

Aug. 2, 1966

G. C. THRONER, JR
FRAGMENTATION TYPE WEAPON

3,263,612

Filed July 22, 1963

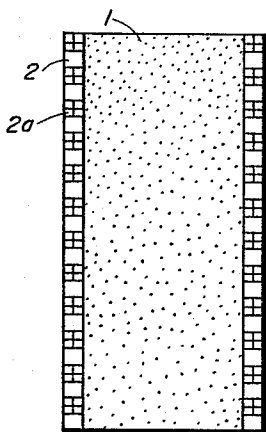


Fig. 1

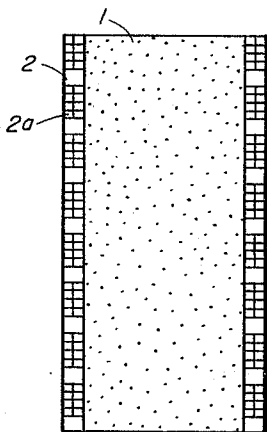


Fig. 2

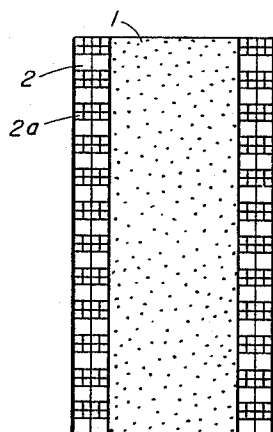


Fig. 3

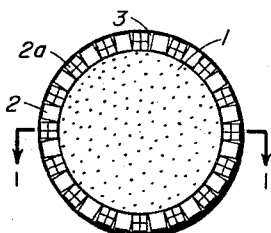


Fig. 1-A

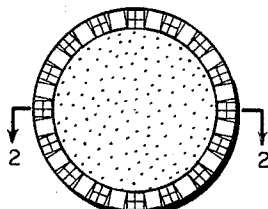


Fig. 2-A

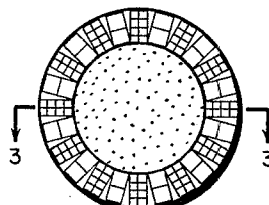


Fig. 3-A

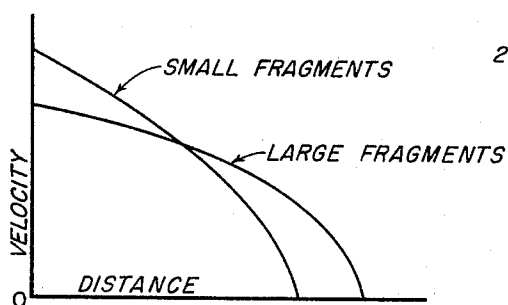


Fig. 5

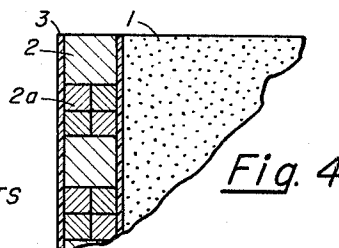


Fig. 4

INVENTOR.
GUY C. THRONER JR.
BY *D. Gordon Rogers*
ATTORNEY.

1

3,263,612

FRAGMENTATION TYPE WEAPON

Guy C. Throner, Jr., Glendora, Calif., assignor to Aerojet-General Corporation, Azusa, Calif., a corporation of Ohio

Filed July 22, 1963, Ser. No. 297,183

2 Claims. (Cl. 102-67)

This application is a continuation-in-part of my co-pending U.S. patent application, Serial No. 588,922, filed June 1, 1956, now abandoned.

This invention relates to explosive weapons of the type adapted to destroy or damage both equipment and personnel.

More particularly, the invention relates to a fragmentation or shrapnel type of bomb, warhead, projectile, missile or grenade in which a charge of high explosive is surrounded by a casing including separate slugs of metal, wherein the slugs are disposed in at least two groups of slugs with each group of slugs comprising a plurality of uniformly sized slugs differing in size from the size of the slugs in another group and each group of slugs including uniformly spaced portions of the slug group which are arranged about the charge of high explosive.

Heretofore, fragmentation devices of the type mentioned have been made by enclosing a body of high explosive in an outer casing which is provided with uniformly arranged notches to form slugs of metal when the body of high explosive is detonated, such as the notches employed in the outer casings of hand grenades, or by placing a body of high explosive in a container which normally fragments into random sizes, with many small fragments and dust particles being formed when the body of high explosive is detonated.

The disadvantages of these prior fragmentation devices are:

(1) If all of the fragments which are produced when the fragmentation-type weapon is exploded are large, their total number must be less and the degree of saturation afforded thereby is less than would be the case where smaller fragments are produced when the fragmentation-type weapon is exploded;

(2) If all of the fragments which are produced when the fragmentation-type weapon is exploded are small, the damage such small fragments may cause to equipment is negligible even though the degree of saturation afforded by the small fragments may be greater than that afforded by larger fragments; and

(3) If the fragments produced by the explosion of a fragmentation-type weapon are of random large and small sizes, these random-sized fragments will not be of the optimum sizes for providing the most effective result in both area saturation and damage to equipment.

