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Cammarata et al.

[11] **3,797,391**

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[54] **MULTIPLE CHARGE INCENDIARY BOMBLET**

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[21] Appl. No.: **308,223**

[52] **U.S. Cl.** ..... **102/4,** 102/6, 102/7.2, 102/24 HC, 102/66

[51] **Int. Cl.** **F42b 25/16**

[58] **Field of Search** ..... 102/24 HC, 56, 4, 7.2, 102/2, 6, 65, 66, 90

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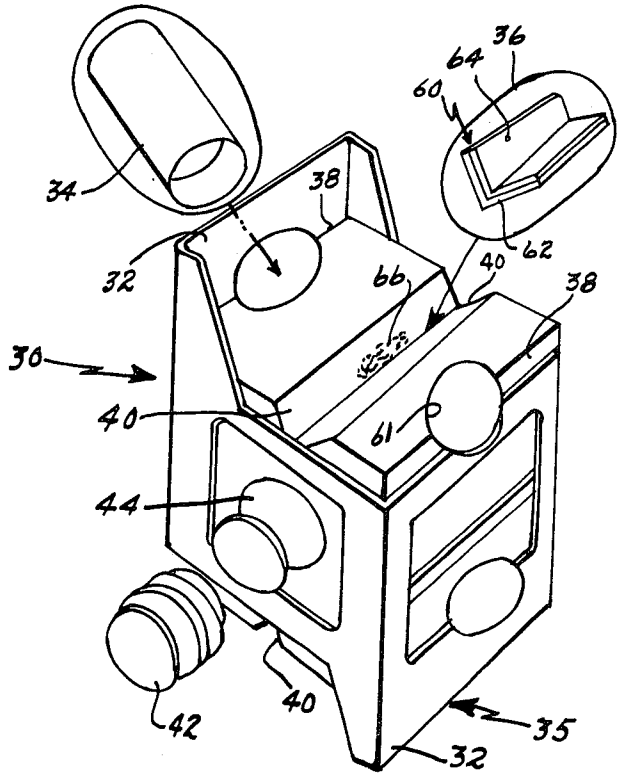
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Primary Examiner—Samuel W. Engle

[57] **ABSTRACT**

A multiple charge incendiary bomblet having a plurality of shaped charges therein. These charges are composed of a bimetallic lining of conical and linear configuration. Each of the charges have the capability of penetrating hard structures and propelling incendiary particles through the perforations made in the target by the shaped charge jet.

