United States Patent

Bodinaux

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[54] HOLLOW CHARGE WARHEAD

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[52] **U.S. Cl.** **102/56,** 102/24

[51] **Int. Cl.** **F42b 13/10**

[58] **Field of Search** ..... 102/24 HC, 56

[56] **References Cited**

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1,220,306	6/1966	Germany	102/24 HC

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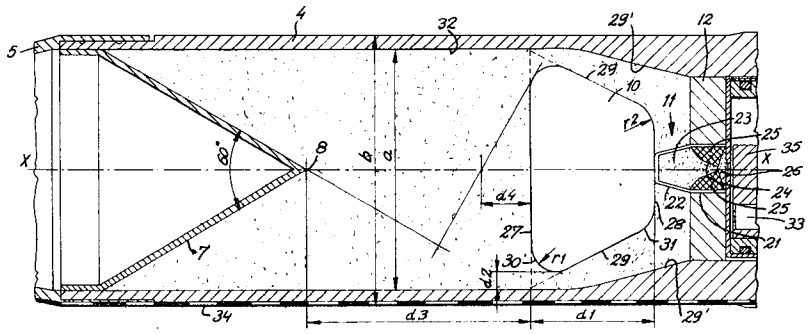
[57] **ABSTRACT**

A hollow charge warhead having an inert deflecting element embedded within said charge, said element being of a generally frusto-conical shape, the small basis of which being directed towards a punctiform detonator.

6 Claims, 4 Drawing Figures



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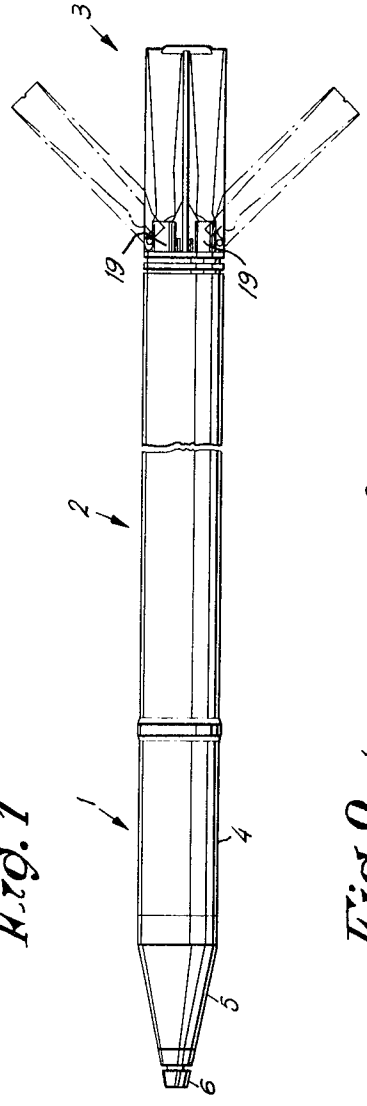