The present invention overcomes the foregoing difficulties by providing an improved fragmentation-type weapon which produces fragments of variable but predetermined size and weight, and uniform planned distribution when it is exploded, whereby maximum area saturation and damage to equipment may be accomplished by the fragments.

In the present invention, pre-sized fragments in the form of slugs are assembled in at least two groups of slugs in a matrix of plastic resin and covered with a sheath preferably formed from fiberglass impregnated with plastic resin. Each group of slugs comprises a plurality of uniformly sized slugs differing in size from the size of the slugs in another group. Portions of each slug group are uniformly arranged in spaced relationship in the matrix to form an outer casing for the fragmentation-type weapon. The advantages inherent in this construction, as compared to prior constructions, are:

(a) Spalling of the slugs is alleviated by having the

2

shock energy absorbed in a less dense material. The slugs are held together in bonded relationship as a shell. A shock wave, instead of being reflected from the outer surface of a fragment, passes through the slugs to be substantially completely absorbed in the matrix material bonding the slugs together and the outer sheath which is preferably made of fiberglass impregnated with plastic resin.

(b) A reduced amount of the energy obtained from the detonation of the explosive charge is used in rupturing the outer casing of the present fragmentation-type weapon as compared to fragmentation devices heretofore known. Therefore, more energy can be imparted by the explosive charge upon its detonation to the slugs.

(c) There is much less wasted weight of material than is entailed in loading pre-cut fragments into a body of a shrapnel-type weapon. In a shrapnel-type weapon, the shell case itself comprises a large percentage of the weight of the missile but is of little value in causing casualties.

(d) The pre-sized slugs of the present fragmentation-type weapon can be made in optimum sizes, shapes and hardnesses for diverse intended purposes.

(e) The formation of the present fragmentation-type weapon is greatly simplified by the use of fiberglass impregnated with plastic resin as an outer sheath for the slugs assembled in the plastic matrix.

(f) The outer casing, which includes the slugs and matrix material, has a high compressive strength giving the present fragmentation type device structural integrity for shipping and handling, and yet a low or minimal strength in transverse section. As may be inferred, the low transverse or shear strength provides a minimum opposition to shearing forces when the explosive charge is detonated to insure proper area distribution of the slugs.

Other objects and advantages of the invention will be apparent from the following description and drawings illustrating preferred embodiments of the invention. It is to be understood that the invention is not limited to the particular embodiments disclosed herein but is of the scope covered by the appended claims.

FIG. 1 is a longitudinal sectional view of one embodiment of the invention taken on line 1-1 of FIG. 1-A;

FIG. 1-A is a top plan view of FIG. 1;

FIG. 2 is a longitudinal sectional view of another embodiment of the invention taken on line 2-2 of FIG. 2-A;

FIG. 2-A is a top plan view of FIG. 2;

FIG. 3 is a longitudinal sectional view of still another embodiment of the invention taken on line 3-3 of FIG. 3-A;

FIG. 3-A is a top plan view of FIG. 3;

FIG. 4 is an enlarged fragmentary longitudinal sectional view of the device shown in FIG. 1; and

FIG. 5 is a graphical representation illustrating the saturation area covered by the large and small fragments or slugs of the present device upon detonation of its explosive charge.

Referring to FIGS. 1, 1-A and 4, a body of high explosive is indicated at 1. The body of explosive is shown as being cylindrical in shape for convenience in assembly, but the invention is not limited to such a shape. The body of explosive is surrounded by a shell composed of pre-cut metal slugs, 2 and 2a assembled in a matrix of plastic resin. The metal slugs are disposed in two groups of slugs, wherein each group of slugs comprises a plurality of slugs of uniform size with the slugs 2 of one slug group being larger than the slugs 2a of the other slug group. The slugs 2 and 2a are cemented together, i.e., bonded to one another, by the plastic matrix in which they are assembled and the resulting shell is enclosed in a sheath 3. The plastic matrix in which the

3

slugs 2 and 2a are assembled comprises a cementitious material. Preferably, but not necessarily, the cementitious material is a resin of the epoxy type. Other materials can be used such as glass reinforced resins, polyvinyl chloride polymers, alkyd resins, phenol-formaldehyde resins and heteropolymerized alkyd resins.

The sheath 3 may be a coating of plastic resin-coated fiberglass applied by placing the groups of slugs 2 and 2a assembled in the plastic matrix comprising the shell on a rotatable mandrel and winding the resin-impregnated fiberglass thereupon. The shell of metal slugs and plastic resin matrix bonding the individual slugs to each other may be cast in cylindrical form separate from the body of explosive 1. The slug cylinder or shell may or may not be bonded to the body of explosive 1. The combined sheath and shell structure has a high compressive strength yet almost no shear strength, and creates a gas seal which increases the velocity of the slugs and minimizes the breaking up or spalling of the slugs by providing a cushion in which the release shock wave generated by the body of explosive 1 upon its detonation is partially absorbed. The strength of the sheath and shell structure prior to detonation of the body of explosive 1 is tantamount to that of a steel case, yet when the bursting point is reached upon detonation of the body of explosive 1, the sheath 3 and the matrix material will disintegrate and the slugs will disperse in the form of discrete high velocity particles. Thus, by forming the slugs 2 and 2a as discrete particles rather than producing particles from the fragmentation of a metallic casing having notches formed therein, complete breakup of the cylinder of slugs is accomplished when the body of explosive 1 is detonated. It is therefore not necessary to form notches between adjacent slugs to assure complete breakup, which would otherwise weaken the cylindrical slug structure to lessen its ability to withstand normal handling and transportation.