3 Claims, 4 Drawing Figures



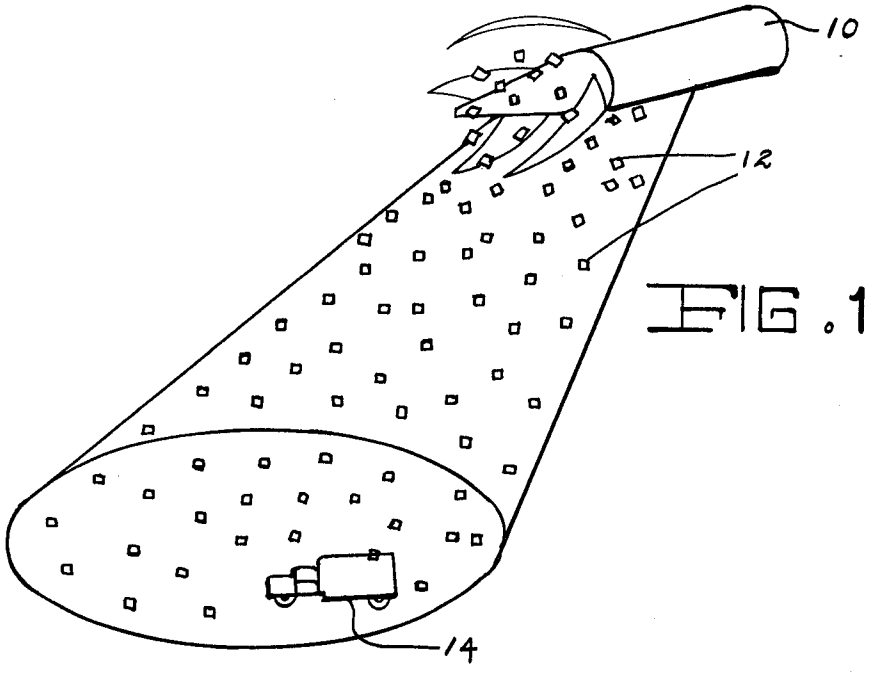


FIG. 1

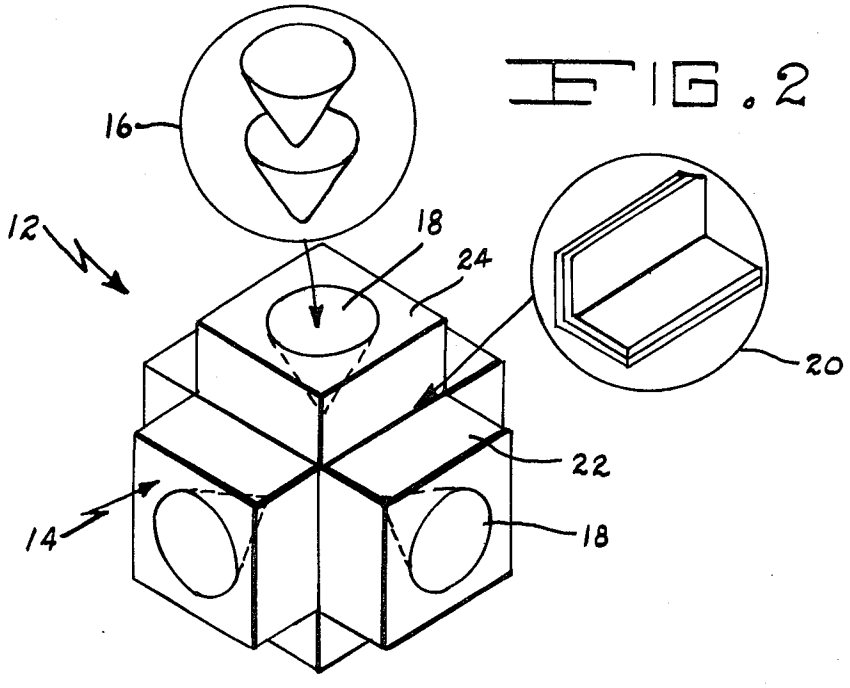


FIG. 2

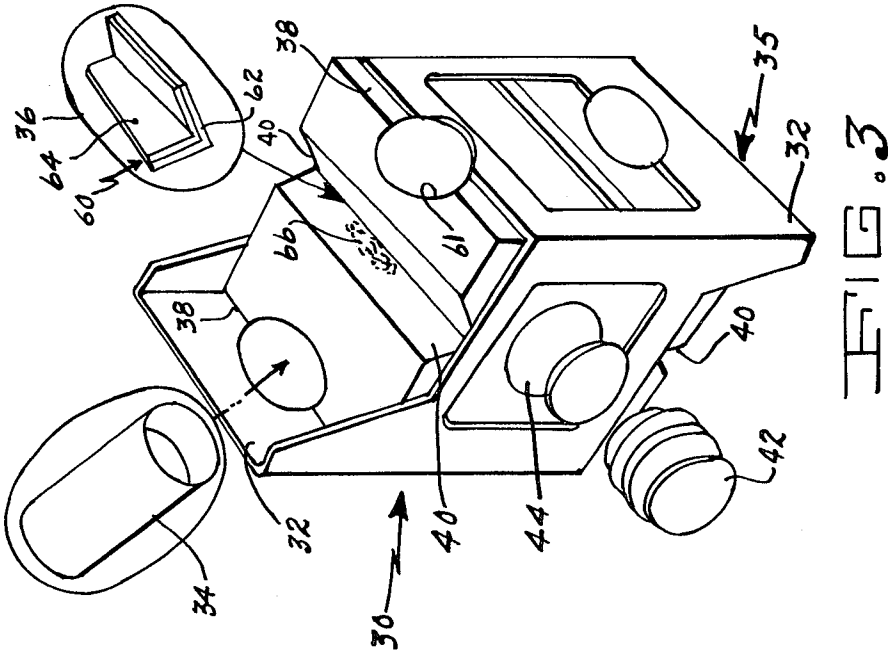


FIG. 3

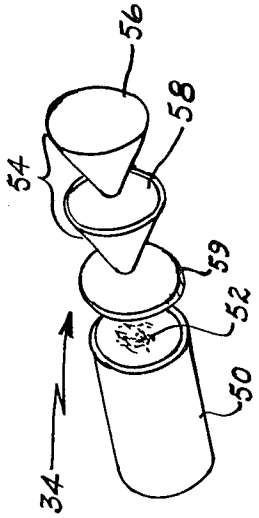


FIG. 4

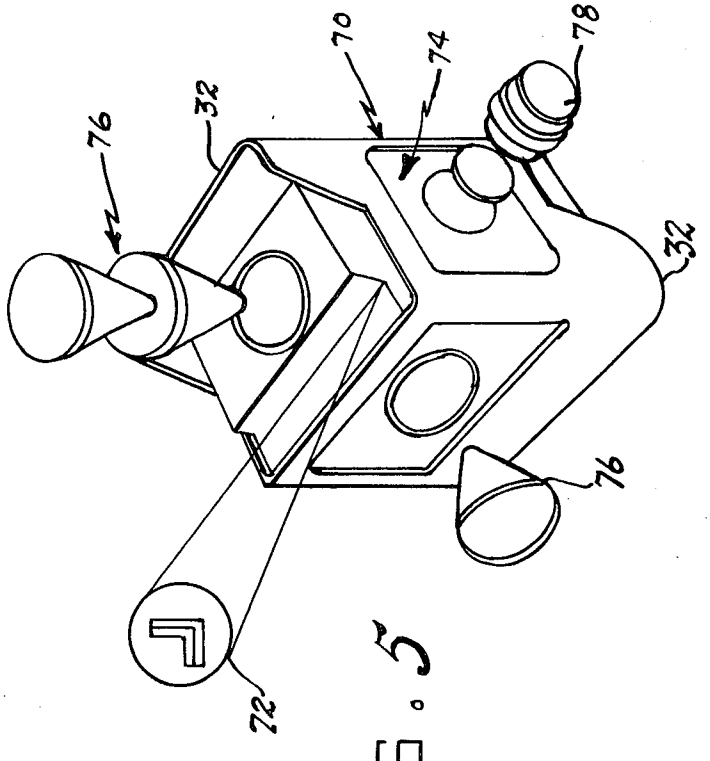


FIG. 5

MULTIPLE CHARGE INCENDIARY BOMBLET

BACKGROUND OF THE INVENTION

This invention relates generally to bombs, and, more particularly to an armor piercing bomblet containing therein a plurality of shaped charges.

It becomes necessary in many instances to destroy or disarm armored targets such as ships, tanks, trucks or the like. These targets are capable of withstanding the explosive force of most conventional weapons. There are two basic elements which must be considered in defeating such an armored target. First, it is necessary for the housing of the bomb to be of sufficient strength to pierce the protective shield of the target, and second, the explosive action of the bomb must be capable of destroying the components located behind the shield after such perforation. Merely punching a hole in the armor does not constitute a defeat or a disablement of such an armored vehicle.

Heretofore, a charge jet was effective in penetrating thick armor plate but did not reliably ensure immobilization of a vehicle or incapacitation to its personnel or components. It was necessary to inject a secondary material such as an incendiary agent through a breeched target in order to increase lethality of a standard shaped charge. This problem of introducing an active substance through a perforated hole to interact physically and chemically with the internal component materials of a target has been in existence since the evolution of shaped charge devices. Heretofore, the defeat of a target using a conventional shaped charge device relied upon the penetrating action of the shaped charge having sufficient residual penetration so that the remaining jet energy and spalled fragments impacted with the internal components. In many cases, however, this remaining energy was insufficient to severely damage the armored target. The terminal performance of these type of munitions heretofore in existence were dependent upon certain fixed parameters such as the standoff distance and the unidirectionality of the single jet. These fixed parameters however were self-defeating to the extent that a random hit on a target by a munition encountered varying obliquities of armor. Furthermore, these weapons were usually deployed by parachutes and were unsatisfactory in this respect since it could be easily visually detected thereby allowing a highly mobile vehicle to avoid a hit. Also stabilizing mechanisms such as parachutes require additional warhead storage volume and limits the packaging arrangement within a clustered warhead.

