March 14, 1961 H. H. MOHAUPT 2,974,595

PROJECTILE

Original Filed Oct. 28, 1942

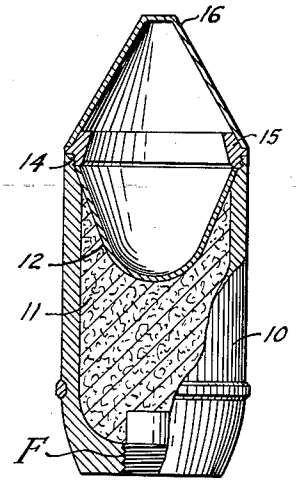


Fig. 1.

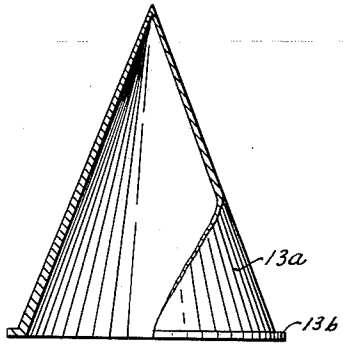


Fig. 3.

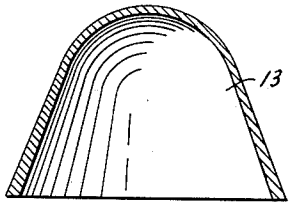


Fig. 2.

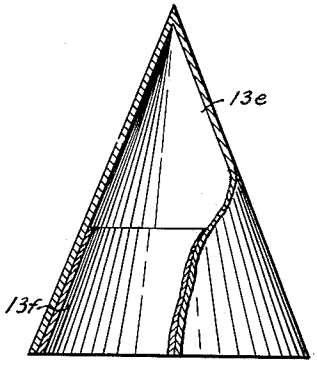


Fig. 5.

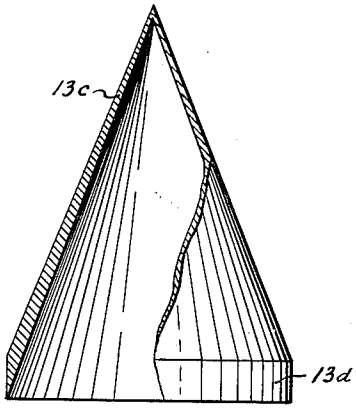


Fig. 4.

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2,974,595

Patented Mar. 14, 1961

2,974,595

PROJECTILE

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Continuation of application Ser. No. 463,677, Oct. 28, 1942. This application Sept. 11, 1947, Ser. No. 773,375

7 Claims. (Cl. 102—56)

This invention relates to penetrating charges, and has reference to a charge having a cavity in one end and a hollow conical piece, or substantially conical piece, positioned in the said cavity. This application is a continuation of my copending application, Serial No. 463,677, filed October 28, 1942, and now abandoned.

The invention may be employed in many ways, both military and commercial, for penetrating objects or targets, such as thicknesses of steel, cement walls, oil bearing sand formations, and the like.

An object of the invention is to provide an improved conical liner, referred to, whereby the penetrating effect of the charge is greatly enhanced.

Another object of the invention is to provide a conical liner for charges of the described class whereby the said liner is uniformly collapsed without substantial breakage from its apex to its mouth or open end so as to prevent extroversion of the same, and to thereby form a pencil-like projectile.

The foregoing objects are attained by providing a conical liner having a tapered wall thickness, and which thickness increases from the conical apex to the mouth or free end. When positioned in a cavity at the end of a charge having a high velocity propagation wave, the resistance of the liner to collapse by reason of the tapered wall thickness, is such that the apex end of the cone is the first part of the liner to collapse. As the wave continues, the liner continues to collapse from apex to mouth or free end to form the pencil-like projectile.

By empirical tests it has been found that the angle of the conical liner may be varied up to 120 degrees without extroversion of the liner. However, when larger angles are employed, the degree of taper of the tapered walls of the liners must be accordingly increased. The degree of taper and the nominal angle of the liner also depend on the characteristics of the liner material, which is usually a metal, on the size and characteristics of the explosive charge, and on the amount of standoff given the charge at the time of detonation. Standoff is a hollow, air, or gas filled space comprising the hollow interior of the liner plus an integral additional air or gas filled space beyond the open end of the liner.

