March 19, 1963 G. T. BOSWELL 3,081,704

ROD PRODUCING WARHEAD

Filed March 28, 1956

FIG.1.

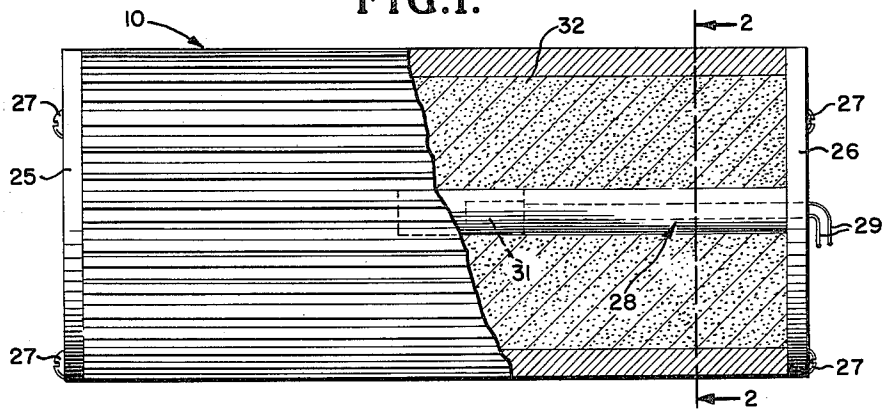


FIG.2.

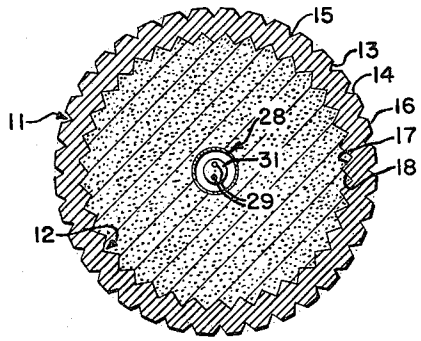


FIG.3.

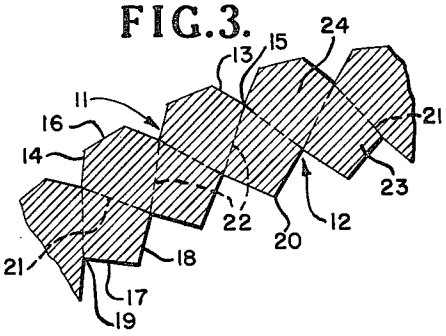


FIG.4.

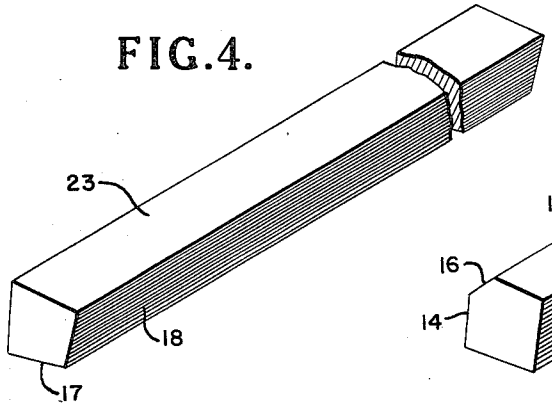
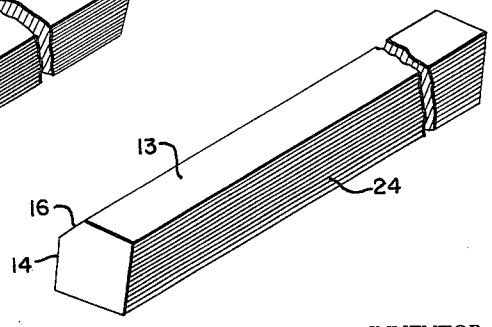


FIG.5.



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ROD PRODUCING WARHEAD

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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.

This invention relates to warheads for a missile and more particularly to a warhead of unitary construction which utilizes the phenomenon of a natural shear in response to high explosive impact to obtain rod-like fragments of the metal of which the warhead is composed with a minimum of non-lethal metallic dust. It has been the usual practice in warheads of this character heretofore devised to provide a plurality of grooved sections such that fragmentation of the warhead in response to the explosion of a charge therein is achieved in such manner that the flying fragments in the form of small cubes or irregular shaped pieces of metal. While such warheads are generally effective when employed against personnel, their effectiveness is considerably decreased when employed against structures such, for example, as aircraft and other automotive vehicles. Other types of warheads have been devised in which the fragmenting casing is composed of a plurality of individual fragmentary elements securely held together by any suitable means such, for example, as by brazing the parts together, have also been employed.

