

[54] CONTROLLED FRAGMENTATION
EXPLOSIVE DEVICE

1,257,604 2/1961 France..... 102/67

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[57] ABSTRACT

A method and apparatus for controlling the fragmentation of explosive devices of the type including a cylindrical metallic fragmentation casing having a longitudinal axis and an explosive charge therein. The present invention teaches applying to the inner or outer surface of the casing a longitudinal array of metallic strips, so that the strips conform to the contour of the cylindrical casing, the longitudinal axis of the array being substantially parallel to that of the casing. The density of the metal from which the strips are formed is greater than that of the metal from which the casing is formed. The arrays may be in the form of rectangles, diamonds, or parallel bars.

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[58] Field of Search 102/64, 67

[56] References Cited

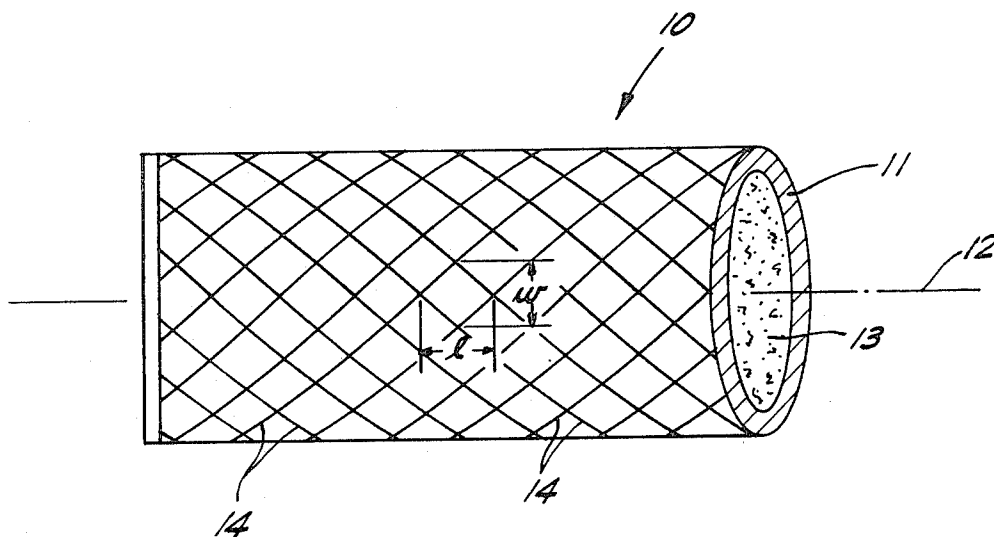
UNITED STATES PATENTS

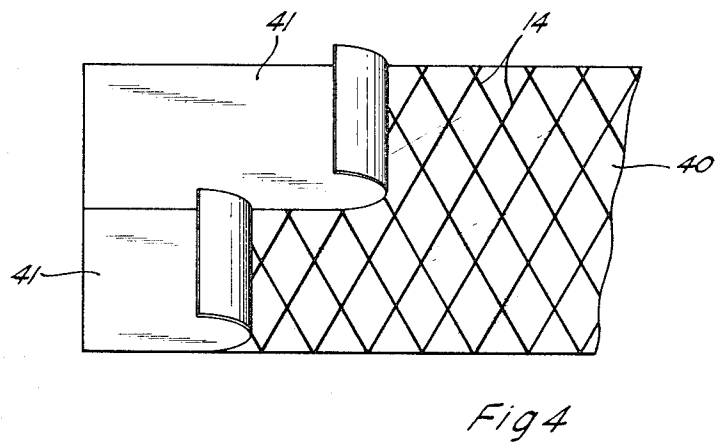
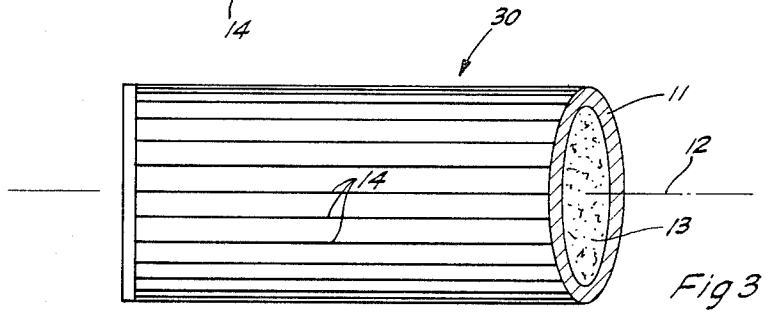
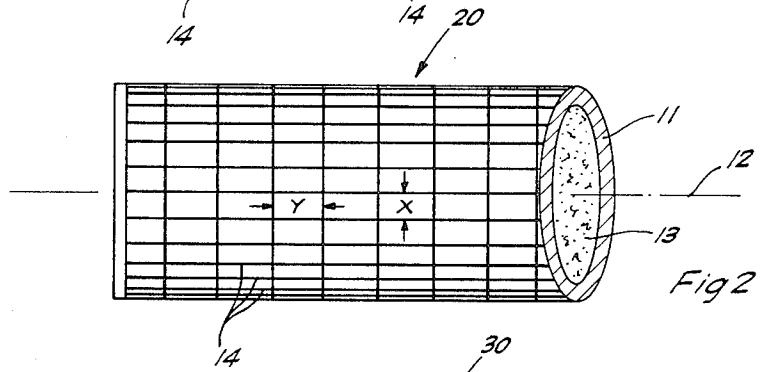
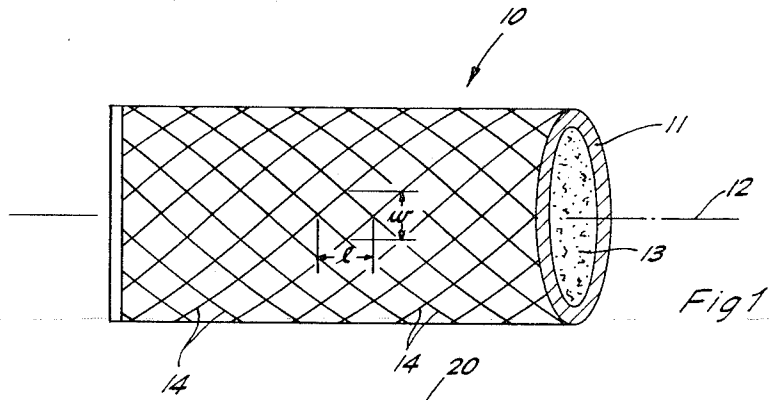
1,276,434 8/1918 Steinmetz 102/64
3,298,308 1/1967 Throner, Jr. 102/67

FOREIGN PATENTS OR APPLICATIONS

1,191,585 2/1958 France 102/67

18 Claims, 4 Drawing Figures





CONTROLLED FRAGMENTATION EXPLOSIVE DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to controlled fragmentation explosive devices and, more particularly, to a method and means for applying controlled fragmentation to conventional explosive devices.

2. Description of the Prior Art

The general field of the present invention is explosively loaded weapons generally designed to cause damage to, or to destroy, equipment, materiel, and/or personnel. Devices of this type generally consist of a cylindrically shaped metallic casing containing an explosive composition. Upon detonation of the explosive composition, the metallic casing ruptures producing fragments of high velocity and high kinetic energy, which fragments cause damage and inflict casualties in the vicinity of the detonation.

In the absence of some method or means for controlling the sizes and shapes of the fragments produced, it has been found that the detonation of ordinary cylindrical casings will produce a random distribution of fragments, both large and small. It is apparent from kinetic energy considerations that small fragments of low mass do not possess the same energy as larger fragments traveling at the same velocity. On the other hand, large fragments present larger surface areas to the atmosphere, causing increased drag and a decrease in velocity, with a resultant lower kinetic energy. For this reason, much attention has been given to methods of producing fragments of controlled size and weight, so that area and energy distributions can be optimized.