SUMMARY OF THE INVENTION

This invention sets forth a multiple charge incendiary bomblet which is capable of penetrating hard structures and propelling incendiary particles through the perforations made by the shaped charges thereby overcoming the problems encountered by prior armor piercing devices set forth hereinabove.

The bomblet of the instant invention utilizes a plurality of conical and linear shaped charges packaged in a cubical body of known physical, aerodynamic and ballistic characteristics. A large number of these bomblets are ejected from a clustered warhead at some predetermined altitude and over a specified target. Upon release from the warhead the bomblets spin-up and glide. They are spin-armed and impact functioned. The mechanism of target destruction is generated from the combined effects of the residual penetrating jets and the incendiary materials which follows through into the perforated target.

The cubic body making up the bomblet of this invention has a plurality of cavities therein and inserted within each cavity is the shaped charges. These charges may be in the form of conical lined cavity charges or linear lined cavity charges. The shaped charges are surrounded by an explosive package. A fuze is positioned centrally within the body in order to initiate this package.

The conical shaped charge of this invention is made up of a composite or bimetallic conical liner, a defining body, a high explosive, and wave shaper. The bimetallic liner is in the form of a double cone, one of copper and the other of an incendiary metal. The incendiary cone is sandwiched between the explosive charge and the copper cone. A wave shaper is located within the explosive mass to shape the explosive wave in order to obtain an essentially planar detonation front for controlled collapse of the cone. The linear charge assembly of the instant invention is made of bimetallic liners, with a cross section preferably V shaped. The incendiary liner is similarly sandwiched between the copper liner and the explosive charge.

The cubical configuration of the bomblet body permits a high efficiency factor so that a number of bomblets can be carried in a fixed warhead volume. Each bomblet body is also equipped with a pair of aerodynamic driving vanes or fins which are extended from the body in order to cause rotation of the bomblet during release thereof. This rotation imparts a lift to the bomblet causing it to glide at some predictable angle as well as to arm the bomblet fuze.

It is therefore an object of this invention to provide a multiple charge incendiary bomblet which is multifunctional in that it is effective against a wide array of soft and hard targets.

It is another object of this invention to provide a multiple charge incendiary bomblet which is composed of a plurality of bimetallic liner shaped charges.

It is a further object of this invention to provide a multiple charge incendiary bomblet which is capable of penetrating extemely hard structures and of propelling incendiary particles through the perforations made by the shaped charges.

It is another object of this invention to provide a multiple charge incendiary bomblet which redues the need to preorientate the bomblet prior to impact.

It is still another object of this invention to provide a multiple charge incendiary bomblet which is economical to produce and which utilizes conventional, currently available components that lend themselves to standard mass producing manufacturing techniques.

For a better understanding of the present invention together with other and further objects thereof, reference is made to the following description taken in connection with the accompanying drawing and its scope will be pointed out in the appended claims.

DESCRIPTION OF THE DRAWING

FIG. 1 is a pictorial view of a warhead releasing the multiple charge incendiary bomblet of this invention on a hard target;

FIG. 2 is an exploded pictorial view of one embodiment of the multiple charge incendiary bomblet of this invention;

FIG. 3 is an exploded pictorial view of an alternate embodiment of the multiple charge incendiary bomblet of this invention;

FIG. 4 is an exploded pictorial view of the conical shaped charge utilized with the multiple charge incendiary bomblet of this invention;

