deployable flexible fragmentation sleeve for use with a non-fragmenting explosive device. The flexible fragmentation sleeve illustratively includes a flexible first liner configured to convert from a storage mode to an operating mode. The flexible first liner is folded onto itself in the storage mode, the flexible first liner defines a cylindrical wall forming a receiving chamber for an explosive device in the operating mode. The flexible fragmentation sleeve may further include a plurality of fragmentation members supported by the flexible liner.

An illustrative method of using a hand deployable flexible fragmentation sleeve with a non-fragmenting explosive device is also disclosed. The method illustratively includes the steps of providing a fragmentation sleeve in a storage mode, the sleeve including a folded flexible side wall in the storage mode, and extending the flexible side wall of the fragmentation sleeve to increase the volume of a receiving chamber, thereby defining an operating mode. The illustrative method further includes the step of slidably receiving a hand held explosive device within the receiving chamber.

An illustrative method of making a hand deployable flexible fragmentation sleeve for use with a non-fragmenting explosive device is also disclosed. The method comprises the steps of providing a first liner and supporting a plurality of fragmentation members on an inner surface of the first liner. The fragmentation members may be placed in spaced relation to each adjacent fragmentation member. The method may further include the step of placing a second liner over the first liner, wherein the inner surface of the first liner faces an inner surface of the second liner. The plurality of fragmentation members are illustratively positioned intermediate the inner surface of the first liner and the inner surface of the second liner. The method may also include the step of providing a plurality of first coupling elements to secure the first liner to the second liner. Each of the first coupling elements may be spaced apart and extend parallel to each adjacent first coupling element. The method may also include the step of providing a plurality of second coupling elements to secure the first liner to the second liner. Each of the second coupling elements may be spaced apart and extends parallel to each adjacent second coupling element. The second coupling elements may extend perpendicular to the first coupling elements, wherein a plurality of pockets may be defined by the intersecting first coupling elements and second coupling elements. Each pocket illustratively receives at least one of the fragmentation members.

Additional features and advantages of the present invention will become apparent to those skilled in the art upon consideration of the following detailed description of the illustrative embodiment exemplifying the best mode of carrying out the invention as presently perceived.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing aspects and many of the intended advantages of this invention will become more readily appreciated as the same becomes better understood by reference to the following detailed description when taken in conjunction with the accompanying drawings.

FIG. **1** is a front exploded perspective view of an illustrative flexible fragmentation sleeve and a hand deployable explosive device;

FIG. **2** is a rear exploded view of the flexible fragmentation sleeve and the hand deployable explosive device of FIG. **1**;

FIG. **3** is a perspective view of the flexible fragmentation sleeve including a partial cut-away showing fragmentation members;

FIG. **3**A is a detail view of a fragmentation member of the flexible fragmentation sleeve of FIG. **3**;

FIG. 4 is a front elevational view of the flexible fragmentation sleeve of FIG. 3;

FIG. 5 is a top plan view of the flexible fragmentation sleeve of FIG. 3;

FIG. 6 is a bottom plan view of the flexible fragmentation sleeve of FIG. 3, including a partial cut away showing fragmentation members;

FIG. 7 is a cross-sectional view of the flexible fragmentation sleeve along line 7-7 of FIG. 4;

FIG. 8 is a cross-sectional view of the flexible fragmentation sleeve along line 8-8 of FIG. 4;

FIGS. 9A-9E show illustrative assembly steps of a side wall of the flexible fragmentation sleeve;

FIGS. 10A-10D show illustrative assembly steps of a base member of the flexible fragmentation sleeve; and

FIG. 11 is a perspective view of the flexible fragmentation sleeve of FIG. 1 in a storage mode of operation.

Corresponding reference characters indicate corresponding parts throughout the several views. Although the drawings represent embodiments of various features and components according to the present disclosure, the drawings are not necessarily to scale and certain features may be exaggerated in order to better illustrate and explain the present disclosure. The exemplifications set out herein illustrate embodiments of the invention, and such exemplifications are not to be construed as limiting the scope of the invention in any manner.

DETAILED DESCRIPTION OF THE DRAWINGS

For the purposes of promoting an understanding of the principles of the invention, reference will now be made to the embodiments illustrated in the drawings, which are described below. The embodiments disclosed below are not intended to be exhaustive or limit the invention to the precise form disclosed in the following detailed description. Rather, the embodiments are chosen and described so that others skilled in the art may utilize their teachings. It will be understood that no limitation of the scope of the invention is thereby intended. The invention includes any alterations and further modifications in the illustrated devices and described methods and further applications of the principles of the invention which would normally occur to one skilled in the art to which the invention relates.

