

[54] **PRE-SHAPED FRAGMENTATION
DEVICE**

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[73] Assignee: The United States of America as
represented by the Secretary of the Navy

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102/89, 91

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ABSTRACT

There is disclosed a cylindrically-shaped fragmentation device consisting of a plurality of preformed shims or wafers arranged in brick-like fashion to form an explosive casing. The shims project edge-on when the munition is detonated but due to their unique shape they assume a dynamically stabilized flight path.

7 Claims, 6 Drawing Figures

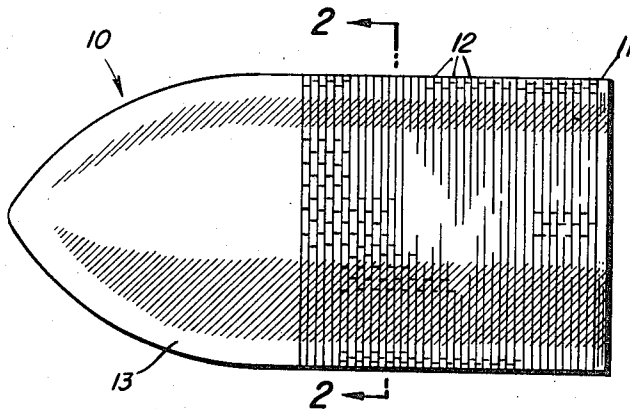


FIG. 1

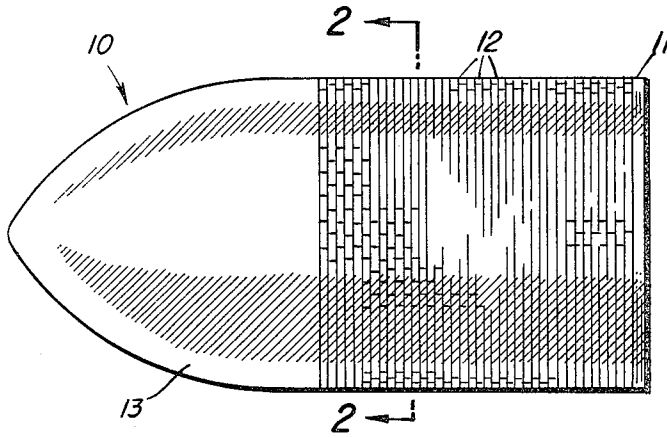


FIG. 2

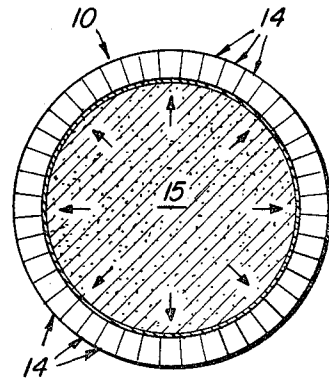


FIG. 3

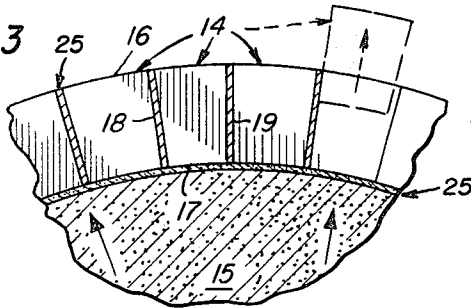


FIG. 4

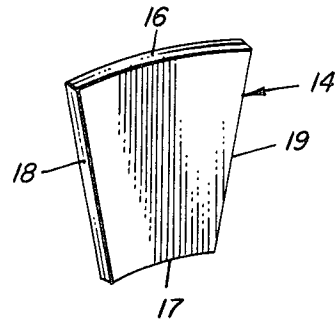


FIG. 5

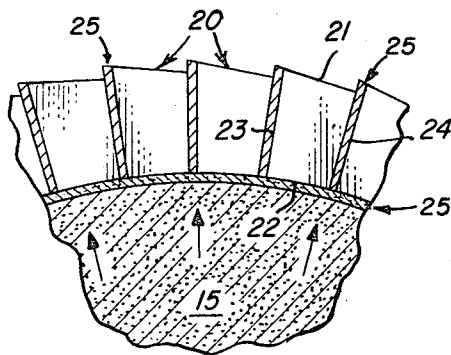
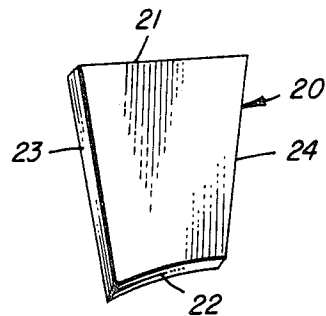


FIG. 6



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PRE-SHAPED FRAGMENTATION DEVICE

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

The present invention relates generally to a pre-formed fragmentation type ordnance device and, more particularly, to a munition of the conventional bomb configuration capable of producing fragments with improved ballistic densities.