Fig. 1

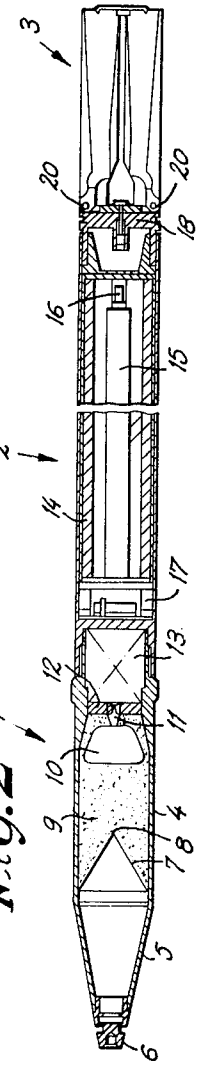

Fig. 2

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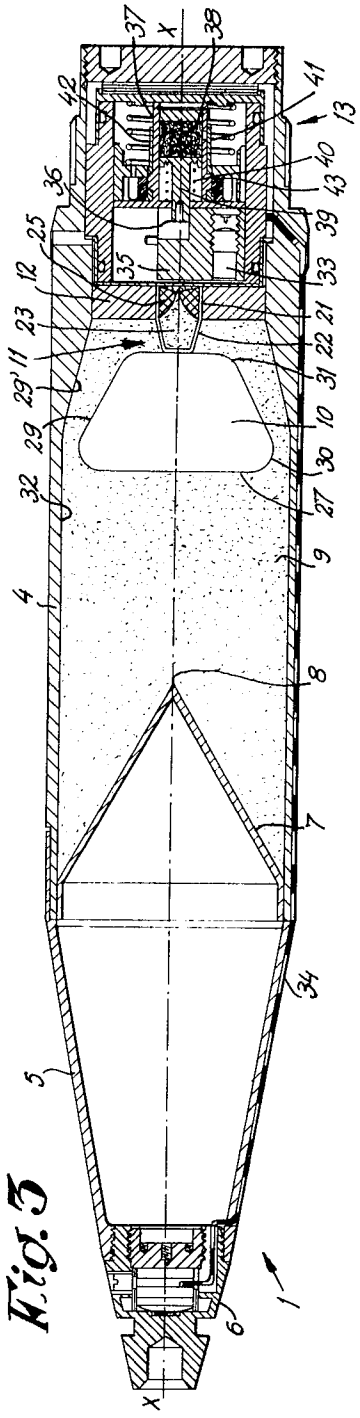

Fig. 3

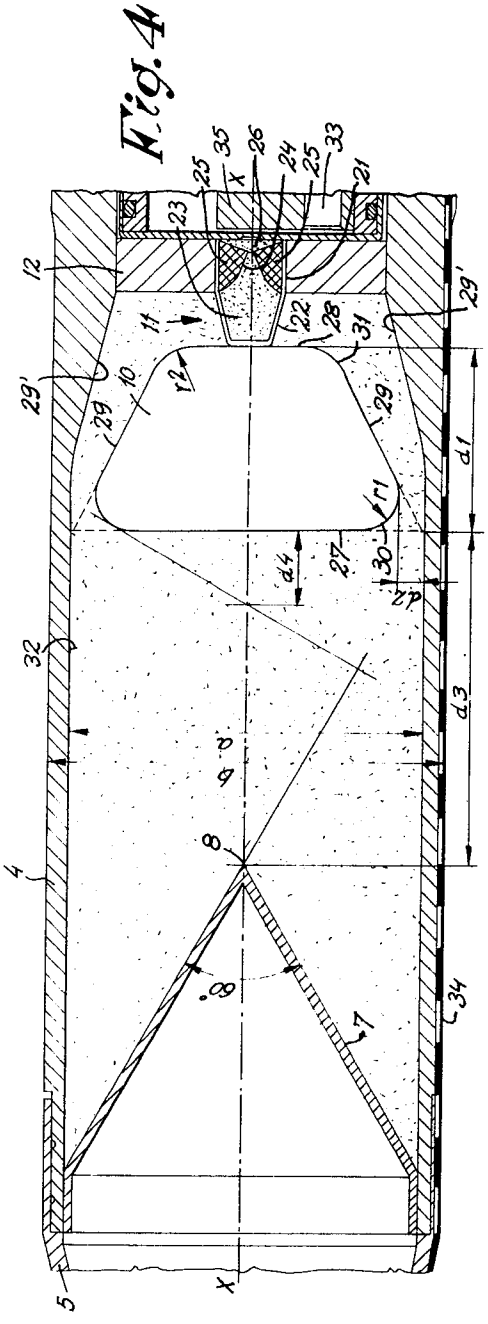

Fig. 4

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HOLLOW CHARGE WARHEAD

This invention relates to a hollow charge rocket having a particularly high perforating power.

It is well known that the efficiency of a hollow charge depends on a large number of parameters. In the present state of technics, neither the values of some of such parameters nor their interdependence may not always be formulated rigorously. Accordingly, the research of optimum results implies mandatorily a certain empiricism at a more or less important extent according to the cases.

Thus, in the hollow charges with a liner, it has already been proposed (DAS 1,070,536) to embed, within the explosive charge and at close vicinity of the firing area, an inert lenticular screen for guiding the detonating wave towards the periphery of the charge. However, such initially attractive solution has not resulted in satisfactory practical results and, consequently, it has not found a successful utility in the armaments technics.