Referring initially to FIGS. **1** and **2**, an illustrative flexible fragmentation sleeve **10** and hand deployable, non-fragmenting explosive device **100** are shown. Hand deployable, or hand held, explosive device **100** may be an offensive hand grenade, often referred to as a concussion grenade. Such explosive devices may be carried in the field and are capable of being thrown or placed at a desired location by an operator without the use of a separate propellant. Hand deployable explosive devices may be used for concussion effects in enclosed areas. Additionally, hand deployable explosive devices may be used for blasting or other demolition operations.

An illustrative hand deployable, non-fragmenting explosive device is an offensive hand grenade (OHG), which may include approximately eight ounces of explosive material and weigh approximately 16 ounces. Furthermore, illustrative OHGs are often configured to be thrown up to a distance of approximately 130 feet. An illustrative OHG may have an effective radius of approximately six feet in an open area, resulting from a shock front moving at approximately 170,000 mph with an explosive loading of approximately 3,000,000 psi. An illustrative example of hand deployable explosive device **100** is the MK3A2 OHG.

Flexible fragmentation sleeve **10**, in its use or operating mode of FIGS. **1** and **2**, may slidably receive explosive device **100**. More particularly, sleeve **10** includes a cylindrical side wall **20** having an inner diameter (id) dimensioned to receive a cylindrical body **103** of explosive device **100** (FIG. **5**). An outer diameter (od) of side wall **20** is dimensioned to accommodate the detonation means of explosive device **100** (FIG. **5**). The detonation means of explosive device **100** illustratively include a safety lever **101** and a pull ring **102**. When pull ring **102** is removed and safety lever **101** is released, a fuse within explosive device **100** is ignited in order to detonate explosive material within body **103** of explosive device **100** after a predetermined time period. Illustratively, inner diameter (id) of cylindrical wall **20** is approximately the same size as an outer diameter of body **103** of explosive device **100**. As such, explosive device **100** is retained within cylindrical wall **20** by an interference fit. The height of cylindrical wall **20** may be determined by the level of explosive fill within body **103** of explosive device **100**. In other words, cylindrical wall **20** substantially covers cylindrical body **103** but does not interfere with the detonation means of explosive device **100**. Outer diameter (od) of cylindrical wall **20** slides under safety lever **101** but does not interfere with operation of explosive device **100**. In this way, the size and shape of explosive device **100** may dictate the dimensions of fragmentation sleeve **10**. The dimensions of sleeve **10** disclosed herein are tailored to an MK3A2 OHG; however, the dimensions of sleeve **10** may vary to accommodate different explosive devices.

Referring to FIGS. **1-5**, illustrative flexible fragmentation sleeve **10** may have a length l (FIG. **4**) extending axially approximately 4 inches, inner diameter (id as shown in FIG. **5**) of approximately 2 inches, and outer diameter (od as shown in FIG. **5**) of approximately 2.25 inches. Flexible fragmentation sleeve **10** illustratively includes cylindrical wall **20** extending between opposing ends of fragmentation sleeve **10**. Cylindrical wall **20** defines a longitudinal axis **21** and a circumference **22**. Circumference **22** of cylindrical wall **20** extends in a plane perpendicular to longitudinal axis **21**. Flexible fragmentation sleeve **10** illustratively includes a base member **80** that assists in retaining explosive device **100** within fragmentation sleeve **10** by preventing explosive device **100** from sliding through a lower end **27** of sleeve **10**. More particularly, cylindrical wall **20** of fragmentation sleeve **10** includes an open upper end **26** to receive explosive device **100**, and lower end **27** coupled to base member **80**. Body **103** of explosive device **100** is configured to fit tightly (i.e., interference fit) within flexible fragmentation sleeve **10**. This interference fit assists in retaining hand deployable explosive device **100** within fragmentation sleeve **10**. Additionally, fragmentation sleeve **10** and explosive device **100** may include other conventional couplers to further secure explosive device **100** within fragmentation sleeve **10**. For example, fragmentation sleeve **10** and explosive device **100** may include cooperating pins, grooves, snap rings, hook and loop fasteners, resilient fingers, a drawstring, elastic bands, adhesive, double-sided tape, or other known fasteners.