In the design of fragmenting munitions, the principal parameters involved are those relating to control of the number, sizes and velocities of fragments and their distribution in the space about the detonating device. A number of methods have been used for control including over-all munition shape, composition and treatment of fragmenting material and other special techniques for fragment size control. The size of the fragments have been currently controlled through the use of scoring on the casing, jet forming explosive shapes and other techniques. Also, the use of pre-formed fragments of a desired type held together in some sort of a matrix is quite common. Casings formed of notched bars or wires rolled into the cylinder have also been used for size control. Since the optimum type of fragment differs depending upon the nature of both the explosive charge and the intended target for the device, the varieties of fragmenting devices that have been designed and built to date is extremely large. Nevertheless, attempts to efficiently project fragments in the conventional bomb configuration with good ballistic shapes have not been satisfactory, especially when used against hard targets such as armored trucks and the like.

Accordingly, it is an object of the present invention to provide a pre-shaped fragmentation type ordnance device capable of producing a larger number of effective fragments from a given size and weight of munition used against a particular range of targets, as compared with other methods of fragmentation control.

Another object of the present invention is to provide an ordnance device whose fragments are pre-formed and of a special design such that target damage or penetration for a given fragment weight may be greatly enhanced.

A further object of the present invention is to provide a fragmentation warhead in which the fragments are shaped like a thin wafer or plate with one dimension quite small in comparison with the other two such that the fragments may be projected edge-on and continue to fly in that attitude until impact.

A still further object of the present invention is to provide a pre-shaped fragmentation warhead in which the unique design of each fragment and their lateral confinement in forming the casing is such so as to prevent fragment deformation at detonation and to stabilize fragments during flight.

A still further object of the present invention is to provide a pre-shaped fragmentation device comprising wafer-like fragments stacked in brick-like fashion about the detonating device such that permanent deformation of the fragments is avoided and the fragments are made to project edge-on until the target is reached.

A still further object of the present invention is to provide a fragmentation device in which pre-shaped fragments comprise its casing each uniquely shaped in a manner to control the rotation of each fragment thereby stabilizing them and substantially increasing their effectiveness against hard targets.

Other objects, advantages and novel features of the present invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings wherein:

FIG. 1 is a side view of a pre-shaped fragmentation type munition according to the instant invention;

FIG. 2 is a cross-sectional view taken at line 2—2 of FIG. 1 showing the pre-shaped fragments and how they are assembled to form the munition casing;

FIG. 3 is a view similar to FIG. 2 but greatly enlarged showing a part of the pre-shaped fragments in assembly;

FIG. 4 illustrates the shape of a single fragment of the munition device of FIGS. 1, 2 and 3;

FIG. 5 is a view similar to FIG. 3 showing a modified design of a pre-shaped fragment in relation to other fragments for forming the munition casing; and

FIG. 6 illustrates the shape of a single fragment of the munition device according to FIG. 5.

Referring now to the drawings for a more complete understanding of the invention wherein like reference characters designate like or corresponding parts throughout the several views, there is shown in FIG. 1 a warhead generally designated 10 and having a base 11, a tubular casing joined thereto, formed of a series of rings 12, each comprised of a plurality of wafer-like shims 14 and a forward nose portion 13 which is joined to the forward ring of the warhead. A high explosive 15 is contained within the interior of the projectile as clearly shown in FIG. 2.