To overcome this drawback, it has been suggested to embed, within the explosive charge, an inert revolution body of synthetic material, this element having a spherical area with rounded edges the smallest front surface of which lies in front of the liner tip at a distance therefrom which is lower than the half-diameter of the caliber, the thickness of said element being at least equal to 25 percent of the caliber diameter. Such disposition is namely described with details in the French Pat. No. 1,457,972. It has given excellent results for heavy missiles, but practical tests have demonstrated that most of its effects were lost for smaller calibers, namely in rocket heads of 2.75 inch. As regards the latter, there was presently no truly satisfactory solution. In fact, such known heads are able to pierce only blindages having a maximum thickness between about 150 and 200 mm under optimum conditions.

It is an object of the present invention to bring a solution to the problem set by the efficiency of small size hollow charge heads. The efficiency of the suggested solution will be appreciated in that, when proceeding with test firings, blindages with a thickness of 450 mm have been regularly pierced, the penetration openings of the tips having only a very small widening.

Such results are obtained according to the invention with a hollow charge having a liner comprising one or several of the following features:

a. in the explosive charge, is embedded an element under the form of a truncated revolution body the large base of which is directed to the liner and the small base, towards a pin-point detonator;
b. the connecting surfaces between the conical surface of the said element and the bases thereof are torus-shaped surfaces;
c. the liner, the said element and the pin-point detonator are strictly coaxial;
d. the distance between the large base of the said element and the tip of the said liner is at least equal to the half-caliber size.

Preferably, the inner wall of the head casing will have, in front of the conical surface of the said element, a truncated length the top angle of which is lower than that of the said conical surface of the element.

The intersection circle of the conical surface of the said element with the plane of its large basis is advantageously situated in the cylindrical surface defined by the inner wall of the casing.

The minimum distance between the element and the inner wall of the casing is of about one-fifteenth of the inner diameter of the latter.

The thickness of the said element, i.e., the height of the resolution body, is preferably between the half inner diameter and the half outer diameter or caliber size of the casing.

The characteristics of the invention will be more apparent by the following description of a specific embodiment given by way of information, reference being made to the enclosed drawings wherein:

FIG. 1 is a vertical section of a rocket according to the invention;

FIG. 2 shows the rock according to FIG. 1 in axial section;

FIG. 3 shows, on an enlarged scale, the head of the rocket illustrated in FIG. 2 and

FIG. 4 shows the geometry of the hollow charge.

The rocket shown in FIG. 1 comprises a head 1 a motor 2 and spreadable fins 3.

The head 1 comprises a cylindrical tubular casing 4 on the front portion of which is fastened a hollow cap 5 the top of which is provided with a piezoelectric generator 6 operating at the impact. In the front portion of the casing, is disposed a conical metal liner 7 the top or tip 8 of which is directed to the rear portion of the head and is situated as accurately as possible on the axis of the said casing 4. This liner is housed in a corresponding conical recess of a cylindrical explosive charge 9. Within this charge, is embedded an element 10 described hereafter. The basis of the said charge 9 opposite to that receiving the liner 7 is centrally provided with a truncated recess in which is inserted a pin-point detonator 11 which passes through a radial wall 12 provided in the said casing.

Behind this wall, is provided a fuse 13 of any suitable type cooperating with the said piezoelectric generator 6.

The motor tube 2 contains a propellent charge 14 of the double base type as well as a ballistic auxiliary means 15 applied on a rigid support 16. The charge 14 may be fired by means of a device shown diagrammatically in 17.

In its rear portion, the motor tube 2 is closed by a wall 18 supporting nozzles 19 as well as the pins 20 of the fins 3.

The detonator 11 is housed in a metallic case having a cylindrical portion 21 extended by a truncated portion 22. The length of portion 21 is substantially equal to the thickness of wall 12.