Cylindrical wall **20** illustratively includes an inner, or first, liner **30** and an outer, or second, liner **31**. Inner liner **30** includes an inner surface proximate to and facing an inner surface of outer liner **31**. Inner liner **30** and outer liner **31** are illustratively comprised of a flexible fabric material that may have at least partial elasticity. For example, the fabric material may be weather-resistant woven cloth, elasticized nylon, para-aramid nylons (e.g., Kevlar), rubber, polyurethane-polyurea copolymers (e.g., Spandex), or other polymer composites. Such fabric may be used because it is lightweight and may be folded, making it easily transportable.

Inner liner **30** and outer liner **31** are shaped, or contoured, to form cylindrical wall **20**. Side edges **24**, **25** of inner liner **30** and outer liner **31** are illustratively contoured to extend outwardly from cylindrical wall **20** and form a securing tab **28**. Side edges **24**, **25** defining securing tab **28** are coupled with at least one securing member **23**. Securing tab **28** may be formed when side edges **24**, **25** are configured in an overlapped position and extend radially outwardly from cylindrical wall **20**. Securing member **23** couples side edge **24** with side edge **25** to define securing tab **28** and assists in retaining the shape of cylindrical wall **20**. Securing member **23** is illustratively shown as a line of stitched thread. However, securing member **23** may include adhesive, staples, pins, metal wire or thread, or other conventional fasteners to secure side edges **24**, **25** of inner liner **30** and outer liner **31** of cylindrical wall **20**. Alternatively, securing tab **28** may extend inwardly from cylindrical wall **20**, such that securing tab **28** is positioned intermediate cylindrical body **103** of explosive device **100** and cylindrical wall **20**. Another alternative embodiment of sleeve **10** eliminates securing tab **28** and instead, includes a seamless cylindrical wall **20**.

With reference to FIG. **4**, flexible fragmentation sleeve **10** illustratively includes a plurality of first coupling elements **40** and a plurality of second coupling elements **50** for securing inner liner **30** with outer liner **31**. Each first coupling element **40** is illustratively spaced apart from adjacent first coupling elements **40** and extends parallel to longitudinal axis **21** of cylindrical wall **20**.

The plurality of second coupling elements **50** illustratively extend circumferentially along cylindrical wall **20** and are perpendicular to the plurality of first coupling elements **40**. First coupling elements **40** and second coupling elements **50** extend between inner liner **30** and outer liner **31** of cylindrical wall **20**. In this way, first coupling elements **40** and second coupling elements **50** are used to couple inner liner **30** with outer liner **31**. Illustratively, first coupling elements **40** and second coupling elements **50** are shown as stitching. More particularly, first coupling elements **40** and second coupling elements **50** may be comprised of a stitched thread-like material that is sufficiently durable to withstand wear during transportation and field-installation of sleeve **10**. Alternatively, first coupling elements **40** and second coupling elements **50** may include adhesives, polymeric materials, staples, pins, metal wire or thread, or other conventional fasteners.

First coupling elements **40** illustratively extend longitudinally approximately four inches between upper end **26** and lower end **27** of cylindrical wall **20**. Second coupling elements **50** illustratively extend about 6.25 inches around circumference **22** of cylindrical wall **20** between opposing side edges **24**, **25** (FIG. 9D). The present embodiment of cylindrical wall **20** includes 21 first coupling elements **40** and 10 second coupling elements **50**, however, the dimensions and number of coupling elements **40**, **50** may vary, depending on the size of explosive device **100** and the desired effect of sleeve **10**.

Referring further to FIG. **4**, first coupling elements **40** illustratively intersect with second coupling elements **50** at right angles to define a plurality of pockets **60** within cylindrical wall **20**. Each of pockets **60** is illustratively at least 0.25 inch wide and at least 0.25 inch long in order to receive at least one fragmentation member **70**. Pockets **60** may be necessary to position fragmentation members **70** on cylindrical wall **20**. Pockets **60** are illustratively shown as identical squares extending in a series of longitudinally extending, circumferentially spaced columns and circumferentially extending, longitudinally spaced rows. In one illustrative embodiment, cylindrical wall **20** is configured to include **231** pockets in 11 rows (rings) and 21 columns. However, the number of pockets and corresponding columns and rows may vary depending upon the desired application of fragmentation sleeve **10**.