Experimentation with explosive metal systems has shown that permanent deformation or fracture of pieces of metal such as wafers 14 during explosive detonation may be prevented by suitable adjacent confinement of the wafers. This prevents metal flow in the direction lateral to the direction of the applied pressure during the very short time interval and distance during which applied pressures are so extremely high that mechanical strength of the metal or other material is literally negligible. The lateral confinement is thus provided by material which is identical to that requiring protection. In other words, if identical pieces of material are packed tightly together with essentially no void spaces between them and having a thin layer of adhesive coating between the rings, they can be subjected to the extremely high pressures without residual deformation. Such an assembly of wafers 14 wherein adjacent legs of each wafer are wholly in contact with each other in forming the munition 10 casing is shown in FIG. 3. In addition, they will retain the direction shown in phantom in FIG. 3 of the initially applied impulse from the detonating explosive unless subject to external forces in flight. It is seen, therefore, that when a large number of shims or wafers 14 are stacked in such a way that one edge of each is adjacent to the explosive charge as in FIGS. 2 and 3, the opposite edge being free and all other surfaces directly in contact with adjacent identical wafers or shims 14, the necessary requirement is met for edge-on projection without deformation. The general configuration of wafers 14 is shown in FIG. 4 wherein each shim is of a substantially trapezoidal shape having a side 16 exposed to the exterior of the projectile, a side 17 parallel to side 16 exposed directly to high explosive 15 and sides 18 and 19 in contact, respectively, with adjacent shims as shown in FIGS. 2 and 3. The direction of projection of such shims 14 will be edge-on, as seen in phantom in FIG. 3, provided that direction of the impulse delivered by detonation pressures lie within the large surface of wafer 14 formed by sides 16 through 19.

In FIG. 2, the arrows depict the generally radially outward direction of the impulse applied by the explosive charge. This is one requirement of impulse direction for the end-on projection of the wafer. Another requirement is that the direction also be normal to the longitudinal axis of the cylinder for the wafers oriented as shown. This requirement is met exactly only at the center of the cylinder length. Although the explosive effect is somewhat minimized toward the ends of the projectile, a satisfactory approximation of this requirement can be had by adding confinement at the cylinder ends, through addition of a conical cap as at 13, or a flat cap as at 11. Elements 11 and 13 may also be made up from wafer type fragments or they may be solid. The conical cap at 13 and the flat cap at 11 act as clamp devices to aid in preventing the lateral movement of the wafers.

Assembly of the fragments 14 into the device 10 of the type shown in FIGS. 1, 2 and 3 is accomplished by cementing them together with adhesive or solder-like material 25, shown graphically in FIG. 3. Wafers 14 in each ring 12 are misaligned from adjacent wafers in adjacent rings by approximately one-half the length of side 16. Such overlapping of adjacent wafers in the adjacent rings appear brick-like as in a wall or chimney. Two purposes are served by the overlap, namely, enhancing

the strength of the fabricated casing and increasing the likelihood of a separation into the original individual fragments. Strength therefore is gained in the same way as in the bricks used in building. Separation is caused by the radial diversion in the direction of applied impulse. Each particle of a wafer will tend to continue along the original radial direction of projection. The strength of the wafer is sufficient, however, to resist fracture from stresses arising from this radial diversion provided only that its circumferential dimension remains small. If this requirement is met, the resultant direction of each fragment will be the line from the center of the cylinder through its center of mass. Since fragments cemented together and overlapping will have their centers of mass in different azimuthal positions, they will travel in different azimuthal directions, and thus separate, even though strongly adhered originally.

An infinitely thin wafer traveling supersonically will have neutral overturning moment. Thus, the initially edge-on attitude of these wafers should be retained for a relatively long distance since overturning moments will be small and times for them short to act. For short stand-off distances, therefore, stabilization is not a factor. However, for the wafers involved in the instant application which are of finite thicknesses, positive stabilization of the wafers may be desirable in order to overcome such above-mentioned overturning moments. A technique utilized for achieving stabilization is one for causing them to rotate about an axis normal to their surface of greatest area. Such a rotation can be imparted during their explosive acceleration by giving one edge of the wafer a higher velocity than the other. This is easily accomplished by adjusting the mass of the wafer which is presented to the explosive pressure.