FIG. 5 is an exploded pictorial view of another embodiment of the multiple charge incendiary bomblet of this invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Reference is now made to FIG. 1 of the drawing which discloses in pictorial fashion a conventional warhead **10** releasing a large number of the multiple charge incendiary bomblets **12** of this invention at a predetermined time and altitude on a conventional hard target **14** such as an armored vehicle. Upon release, bomblets **12** spin to arm and upon impact or at some other predetermined time release the shaped charge assemblies within bomblet **12** upon target **14.**

The basic design of the bomblet **12** of the instant invention is shown in exploded fashion in FIG. **2** of the drawing. The bomblet **12** is preferably made up of a high packing density cubic body **14** composed of any suitable pyrophoric metal such as aluminum, magnesium, zirconium, or misch metal. The basic design as shown in FIG. **2** includes six face centered conical shaped charges **16** inserted within conical openings **18** in body **14** and twelve linear shaped charges **20** inserted within the edges **22** of body **14.** The makeup of charges **16** and **20** will be more fully explained with respect to FIG. **4.** It should also be noted that although a specific number of charges and locations are set forth with respect to bomblet **12** of FIG. **2,** this number and location can be varied in a variety of manners as shown in the following Figures. It is seen from FIG. **2** that each of the conical shaped charges **16** is centered within a face **24** of body **14** while the indentation along the edges **22** of body **14** have a configuration which permits accomodation of the linear shaped charges **20.** The explosive utilized within bomblet **14** is contained within body **14** and is conventionally actuated in a manner not shown in this Figure.

Reference is now made to FIG. **3** of the drawing which best shows a modified bomblet **30** of this invention which utilizes a cubic body **35** similar to that of FIG. **2** having a plurality of fins **32** thereon. Fins **32** cause rotation of bomblet **30** after release from warhead **10.** This rotation imparts a lift to bomblet **30** causing it to glide at some predictable angle from the vertical after a brief period of descent. This rotation is also employed to arm the bomblet **30.** Within bomblet **30** are four conical lined cavity charges **34** and four linear lined cavity charges **36.** The conical charges **34** are located radially 90° apart with each longitudinal axis of a cavity charge **34** positioned 45° to an edge **38** formed by two perpendicular planes of the cubic body **35.** Each linear charge **36** is positioned centrally within an indentation **40** along one of four principal surface planes of the cubic body **35.** A fuze **42** is positioned centrally in well **44** so as to initiate the explosive package in any conventional manner. Continuity of detonation of the explosive train is maintained by intimate contact between the explosive masses. The body **35** of bomblet **30** is again constructed of any suitable incendiary metal such as magnesium, aluminum, zirconium or misch metal, so that upon initiation of the bomblet **30** the body mass will provide additional incendiary fragmentary "matches."

A typical conical shaped charge **34** which is utilized with the instant invention is best shown in FIG. **4** of the drawing. This charge **34** is made up of a confinement body **50** of any suitable configuration but preferably in the shape of a tube or cylinder. Within the confining body **50** is located a high exposive **52** and a composite or bi-metallic conical liner **54.** The bi-metallic liner **54** is in the form of a double cone, one cone **56** made of copper and the other cone **58** made of any suitable incendiary metal. The incendiary cone **58** is sandwiched between the explosive charge **52** and the copper cone **56.** A normal shaped charge jet arises from the symmetrical collapse of the homogeneous conical liner **54.**

The composite liner components **56** and **58** are designed on the following principles:

1. The incendiary component is axisymmetrical, i.e., in the form of a coaxial cone;
2. The incendiary component is in the form of a homogeneous sleeve;
3. Intimate contact between the surfaces of the copper and incendiary liners is required; and
4. The shock properties of the added incendiary material govern the relative thickness and distribution of the mass in the composite copper-incendiary liner. The ideal situation is to have an incendiary material that has the same shock velocity and density at that of copper. Since this is unlikely, the concept of impedance matching is used.

a. The shock impedance Z of a material at a given pressure, P, is

$$Z=DC \tag{1}$$

where D is the material density and C is the shock velocity at pressure P. The shock impedance of the incendiary Zi is related to the shock impedance of the explosive detonation products (Zo) and the shock impedance of the cone (Zc) by the relationship

$$Zi)^2 = Zo\ Zc \tag{2}$$

An efficient impedance match exists for coupling the explosive energy to the jet forming part of the cone by expression (2).