It has also been found by test that in addition to the referred to pencil-like projectile, an outwardly propelled jet is formed along the axis of the cone, and which jet has extremely high penetrating powers. It is believed that this jet is formed of particles from the inner wall of the liner and, by reason of the vectors involved, attains a velocity substantially equal to the propagation wave of the charge.

Exemplary forms of the invention are shown in the accompanying drawings, wherein:

Figure 1 is a diagrammatic view of a structure including the conical liner or projectile of the present invention.

Figure 2 is an enlarged vertical sectional view of the liner or projectile illustrated in Figure 1.

Figures 3, 4, and 5, show modified forms of the present conical liner or projectile.

In these drawings, Figure 1 illustrates one manner of employing the invention as applied to a main or primary projectile to be fired from a cannon, and comprising a strong body **10** having an explosive charge **11** therein of extremely high detonation velocity, with a cavity **12** at its forward end. A fuse F of extremely short action period is provided to cause the charge to be detonated with great rapidity upon the initial impact. A hollow piece **13**, which is to be shaped by the explosion of the charge **11** into a compact elongated mass and propelled at high velocity, is positioned with its smaller rearward end contacting the wall of the cavity **12**, and held in position against forward movement, at the instant of initial impact, by a shoulder **14** of an intermediate member **15**. The nose or ogive **16** is hollow and is illustrated as of this material, fitting over the exterior of the intermediate member **15** so that it tends to be flared by the action of this intermediate member during the instant succeeding the initial impact and prior to the expulsion of the secondary projectile.

As shown in Figure 2, the projectile of this invention may have initially the general form of a hollow piece of conical form, with a dome-like shape closing its smaller end.

In the form shown in Figure 3, the dome-like truncation of the hollow piece is omitted, and external wall surface of the body includes a flange **13***b* at the larger end, by which the projectile may be held fixedly in position in the body.

In the form shown in Figure 4, the hollow body **13***c* is shaped with an internal conical surface substantially as described in Figure 3, but the external conical surface has a greater apex angle, and the cylindrical surface **13***d* is provided adjacent the free end, for resting within the main body.

In Figure 5, it is indicated that the hollow piece may be constructed of several elements. The outer hollow conical member **13***e* has a uniform wall thickness from the apex to the free edge. Within this is seated an inner truncated conical member **13***f* which may be fixed in position by spot welding or the like. It will be noted that this inserted piece operates to strengthen the hollow piece over its portions of maximum diameter; and for this purpose, the inner truncated conical member **13***f* may have an increasing thickness from its smaller to its larger diameter.

It will be noted that the structure of Figure 2 may be very easily and simply made by punching operations from sheet steel stock.

Success has been attained in firing tests with explosives such as pentolite, when the apex angle of a 3" diameter steel liner has been around 40 to 60 degrees, and when the thickness of wall adjacent the lip or free edge has been about twice as great as the .030" thickness adjacent the apex. It should be understood that the ratio of wall thickness at the open end to that near the apex or closed end depends also on the size of the liner (i.e., the length of the sidewall of the liner). The apex angle for some particular employments may be as large as 120 degrees when due attention is given to the thicknesses and resistances at the various parts of the device to ensure against extroversion and for breaking of the liner. The illustrated forms may be simply and cheaply formed from metal such as steel by drawing or by turning from bar stock, but obviously may be made in other ways.

It is obvious that the illustrated forms of the invention, and the illustrative practice of Figure 1 are not restrictive, but that the same may be employed in many ways within the scope of the appended claims.

I claim:

1. A collapsible projectile for employment in front of an explosive charge which has a surface cavity therein

for receiving the projectile and by which charge an external collapsing pressure is exerted upon the outside of the projectile to cause it to be propelled forwardly and also to be reduced in cross-sectional area, comprising a metal structure having a convex outer surface presented against the explosive charge and a concave inner surface positioned in the direction in which the projectile is to be propelled, said surfaces being essentially symmetrical about an axis extending forwardly from the bottom of the cavity and giving the projectile the general form of a hollow cone having an apex half-angle of substantially 22 degrees, with its minimum wall thickness adjacent the axis and having an increasing wall thickness toward the free edge, whereby the collapsing effect of the explosion gases upon the units of area of the external surface is relatively decreased in the direction from the apex toward the free edge, the apex half-angle of the conical form and the thickness of the parts of the projectile being constructed and arranged to prevent extroversion under the effect of the pressure of the explosive charge.