Prior methods of achieving fragmentation control of ordnance articles have involved the casting, forging, engraving, embossing, or otherwise machining of notches or grooves in the inner or outer surface of the casing. On detonation, stress waves are reflected from these angular surfaces and, under proper geometrical conditions, may enhance each other so that externally high stress levels are reached, producing controlled fractures.

The notches or grooves may be located on either the external or internal surfaces of the explosive device and may be circumferential, longitudinal, or both. Alternatively, the explosive charge itself may be scored instead of the metallic surfaces. Furthermore, plastic liners with embossed angular surfaces have also been used between the explosive charge and the metallic casing. Finally, it has been proposed to use preformed fragments bonded together by various matrix materials, such as resin or adhesives, to form the casing.

The above methods and apparatus are not completely satisfactory for several reasons. In the first instance, many of the machining methods for forming grooves in the casing are difficult and relatively expensive. In addition, the grooved casings often make the structures unable to withstand the high stresses of acceleration caused by firing of the projectile. Furthermore, none of the methods outlined above can be applied to stockpiled live munitions that have explosive contents. In other words, there presently are stockpiles of explosive devices which were manufactured prior to the establishment of controlled fragmentation requirements. Heretofore, in order to apply the above controlled fragmentation methods to the stockpiled de-

vices, it has been necessary to completely disarm them by removal of the explosive charges.

SUMMARY OF THE INVENTION

According to the present invention, these problems of the prior art are solved by providing a novel controlled fragmentation explosive device. With the present invention, a controlled fragmentation explosive device may be manufactured without the difficult and expensive machining operations discussed previously. In addition, the present explosive device does not interfere in any way with the structure of the metallic casing thereby permitting the casing to retain its strength in the presence of high stress levels. Finally, the present method and apparatus may be readily applied to stockpiled explosive devices to control the fragmentation thereof, without disarming or removing the explosive charges therefrom.

It is therefore an object of the present invention to provide a controlled fragmentation explosive device.

It is a further object of the present invention to provide a method and means for controlling fragmentation in an explosive device which eliminates the necessity for notches or grooves machined into the device's liner or body.

It is a still further object of the present invention to provide a controlled fragmentation explosive device which does not affect the strength of the metallic casing.

It is another object of the present invention to provide a method for controlling the fragmentation of existing explosive devices possessing no provision for fragment control.

It is still another object of the present invention to provide explosive devices having improved characteristics of predictable and controlled fragmentation upon explosion or other impulse loading.

Still other objects, features, and attendant advantages of the present invention will become apparent to those skilled in the art from a reading of the following detailed description of the preferred embodiments constructed in accordance therewith, taken in conjunction with the accompanying drawings wherein like numerals designate like parts in the several figures and wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1, 2, and 3 are plan views of first, second, and third embodiments, respectively, of controlled fragmentation explosive devices constructed according to the teachings of the present invention; and

FIG. 4 is a plan view of a portion of a sheet of material showing a method of applying the present invention to metallic casings.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings and, more particularly, to FIGS. 1-3 thereof, there is shown portions of controlled fragmentation explosive devices, generally designated 10, 20, and 30, respectively. Each of explosive devices 10, 20, and 30 includes a generally cylindrical, metallic fragmentation casing 11 having a longitudinal axis 12 and an explosive charge 13. Casing 11 and charge 13 are the same as in conventional explosive devices, except that the inner and outer surfaces of casing 11 are entirely smooth.

Applied to the outer surface of casing 11 is an array of flexible metallic strips 14. Strips 14 may be in the form of wire or rods having a circular or other cross-section, or they may be in the form of flat ribbons so as to permit strips 14 to conform to the contour of casing 11. In any event, it is necessary that the density of the metal from which strips 14 are formed be greater than that of the metal from which casing 11 is formed. If the density of the metal of strips 14 is equal to or less than that of casing 11, controlled fragmentation will not result. For example, if casing 11 is made from steel, having a density of 0.28 lb./in.³, it is possible to use any metal for strips 14 which has a density greater than that value. Therefore, it is possible to use lead for strips 14 since lead has a density of 0.41 lb./in.³. Excellent results have been achieved with a steel casing and with strips 14 made of tungsten which has a density of 0.7 lb./in.³.