Referring further to FIG. **3**, pockets **60** may receive at least one of fragmentation members **70** and as such, pockets **60** illustratively support a total of 231 fragmentation members **70** in 11 rows (rings) and 21 columns. Again, the number of fragmentation members **70** may vary depending upon the desired application of fragmentation sleeve **10**. Fragmentation members **70** may be comprised of metal, such as hardened tool steel. Alternatively, fragmentation members **70** may be comprised of a non-metal material. For example, fragmentation members **70** may be non-lethal fragmentation members, such as rubber balls, pepper balls, or marking agents. Specific applications of flexible fragmentation sleeve **10** may specify fragmentation members **70** be comprised of gels, particulate material, or polymers. Illustratively, fragmentation members **70** define identical squares (in cross-section) having a width of 0.25 inch and a length of 0.25 inch. Further, fragmentation members **70** may have a thickness between 0.0625 inch and 0.125 inch and a mass of 0.5 to 1.0 gram. Specific applications of fragmentation sleeve **10** dictate the size and, therefore, the number of fragmentation members **70** retained on cylindrical wall **20**. For example, larger fragmentation members **70** may be more effective for penetrating a target, but the larger size of fragmentation members **70** would limit the number of fragmentation members **70** that may be accommodated on cylindrical wall **20**.

Fragmentation members **70** may define a plurality of shapes, although illustratively fragmentation members **70** are square prisms, or parallelepipeds. Fragmentation members **70** having a parallelepiped configuration include flat surfaces for receiving the shock waves produced by explosive device **100**. The flat surfaces of fragmentation members **70** are effective in coupling the momentum of the shock waves to accelerate fragmentation members **70** towards a target.

Referring to FIG. **6**, base member **80** is coupled to lower end **27** of cylindrical wall **20** to define a closed cylinder. Illustratively, base member **80** has a circular configuration and lower end **27** of cylindrical wall **20** extends radially outwardly in a flat configuration to couple with the perimeter of base member **80**. The coupling of lower end **27** with base member **80** forms a base securing tab **88**. A base securing member **87** couples lower end **27** with base member **80** at base securing tab **88**. Base securing member **87** may be comprised of a woven fabric material, adhesive, polymeric materials, staples, pins, metal wire or thread, or other conventional fasteners. Illustratively, base securing member **87** is shown as a line of stitched thread.

Base member **80** includes an inner liner **81** and an outer liner **82**. Inner liner **81** and outer liner **82** may be comprised of weather-resistant woven cloth, elasticized nylon, para-aramid nylons (e.g., Kevlar), rubber, polyurethane-polyurea copolymers (e.g., Spandex), or other polymer composites.

Base member **80** may further include a plurality of first coupling elements **83** and a plurality of second coupling elements **84** for securing inner liner **81** with outer liner **82**. First coupling elements **83** extend in a first direction. Second coupling elements **84** extend in a second direction that is perpendicular to the first direction. First coupling elements **83** and second coupling elements **84** extend between inner liner **81** and outer liner **82** of base member **80**. As such, first coupling elements **83** and second coupling elements **84** may be used to couple inner liner **81** with outer liner **82**. First coupling elements **83** and second coupling elements **84** may be comprised of a thread-like material. Illustratively, first coupling elements **83** and second coupling elements **84** are formed of stitched thread like material that is sufficiently durable to withstand wear during transportation and installation of fragmentation sleeve **10**. Alternatively, first coupling elements **83** and second coupling elements **84** may be adhesive, polymeric materials, staples, pins, metal wire or thread, or other conventional fasteners.

First coupling elements **83** intersect second coupling elements **84** at right angles to define a plurality of pockets **85** supported within base member **80**. Illustratively, pockets **85** are shown as identically-sized squares (in cross-section) having a width of at least 0.25 inch and a length of at least 0.25 inch to receive at least one fragmentation member **86**. Pockets **85** illustratively support **21** fragmentation members **86**, however, as with fragmentation members **70**, the application and desired effect of sleeve **10** dictates the size and, therefore, the number of fragmentation members **86** retained on base member **80**. Fragmentation members **86** may be identical to fragmentation members **70** and formed of metal, such as hardened tool steel.

Base member **80** is used to support hand deployable explosive device **100** as it is received within fragmentation sleeve **10**. Inner surface of fragmentation sleeve **10** may define a receiving chamber **90**. Receiving chamber **90** may extend from upper end **26** of fragmentation sleeve **10** to base member **80** and receive body **103** of hand deployable explosive device **100**.