The device of the present invention possesses all of the advantages of the prior art devices and none of the foregoing disadvantages. It also possesses the advantage of being more effective when employed against structures.

One of the objects of the present invention is the provision of a warhead of unitary construction having new and improved means for causing the warhead to be fragmented into a plurality of rod-like elements in response to a high explosive impact applied thereto.

Another object is to provide a unitary warhead of generally cylindrical configuration having new and improved means formed on the outer surface thereof and means on the inner surface complementing the first-named means whereby the warhead is disintegrated into a plurality of rod-like fragments with a minimum of non-lethal dust in response to the explosion of a high explosive charge disposed therein.

Still another object is a hollow cylindrical warhead having a plurality of longitudinally weakened portions exteriorly thereof and a corresponding number of complementary weakened portions interiorly formed thereon whereby a plurality of rod-like elements of generally square cross sectional configuration and a second plurality of rod-like elements of different configuration are produced as the warhead is disintegrated by a high explosive impact applied interiorly thereto.

Still other objects, advantages and improvements will be apparent from the following description taken in connection with the accompanying drawing of which:

FIG. 1 is a view in elevation and partly broken away of a warhead of the instant invention in accordance with a preferred embodiment thereof;

FIG. 2 is a sectional view taken along the line 2—2 of FIG. 1;

FIG. 3 is an enlarged fragmentary view of the device of FIG. 2;

FIG. 4 is a view in perspective of one of the rod-like elements; and

FIG. 5 is a view of another rod-like element produced by shear forces as the casing is disintegrated.

Referring now to the drawing for a more complete understanding of the invention and more particularly to FIG. 1 thereof, there is shown thereon a warhead suitable for use with a missile which may be of the guided or unguided variety and indicated generally by the numeral 10. The warhead is composed of any material suitable for the purpose such, for example, as cold rolled steel preferably having the grain thereof in a direction generally parallel to the axis of the warhead. The warhead casing is provided with a plurality of equally spaced grooves indicated generally by the numeral 11 extending longitudinally throughout the length thereof and a complementary plurality of grooves indicated generally by the numeral 12 extending interiorly and longitudinally of the warhead. The grooves 11 are defined by two intersecting flat surfaces 13 and 14 formed in the outer peripheral portion of the warhead at a predetermined angle such, for example, as 80° which has been found to be satisfactory for the purpose, the lines of intersection of these surfaces being designated by the numeral 15. Between surfaces 13—14 of each pair of grooves is disposed a cylindrical surface 16 extending circumferentially along the outer periphery of the warhead for a distance substantially equal to the maximum peripheral distance subtended by the surfaces 13—14 forming the grooves 11.

Each of the interior grooves 12 comprises two intersecting flat surfaces 17 and 18 respectively extending throughout the length of the warhead casing, the angle of intersection of surfaces 17—18 being substantially 90°. Each of the grooves 12 has the surface 17 thereof intersecting the surface 18 of an adjacent groove 12 thereby forming a plurality of apexes or lines 19 mutually and uniformly spaced and extending interiorly and longitudinally of the cylindrical warhead casing.

The grooves 12 are so positioned with respect to the grooves 11 that the apexes 19 are in radial alignment with the central portions of the cylindrical surfaces 16, respectively, and lines 15 formed by the intersection of the pairs of surfaces 13—14 of the grooves 12 are in radial alignment with the lines 20 formed by the intersection of surfaces 17—18 at the innermost portion thereof. The thickness of the frangible wall of the warhead is such that the plane of surface 17 of each of the grooves 12 coincides with one of the lines 15 thereby forming a shear plane indicated by the numeral 21 and in like manner the plane of surface 18 of each of the grooves 12 coincides with each of the lines 15 of grooves 11 substantially as shown thereby forming a plurality of shear planes 22.