It has been found that in order to obtain optimum saturation and equipment damage, with the present fragmentation-type weapon, the slugs 2 and 2a comprising the two groups of slugs should be distributed in the proportion of approximately eight to sixteen small (secondary) slugs 2a to one (primary) slug 2. FIGS. 1 and 3 illustrate the ratio of eight small slugs 2a to one large slug 2 whereas FIG. 2 illustrates sixteen small slugs 2a to one large slug 2. The size of the slugs will depend partly upon the type of equipment against which the fragmentation-type weapon is to be used for inflicting damage.

FIG. 5 illustrates graphically the relative area saturation obtained by large and small slugs or fragments when a fragmentation-type weapons is exploded. It will be observed that although the smaller slugs travel at a higher initial velocity than the larger slugs, they travel a shorter distance than the larger slugs. The larger slugs have the greater kinetic energy and cause the most damage to equipment.

It has been determined that in order to cause the maximum damage to equipment, the larger slugs should have a mass of about 140 grains, while the smaller slugs should have a mass of about 30 grains in order to cause the maximum damage to personnel.

If the slugs are made of steel (for example 1010 or 4140), a satisfactory range of sizes is from 1/4 inch to 1/2 inch cubes for the larger slugs 2 and 1/8 to 1/4 inch cubes for the smaller slugs 2a. The shape of the slugs is not critical, but cubes are preferred because of ease of manufacture and assembly.

FIGS. 2 and 2-A illustrate a fragmentation type warhead similar to that shown in FIGS. 1 and 1-A, except that instead of the single row of two slug groups distributed in a one to eight ratio of the large to small slugs, the slugs are arranged in a single row of two slug groups distributed in a one to sixteen ratio of the large to the small slugs.

4

FIGS. 3 and 3-A illustrate another arrangement wherein the the slugs are arranged in a double row of two slug groups distributed in a one to eight ratio of large to small slugs.

Obviously many modification and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

I claim:

1. A fragmentation-type weapon comprising a body of explosive material, an outer casing enclosing said body of explosive material and comprising a shell of a multiplicity of discrete solid metallic slugs forming at least two groups of discrete slugs, each of said groups of slugs comprising a plurality of discrete slugs of uniform size differing from the size of the slugs comprising another group of slugs to provide relatively large slugs in one group and relatively small slugs in another group, each of said groups of slugs including uniformly spaced portions of the slug group which are sequentially arranged with other slug group portions, a cementitious matrix of plastic material in which said slugs are assembled, said matrix being disposed between adjacent faces of juxtaposed slugs to bond said slugs together in substantially contacting relationship for defining a pressure-tight seal extending between adjacent faces of juxtaposed slugs and providing said shell with a high compressive strength and a minimal shear strength, and a sheath of plastic material disposed about the outer surface of said shell in intimate secured relationship therewith, the plastic material of said matrix and said sheath having sufficient uniformity and inherent strength to insure that the explosive force generated by the detonation of said body of explosive material is effective to project all of said slugs outwardly at high velocity in discretely dispersed relationship in a predetermined pattern.

2. A fragmentation-type weapon comprising a body of explosive material, an outer casing at least partially enclosing said body of explosive material and comprising a shell of a multiplicity of discrete metallic slugs forming two groups of discrete slugs, each of said groups of slugs comprising a plurality of discrete slugs of uniform size differing from the size of the slugs comprising another group of slugs to provide relatively large slugs in one group and relatively small slugs in the other group, said discrete slugs being distributed in the ratio of about 8-16 slugs of said relatively small slugs weighing about 30 grains each to each slug of said relatively large slugs, each of said relatively large slugs weighing about 140 grains, and cementitious means comprising a plastic matrix disposed between adjacent faces of juxtaposed slugs bonding said slugs together in substantially contacting relationship for defining a pressure-tight seal extending between adjacent faces of juxtaposed slugs and providing said shell with a high compressive strength and a minimal shear strength, whereby dispersion of said slugs in a predetermined pattern upon detonation of said body of explosive material is facilitated.

References Cited by the Examiner

UNITED STATES PATENTS

723,256	3/1903	Emery	102-67
1,241,095	9/1917	Courtesy	102-67
2,564,751	8/1951	Cook	102-64
2,762,303	9/1956	Fawcett	102-64
2,972,949	2/1961	MacLeod	102-67

BENJAMIN A. BORCHELT, *Primary Examiner.*

SAMUEL W. ENGLE, SAMUEL FEINBERG,

Examiners.

G. L. PETERSON, G. H. GLANZMAN,

Assistant Examiners.