b. The remaining parameter is the thickness of the incendiary liner component. The thickness of a standard copper liner before the incendiary material is added coaxially is between 2 percent to 3 percent of the cone diameter. This is used as a standard reference thickness. The jet forming portion of a standard copper liner, of thickness tc, is approximately 0.2 tc. Based on equal replacement mass, the remaining incendiary portion should be

$$ti = (0.8\ tc)\ Pc/Pi \tag{3}$$

where *Pc* is the density of copper, *Pi* is the density of the incendiary component and ti is the thickness of the incendiary liner.

A wave shaper **59** is located within the explosive mass **52** to shape the explosive wave in order to obtain an essentially planar detonation front for controlled collapse of the cone **54.** Wave shaper **59** being only necessary for situations where the explosive length behind the conical apex is relatively short. The explosive charge is made from any suitable high order explosive such as cast Octol. Conical charges **34** can be indented variably within the body in the hole well **61** provided (FIG. **3**). The edge of the cubic body to the base of the cone **54** would therefore provide a built-in standoff distance to increase optimum performance.

The linear charge **36** is best shown in FIG. **3** and is also made of a bimetallic liner **60** with the cross-section preferably V shaped. Similar to the conical shaped charge **34** the linear charge **36** has a liner **62** of incendiary material sandwiched between copper liner **64** and explosive charge **66.** The length of charge **36** extends across a principal face of the cubic body **35** and thereby comprises a cutting charge with a follow through capability. The linear charge **36** can be indented from the surface to affect a standoff distance. As described the standoff distance can be made to vary by controlling the amount of setback.

Reference is now made to FIG. **5** of the drawing which shows a variation of the basic bomblet design in which the bomblet **70** contains a plurality of linear charges **72** located at the edges of the cubic body **74** and the conical charges **76** are located in the center of a principal plane. Again in a manner described with respect to FIG. **3** bomblet **70** is detonated from a centralized explosive charge by fuze **78.** Fuze **78** is centrifugally armed and impact functioning thereby initiating the main explosive charge (not shown) located behind the shaped cavities.

As shown in FIG. **1** of the drawing upon release of bomblets **12, 30** or **70** of this invention the multiple jet capability of the bomblets made them a multifunctional device that is effective against a wide variety of targets. The multiple jet capability enhances the bomblets versatility and as an example a miss of the target would not necessarily render the bomblet of this invention ineffective since the radial coverage by the additional charges would be effective in a secondary role especially against easily penetrable targets such as ammunition and personnel. Furthermore, the cutting jet derived from the linear shaped charges would be more effective against targets such as thin metal containers. A focused jet derived from the conical shaped charge would have a high penetrating characteristic and would therefore be effective against thicker armor.

Although this invention has been described with reference to particular embodiments it will be understood to those skilled in the art that this invention should not be limited by size, shape, or arrangement within the spirit and scope of the appended claims:

We claim:

1. A multiple charge incendiary bomblet comprising a body made of a pyrophoric material, said body being of cubic configuration, and having at least one fin mounted thereon, a plurality of openings and indentations located within said body shaped charges of conical configuration being situated within said openings, shaped charges of linear V-shaped configuration being situated within said indentations, each of said shaped charges being formed of an incendiary liner sandwiched between an explosive and a copper liner, and an explosive charge within said body whereby upon detonation of said explosive charge within said body, said shaped charges are released causing penetration and subsequent explosion within a target.

2. A multiple charge incendiary bomblet as defined in claim **1** wherein said conical shaped charges further comprise a con-finement body and a wave shaper within said confinement body, and said bimetallic liner is in the form of a double cone, one of said cones being made of copper and the other of said cones being made of an incendiary material.

3. A multiple charge incendiary bomblet as defined in claim **2** wherein said openings are located 90° apart with each longitudinal axis of said conical charges positioned 45° to an edge formed by two perpendicular planes of said body.

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