2. A collapsible projectile for employment in front of an explosive charge which has a surface cavity therein for receiving the projectile and by which charge an external collapsing pressure is exerted upon the outside of the projectile to cause it to be propelled forwardly and also to be reduced in cross-sectional area, comprising a hollow metal piece of conical form with the inner surface at a less apex angle than the outer surface, the apex half-angle of the conical form being substantially 22 degrees whereby a part of the larger cross-sectional diameter has a greater wall thickness than another part of lesser cross-sectional diameter, the apex half-angle of the conical form and the thickness of the parts of the projectile being constructed and arranged to prevent extroversion under the effect of the pressure of the explosive charge.

3. A collapsible projectile for employment in front of an explosive charge which has a surface cavity therein for receiving the projectile and by which charge an external collapsing pressure is exerted upon the outside of the projectile to cause it to be propelled forwardly and also to be reduced in cross-sectional area, comprising a hollow truncated conical metal piece with the smaller diameter closed by a dome-like end, the wall thicknesses at the dome and at adjacent parts of the conical form being less than the wall thickness at portions adjacent the free edge, the apex half-angle of the conical piece being substantially 22 degrees and the radius of the dome being less than substantially one-half the axial length of the truncated conical piece, the apex half-angle of the conical form and the thickness of the parts of the projectile being constructed and arranged to prevent extroversion under the effect of the pressure of the explosive charge.

4. A collapsible projectile for employment in front of an explosive charge which has a surface cavity therein for receiving the projectile and by which charge an external collapsing pressure is exerted upon the outside of the projectile to cause it to be propelled forwardly and also to be reduced in cross-sectional area, comprising a hollow metal structure having essentially conical inner and outer surfaces, the inner surface having a lesser apex angle than the outer surface, the apex half-angle of the outer conical surfaces being substantially 22 degrees and also having a cylindrical outer surface portion extending from the outer part of the free edge or lip, the apex half-angle of the conical form and the thickness of the parts of the projectile being constructed and arranged to prevent extroversion under the effect of the pressure of the explosive charge.

5. An ordnance device comprising an enclosing structure including a strong outer body having therein an explosive charge having an explosion velocity of substantially 25,000 feet per second, said charge having a cavity in the front end thereof with the front edge of the charge spaced rearwardly from the front end of the enclosing structure, and a detonating fuse at the rear of said explosive charge; in combination with a hollow metal projectile piece seated in said cavity and against the charge and having inner and outer conical surfaces each inclined outwardly and forwardly, with the inner surface at a lesser angle than the outer surface, and with the apex half-angle of the outer surface being substantially 22 degrees whereby the wall thickness increases toward the larger forward end of the projectile piece, the thickness at the edge being substantially twice the thickness of rearward parts adjacent the axis, the apex half-angle of the conical form and the thickness of parts of the projectile piece being constructed and arranged to prevent extroversion under the effect of the pressure of the detonated explosive charge upon the outer surface of the projectile piece for propelling the same forwardly and reducing the cross-sectional area thereof by radially inward collapsing into a pencil-like mass.

6. A collapsible projectile for employment in the front of an explosive charge which has a surface cavity therein for receiving the projectile and by which charge an external collapsing pressure is exerted upon the outside of the projectile to cause it to be propelled forwardly and also to be reduced in cross-sectional area, comprising a rigid metal structure having a convex outer surface presented against the explosive charge and a concave inner surface positioned in the direction in which the projectile is to be propelled, said surfaces being essentially symmetrical about an axis extending forwardly from the bottom of the cavity and giving the projectile the general form of a hollow cone having an apex angle of 40 to 120 degrees, with its minimum wall thickness adjacent the axis, and having an increasing wall thickness toward the free edge, whereby the collapsing effect of the explosion gases upon the units of area of the external surface is relatively decreased in the direction from the apex toward the free edge.

7. A collapsible projectile for employment in the front of an explosive charge which has a surface cavity therein for receiving the projectile, and by which charge an external collapsing pressure is exerted upon the outside of the projectile to cause it to be propelled forwardly and also to be reduced in cross-sectional area, comprising a hollow metal piece of conical form with the inner surface at a less apex angle than the outer surface, the apex angle of the conical form being 40 to 120 degrees whereby a part of the larger cross-sectional diameter has a greater wall thickness than another part of lesser cross-sectional diameter, the apex angle of the conical form and the thickness of the parts of the projectile being constructed and arranged to prevent extroversion under the effect of the pressure of the explosive charge.

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