Strips 14 may be applied to casing 11 with any suitable adhesive. For example, strips 14 may be applied with glue or an epoxy compound. On the other hand, strips 14 would not be welded to casing 11. In other words, although strips 14 are adhered to casing 11, the bond strength between casing 11 and strips 14 is relatively low so that they act as independent structures.

As shown in FIG. 4, strips 14 may be adhered to the front side of a sheet of pressure-sensitive paper, plastic, or cloth 40, the back side of sheet 40 having an adhesive thereon. Lengths of removable paper 41 may be positioned in a conventional manner in contact with the back side of sheet 40 to prevent the unintentional adherence thereof. However, when it is desired to attach sheet 40 and strips 14 to the outside of a casing, paper 41 may be removed to permit ready adherence and sheet 40 may be readily wrapped around casing 11.

Strips 14 are applied to the outer surface of casing 11 in an array having the desired geometrical shape. For example, in the embodiment of FIG. 1, strips 14 are applied in a diamond-shaped array. In the embodiment of FIG. 2, a first set of metallic strips 14 is applied to the outer surface of casing 11, parallel to axis 12, and a second set of metallic strips 14 is applied to the outer surface of casing 11, perpendicular to the first set of strips, thus forming a rectangular array. Finally, in the embodiment of FIG. 3, metallic strips 14 are applied to the surface of casing 11 parallel to longitudinal axis 12.

It will be obvious to those skilled in the art that considerable latitude exists in the dimensions of the arrays shown in FIGS. 1-3 and that the geometrical configurations are not limited to the designs shown. On the other hand, it is known that when a cylindrical casing is detonated, there is a tendency for the casing to form longitudinal fragments. This being the case, the pattern of strips 14 is preferably adjusted to enhance this natural fragmentation pattern. For this reason, and in the case of explosive device 10, the length "l" of the individual diamonds is greater than the width "w" thereof. In the case of explosive device 20, the spacing "x" between the longitudinal metallic strips 14 is less than the spacing "y" between the lateral strips. Other geometrical shapes and dimensions will be apparent to those skilled in the art.

The configuration of the array of metallic strips 14 will obviously affect the shape of the fragments. The shape of many of the fragments caused by explosive device 10 will be generally diamond-shaped, having a

length "l" and a width "w." The shape of many of the fragments in the case of explosive device 20 will be rectangular, having a width "x" and a length "y" or an integral multiple of "y." Finally, the shape of the fragments in the case of explosive device 30 will be elongated strips.

Explosive devices 10, 20, and 30 may be originally constructed with strips 14 thereon having any of the configurations shown in FIGS. 1-3. On the other hand, the present invention is ideally suited for application to stockpiled explosive devices which were manufactured prior to the establishment of controlled fragmentation requirements. More specifically, since metal strips 14 are simply applied to the outer surface of an explosive device with any suitable adhesive, such strips may be readily applied to existing projectiles without disarming or removing the explosive charges therefrom.

In the embodiments of FIGS. 1-3, strips 14 have been applied to the outer surface of case 11 since this is the preferred embodiment and this is the only manner in which strips can be applied to existing explosive devices without disarming them. However, in new explosive devices, strips 14 may be applied to the inner surface of casing 11.

It can therefore be seen that in accordance with the present invention, there is provided a method and apparatus for use in controlled fragmentation explosive devices which eliminates the difficult and expensive machine operations used previously. In addition, metallic strips 14 do not interfere in any way with the structure of metallic casing 11 thereby permitting casing 11 to retain its strength in the presence of high stress levels. Finally, the present method and apparatus may be readily applied to stockpiled explosive devices to control the fragmentation thereof without disarming or removing the explosive charges therefrom.