An arrangement is thus provided in which a shear force is applied to the warhead along the planes 21 and 22, FIG. 3, in response to a high explosive impact applied to the interior surface of the warhead sufficient to shear the warhead casing along these planes of shear. The warhead is thus broken up or disintegrated into a first plurality of rod-like segments 23 of generally square cross sectional configuration and a second plurality of rod-like elements 24 of generally pentagonal cross sectional configuration, all of which possess a high degree of inherent structural strength and fly outwardly at high velocity as the warhead disintegrates. Furthermore, it has been found by actual tests that the cross sectional area of each of the rod-like elements 23 is more nearly of square configuration than illustrated on FIG. 3 by reason of the compressive and shearing forces applied thereto during the disintegrating process. It has also been found that the disintegration of the warhead is accompanied by a negligible amount of non-lethal dust whereby substantially all of the material of the warhead is re-

tained in the rod-like elements after disintegration. Furthermore, it has been found that where the length of the warhead does not exceed twice the diameter thereof, substantially all of the rod-like elements are dispersed intact and of the same length as the warhead. It will be understood that, if desired, the length of the warhead may be less than twice the diameter thereof without departing from the invention herein disclosed.

The end portions of the warhead may be sealed in any convenient manner as by the plates **25** and **26** illustrated, the plates being secured thereto as by the screws **27**. The plate **26** is provided with a detonator and booster charge assembly indicated generally by the numeral **28** secured preferably to the central portion of plate **26** and of such proportions that the explosion is initiated at substantially the central interior portion of the warhead in response to a firing impulse applied to the conductors **29** extending to the electroresponsive detonator **31**. A high explosive **32** filling the space within the warhead and retained therein by the barriers **25—26** is employed to burst the warhead into a plurality of rod-like elements **23** of generally rectangular cross sectional configuration and a like number of rod-like elements **24** of generally pentagonal cross sectional configuration as the explosive is fired in response to actuation of the detonator **31**.

Whereas the warhead shown on the drawing comprises 36 external grooves and a like number of complementary internal grooves, it will be understood that this is by way of example only and that the number of grooves may be varied in accordance with the desired size of the warhead, it being merely necessary that the complementary structural relation between the grooves **11** and **12** as set forth herein and as shown on FIG. 3 be maintained.

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 as new and desired to be secured by Letters Patent of the United States is:

1. A frangible rod producing warhead comprising a hollow cylindrical casing for retaining a high explosive charge therein, a plurality of angular axial grooves formed in equispaced relation about the periphery of said casing, each of said grooves being defined by a pair of intersecting planar surfaces extending throughout the length of said casing, and a plurality of complementary angular grooves equal in number to said first-named grooves and arranged axially in the inner circumference of said casing in equispaced relation to form a circular serrated interior wall, said complementary grooves each being defined by a second pair of mutually intersecting planar surfaces extending throughout the length of said casing, said complementary grooves each having an angle between said second pair of planar surfaces greater than the angle between the first-named pair of planar surfaces and arranged in radially staggered and equally spaced arrangement with respect to the first-named grooves to form a plurality of like planes of natural shear within the casing between each of the axially disposed lines formed by the intersection of said second pairs of intersecting planar surfaces and the axially disposed lines formed by the intersection of the first-named pairs of planar surfaces in closest proximate spaced relation with respect thereto, whereby the casing is fragmentized into a plurality of rod-like elements corresponding in number to the number of said grooves as the warhead is burst by said explosive charge and the rods fly outwardly therefrom at high velocity in a predetermined uniform pattern as the casing is burst.

2. A war head according to claim 1 in which the angle between the pair of intersecting surfaces of each of said first-named grooves is 80°.

3. A warhead according to claim 1 in which the angle between the pair of intersecting surfaces of each of said complementary angular grooves is substantially 90°.

4. A warhead according to claim 1 in which said rod-like elements are equally divided into groups, the elements of one group being quadrangular in cross-section and the elements of the other of the groups being pentangular in cross-sectional configuration and interspersed with the rod-like elements of the first-named group.

5. A warhead according to claim 1 including means disposed at the center of the charge for exploding the charge in such manner that the explosion is promulgated from a central portion thereof, whereby the explosive force is applied equally to the complementary grooved portions forming the interior serrated wall of said casing.

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