Referring to FIGS. **9**A-9E, cylindrical wall **20** of flexible fragmentation sleeve **10** may be manufactured by initially providing first liner **30** of fabric in a planar configuration to support fragmentation members **70** on the inner surface of first liner **30**. Fragmentation members **70** are in spaced relation to each adjacent fragmentation member. Second fabric liner **31** is placed in a planar configuration over first liner **30** and fragmentation members **70**. The inner surface of second liner **31** faces the inner surface of first liner **30**. As such, fragmentation members **70** are positioned intermediate the inner surface of first liner **30** and the inner surface of second liner **31**. First coupling elements **40** are provided to secure first liner **30** to second liner **31**. Each first coupling element **40** is spaced apart from adjacent first coupling elements **40**. Additionally, each first coupling element **40** extends parallel to adjacent first coupling elements **40**. Second coupling elements **50** also are provided to secure first liner **30** to second liner **31**. Each of second coupling elements **50** is spaced apart from adjacent second coupling elements **50**. Additionally, each second coupling element **50** extends parallel to adjacent second coupling elements **50** and perpendicular to first coupling elements **40**. The intersection between first coupling elements **40** and second coupling elements **50** defines the plurality of pockets **60**. As such, pockets **60** each include at least one of fragmentation members **70**.

Referring to FIGS. **10**A-**10**D, the method of manufacturing base member **80** is similar to the method described for manufacturing cylindrical wall **20**. First liner **81** is provided and may be comprised of fabric. First liner **81** may support fragmentation members **86** on the inner surface of first liner **81**. Fragmentation members **86** are in spaced relation to each adjacent fragmentation member. Second liner **82** is placed over first liner **81** and fragmentation members **86**. The inner surface of second liner **82** faces the inner surface of first liner **81**. As such, fragmentation members **86** are positioned intermediate the inner surface of first liner **81** and the inner surface of second liner **82**. First coupling elements **83** are provided to secure first liner **81** to second liner **82**. Each first coupling element **83** is spaced apart from adjacent first coupling elements **83**. Additionally, each first coupling element **83** extends parallel to adjacent first coupling elements **83**. Second coupling elements **84** also are provided to secure first liner **81** to second liner **82**. Each of second coupling elements **84** is spaced apart from adjacent second coupling elements **84**. Additionally, each second coupling element **84** extends parallel to adjacent second coupling elements **84** and perpendicular to first coupling elements **83**. The intersection between first coupling elements **83** and second coupling elements **84** defines plurality of pockets **85**. Pockets **85** include at least one of fragmentation members **86**.

Alternatively, flexible fragmentation sleeve **10** may be manufactured by forming an indefinitely long sheet including first liner **30**, fragmentation members **70**, second liner **31**, first coupling elements **40**, and second coupling elements **50**. The sheet may be cut to a desired length for flexible fragmentation sleeve **10**. Further, the desired size and shape for base member **80** also may be cut from the sheet.

The planar assembly of FIG. **9**D is illustratively formed into cylindrical wall **20**, as disclosed in FIG. **9**E. Side edges **24**, **25** of inner liner **30** and outer liner **31** are brought together and overlapped to form a contoured, or rounded, configuration defining cylindrical wall **20**. Securing member **23** illustratively couples side edge **24** with side edge **25** to form securing tab **28**.

Base member **80** is coupled to lower end **27** of cylindrical wall **20** with base securing member **87**, or alternatively, with conventional couplers. Lower end **27** is extended in a flat configuration and is positioned against the rounded perimeter of base member **80**. Overlapping lower end **27** and base member **80** are coupled with base securing member **87** to form base securing tab **88**.

Referring to FIG. **11**, in use, flexible fragmentation sleeve **10** may be combined with hand deployable, non-fragmenting explosive device **100**. Flexible fragmentation sleeve **10** may be provided in a stowed, or storage, mode of operation where cylindrical wall **20** is collapsed and/or folded onto itself. Illustratively, upper end **26** of fragmentation sleeve **10** is folded against opposing sides and lower end **27** of fragmentation sleeve **10** is folded against opposing sides, thereby giving cylindrical wall **20** a generally flat configuration. Likewise, base member **80** may be folded against opposing sides to form a generally flat configuration. The stowed mode of operation may further include folding cylindrical wall **20**, in its collapsed configuration, over and around collapsed base member **80**.