While the invention has been described with respect to the preferred physical embodiments constructed in accordance therewith, it will be apparent to those skilled in the art that various modifications and improvements may be made without departing from the scope and the spirit of the invention. Accordingly, it is to be understood that the invention is not to be limited by the specific illustrative embodiments, but only by the scope of the appended claims.

I claim:

1. A controlled fragmentation explosive device comprising:

a cylindrical metallic fragmentation casing having a longitudinal axis; and

means applied to the inner or outer surface of said casing for causing fractures in said casing along predetermined lines upon detonation of said explosive device thereby forming controlled fragments from said casing defined by said lines, said means comprising:

an array of metallic strips positioned along said predetermined lines so as to conform to the contour of said cylindrical casing, the density of the metal from which said strips are formed being greater than that of the metal from which said casing is formed, said fractures being formed as a result of the interference between said casing and said metallic strips.

2. A controlled fragmentation explosive device according to claim 1 wherein said array of metallic strips

has a longitudinal axis which is substantially parallel to said longitudinal axis of said casing.

3. A controlled fragmentation explosive device according to claim 1 wherein said array forms a series of rectangles, the longer sides of said rectangles being parallel to said longitudinal axis of said casing.

4. A controlled fragmentation explosive device according to claim 1 wherein said metallic strips are applied to said casing in an overlapping pattern to form an elongated, diamond-shaped array, the longitudinal axis of said array being parallel to said longitudinal axis of said casing.

5. A controlled fragmentation explosive device according to claim 1 wherein said metallic strips are applied to said casing parallel to the longitudinal axis thereof.

6. A controlled fragmentation explosive device according to claim 1 wherein a first set of metallic strips is applied to said casing parallel to said longitudinal axis thereof, and wherein a second set of metallic strips is applied to said casing perpendicular to said first set of strips, the spacing between said second set of strips being greater than the spacing between said first set of strips.

7. A controlled fragmentation explosive device according to claim 1 wherein said metallic strips are applied to the outer surface of said casing with an adhesive.

8. A controlled fragmentation explosive device according to claim 1 wherein said metallic strips are in the form of thin rods or wires.

9. A controlled fragmentation explosive device according to claim 1 wherein said metallic strips are in the form of flat ribbons or a metallic network in the form of a preconfigured sheet, or mesh, fashioned from flat sheet metal.

10. A controlled fragmentation explosive device according to claim 1 wherein said casing is made of steel and said metallic strips are made of lead.

11. A controlled fragmentation explosive device according to claim 1 wherein said casing is made of steel and said strips are made of tungsten.

12. A method of controlling the fragmentation of an explosive device, including a cylindrical metallic fragmentation casing having a longitudinal axis and an explosive charge therein, comprising the step of:

applying to the outer surface of said casing an array of flexible metallic strips so that the strips conform to the contour of said cylindrical casing, the density of the metal from which said strips are formed being greater than that of the metal from which said casing is formed, said array of strips causing fractures in said casing along lines defined by said strips upon detonation of said explosive device thereby forming controlled fragments from said casing defined by said strips.

13. A method according to claim 12 wherein said strips are applied to the outer surface of said casing in a rectangular pattern.

14. A method according to claim 12 wherein said strips are applied to said casing in an overlapping pattern to form an elongated, diamond-shaped array.

15. A method according to claim 12 wherein said metallic strips are applied to said casing parallel to the longitudinal axis thereof.

16. A method according to claim 12 wherein said metallic strips are applied to said casing with an adhesive.

17. A controlled fragmentation explosive device according to claim 1 wherein said metallic strips are flexible to permit said array to conform to the contour of said cylindrical casing.

18. A controlled fragmentation explosive device according to claim 1 wherein said metallic strips are in the form of flat, thin, flexible ribbons having a thickness which is substantially less than the wall thickness of said cylindrical casing.

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