FIGS. 5 and 6 show the shape of a wafer fragment 20 having such a design. The length of side 23 is greater than side 24 with sides 21 and 22 being exposed, respectively, to the exterior and interior of the projectile. The arrows show the direction of pressure impulse similar to that applied to wafers 14 of the first embodiment. Thus, as one moves from side 23 to side 24, the force exerted by the explosive gas along edge 22 is constant. However, since edge 22 is shorter than edge 23 and there is less of a downward force exerted by the weight of the fragment along side 22, the resultant effect of the explosive force will be greater along edge 22 than along edge 23 thereby creating a rotational moment on wafer 20 causing it to spin about an axis normal to the surface shown in FIGS. 5 and 6 and coinciding with its center of mass. The magnitude of the rotational moment may be controlled by the adjustment of the ratio of length 23 to length 24. It can be seen that the greater amount of weight at one side of the wafer, as compared to its other side, under a constant applied force to side 22 will cause the one side to lag behind in rotational movement as compared to its other side whereby the wafer 20 will be caused to spin in a counterclockwise motion, thus, controlling the rotation of each fragment and substantially increasing the effectiveness of fragmentation weapons against hard targets. The principal advantage of fragments such as those described hereinabove arises from an increased momentum per unit contact area at impact as compared with the usual chunky fragment of the same total weight. This increase results in a greater depth of penetration or greater perforation ability for fragments of a given weight. Thus, for any stated criteria of penetration ability and given weight of munition there can be more effective fragments for the edge-on impacting wafer fragment than for the randomly oriented chunky fragment. An additional advantage is the lowered air drag of the wafer fragment because of a more favorable ratio of presented area to fragment mass.

The new and novel techniques described in the preceding sections for explosive projection and stabilization of edge-on oriented wafer fragments produces a large number of effective fragments from a given size or weight of munitions used against a particular range of targets as compared with other

methods of fragmentation control. Depending upon the particular numbers and sizes of targets, the pre-shaped fragmentation type munition concept of the instant invention will be utilized in munitions large enough so that sufficient charge size could be afforded to accelerate large wafers to reasonably high velocity. Naturally, the case thickness is the maximum for the long wafer dimensions. The wafers could be also designed such that resultant velocity from vector addition of projection and missile velocity can be achieved. Since velocity of missile at detonation could be known reasonably well, it will be possible to project wafers with principal dimension aligned with resultant direction by use of a forward lean to the wafers. Of course, there are many possible methods of assembly and suitability for mass production might be a strong factor in selection among these alternatives.

Obviously many modifications 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.

What is claimed is:

1. A fragmentation type ordnance device consisting of an explosive charge; and

a fragment producing tubular casing, a nose portion secured to the casing forward end, a base portion secured to the casing rearward end, said casing comprising a plurality of rings secured to the side of said charge by an adhesive means, said rings comprising a plurality of pre-shaped, individual, identical wafer-like shims, arranged in a single layer, each having at least two straight opposite coated sides, said shims being juxtaposed and in a tightly packed relation to each other in each of said rings with essentially no void spaces between said shims;

whereby, upon detonation, said shims are subject to substantially high pressures without residual deformation and are projected in an edge-on attitude continuing to fly in substantially said attitude to deeply penetrate the target.

2. The ordnance device according to claim 1 wherein said shims in each of said rings are shaped in the form of a tetragon.

3. The ordnance device according to claim 2 wherein said shims are substantially in the shape of trapezoids with the smaller of said shims two parallel sides exposed to the explosive charge through said adhesive means, the other of said parallel sides exposed directly to the exterior of the ordnance device and each of the coated non-parallel sides wholly in contact with a coated non-parallel side of an adjacent shim.

4. An ordnance device according to claim 2 wherein said shims have one coated side thereof which is in contact with an adjacent coated shim, longer than its opposite side, such that the force exerted by the weight of said shims is greater at said longer side than at said opposite shorter side, and whereby the counter force from said explosive charge is equal along said shim thereby creating a rotational movement on said shims causing them to rotate about an axis normal to their surface of greater area.

5. The ordnance device according to claim 4 wherein said shims are substantially in the shape of trapezoids with the smaller of said shims two parallel sides exposed to the explosive charge through said adhesive means, the other of said parallel sides exposed directly to the exterior of the ordnance device and each of the shorter non-parallel sides wholly in contact with a longer non-parallel side of an adjacent shim.

6. The ordnance device according to claim 4 wherein said casing shims are arranged in brick-like fashion by the shims of each of said rings being in overlapping relation to the shims of an adjacent ring.

7. The ordnance device according to claim 1 wherein said casing shims are arranged in brick-like fashion by the shims of each of said rings being in overlapping relation to the shims of an adjacent ring.

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