With reference to FIG. **1**, a flexible side wall of cylindrical wall **20** may be extended, or unfolded, to increase the volume of cylindrical wall **20**, thereby defining an operating, or use, mode. With cylindrical wall **20** fully extended, receiving chamber **90** is illustratively defined. Hand held explosive device **100** is slidably received within receiving chamber **90**. More particularly, body **103** of explosive device **100** is received within receiving chamber **90**, whereas, safety lever **101** and pull ring **102** are positioned outside of receiving chamber **90** and cylindrical wall **20**.

Hand deployable explosive device **100** may be detonated when received within receiving chamber **90**. Additionally, when explosive device **100** is received within receiving chamber **90**, the assembly of fragmentation sleeve **10** and explosive device **100** may be released and propelled in a direction away from the operator; or alternatively, the assembly may be placed by the operator at a desired location. Upon detonation of explosive device **100**, an explosive force propagates shock waves into the fragmentation members **70** within cylindrical wall **20** of sleeve **10**, such that cylindrical wall **20** may separate or tear between first coupling elements **40** and second coupling elements **50** as the fragmentation members **70** seek a path of least resistance as they are propelled by the shock waves. As such, fragmentation members **70** may be propelled radially outwardly in a controlled manner. Similarly, fragmentation members **86** may project axially outwardly from base member **80** after shock waves cause the fragmentation members **86** to separate base member **80** intermediate first and second coupling elements **83** and **84**. The resulting blast pattern of fragmentation members **70** and **86** from explosive device **100** may correspond to the shape of sleeve **10**. Flexible fragmentation sleeve **10** may be easy to transport, flexible, and substantially noiseless. Furthermore, because flexible fragmentation sleeve **10** may be removably coupled to hand deployable explosive device **100**, fragmentation sleeve **10** is adaptable to differing needs in the field.

While this invention has been described as having an exemplary design, the present invention may be further modified within the spirit and scope of this disclosure. This application is therefore intended to cover any variations, uses, or adaptations of the invention using its general principles. Further, this application is intended to cover such departures from the present disclosure as come within known or customary practices in the art to which this invention pertains.

What is claimed is:

1. A hand deployable flexible fragmentation sleeve for use with a non-fragmenting explosive device comprising:

a flexible first liner configured to convert from a storage mode to an operating mode, the flexible first liner being folded onto itself in the storage mode, and the flexible first liner defining a cylindrical wall forming a receiving chamber for the explosive device in the operating mode;

a plurality of fragmentation members supported by the liner;

a second flexible liner;

a first set of coupling elements coupling the first flexible liner with the second flexible liner;

a second set of coupling elements extending perpendicular to the first set of coupling elements, and coupling the first flexible liner with the second flexible liner;

a plurality of pockets defined intermediate the first flexible liner and the second flexible liner, and intermediate the first set of coupling elements and the second set of coupling elements; and

at least one fragmentation member received within each pocket.

2. The flexible fragmentation sleeve of claim **1**, wherein the fragmentation members are comprised of metal, each fragmentation member having a mass of at least 0.5 gram.

3. The flexible fragmentation sleeve of claim **2**, wherein the fragmentation members each include a plurality of side walls, the side walls each having a length of at least 0.250 inches.

4. The flexible fragmentation sleeve of claim **3**, wherein the fragmentation members each have a thickness of at least 0.0625 inches.

5. The flexible fragmentation sleeve of claim **1**, wherein the flexible liner is comprised of fabric, the fabric being resistant to weather and temperature fluctuations.

6. The flexible fragmentation sleeve of claim **1**, wherein the first set of coupling elements and the second set of coupling elements are comprised of stitches of thread.

7. The flexible fragmentation sleeve of claim **1**, wherein the operating mode defines a closed cylindrical wall having an inner diameter of at least 2 inches and a length of at least 4 inches.

8. The flexible fragmentation sleeve of claim **7**, wherein an explosive device is slidably received within the cylindrical wall.

9. A hand deployable flexible fragmentation sleeve for use with a non-fragmenting explosive device comprising:

a flexible first liner configured to convert from a storage mode to an operating mode, the flexible first liner being folded onto itself in the storage mode, and the flexible first liner defining a cylindrical wall forming a receiving chamber for the explosive device in the operating mode;

a plurality of fragmentation members supported by the liner; and

a base member, the base member being coupled to an end of the first flexible liner.

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