This case contains a rapid combustion powder charge 23 housed in the said truncated portion 22 and extended within the said cylindrical portion 21 by a concavely flanked point 24. This point 24 surrounded with a slower combustion powder charge 25 contacts the top of a conical charge 26 which is also of rapid powder. These various charges may be made integral with each other by gluing.

This construction provides an accurate centering of the end of point 24 on the axis of casing 4. The bottom of the said truncated portion 22 is parallel with the small base of element 10 at a very small distance therefrom or even in contact therewith.

As previously disclosed, this element 10 has a large base 27 situated in a plane perpendicular to axis X—X of casing 4 and directed to the point 8 of liner 7, a small base 28 directed to the detonator 11, a conical surface 29 and between the latter and the said bases, torus-shaped connecting surfaces 30 and 31 respectively.

As indicated in dotted lines on FIG. 4, the extended conical surface 29 intersects the plane of the large base 27 according to a circle situated in the cylindrical surface defined by the inner wall 32 of casing 4.

The distance d_1 separating the bases 27 and 28 is between the half inner diameter a of the casing and the half outer diameter b of the latter or the caliber size.

The minimum distance d_2 from element 10 to wall 32 is of about $a/15$.

The taper angle of surface 29 is slightly lower than that of liner 7 which is equal to 60°.

The curvature radii r_1 and r_2 of surfaces 30 and 31 respectively have each a distinct value between 1 and 2 times d_2. The distance d_3 separating the face 27 from the point 8 is higher than $b/2$. If d_4 is the distance between the face 27 and the intersection point, with axis X—X, of the tangent to surface 27 perpendicularly to the generatrix of liner 7 in the plane of FIG. 4, the distance d_3 will be preferably higher than $2.5 \times d_4$ and lower than $6 \times d_4$.

Preferably, the inner surface 32 of the casing will have, in front of surface 29 of the element 10, a conical section indicated in 29′ on FIG. 4, the charge 9 being profiled correspondingly. As shown, walls 29 and 29′ are converging towards the plane of the said face 27.

The element **10** may be made of any suitable synthetic material. However, it is preferably made of metal to prevent any distorsion as well under the acceleration effects as when the detonating wave is propagated.

With these arrangements, a detonating wave directed as perfectly as possible as well as an optimum tip effect are obtained, thereby allowing the outstanding performances initially mentioned. As regards fuse **13**, it may be of any suitable type. On FIG. **3**, a suitable fuse has been shown with some details. This fuse comprises an electric detonator **33** which may be energized by the piezoelectric element **6** via cable **34**, said detonator **33** being carried on a slide **35** the shifting of which is allowed after the withdrawal of a locking rod **36**. The withdrawal of said rod **36** is effected through the intermediary of a retardation device comprising a stationary cylinder **37** containing microballs **38** permanently forced back by a piston **39** having a spring **40**.

In the wall of cylinder **37**, is provided an opening **41** allowing the said balls **38** to escape provided this opening is uncovered. This is obtained by the shifting of a sleeve **42** under the inertia effect.

The shifting of the sleeve **42** is controlled by a safety ring **43** which is unlocked by inertia at the start.

It is apparent that the above described embodiments may be variously modified within the scope of the invention.

What I claim is:

1. Hollow charge warhead having a tubular casing, a conical liner, an explosive charge, a deflector embedded into said charge and a pin-point detonator, wherein:

a. the deflector is frusto-conical in shape, the large basic of which faces said liner and the small basis of which faces said detonator;

b. the axis of the conical liner, the deflector and the pin-point detonator are coaxial;

c. a pin-point transfer passage is provided between said detonator and said deflector;

d. at least the connecting surface between the conical surface and the large basis of said deflector is curved, the radius of curvature being at least equal to the shortest distance between said deflector and the inner surface of said casing;

e. the axial length of said deflector is at least equal to one fourth of the outer diameter of said casing; and

f. the inner surface of said casing has a conical portion facing and partly surrounding said deflector.

2. Hollow charge warhead according to claim **1**, wherein the shortest distance between said deflector and the inner surface of said casing is equal to approximately one-fifteenth of the inner diameter of said casing.

3. Hollow charge warhead according to claim **1**, wherein the intersection circle of the conical surface and the plane of the large basis of said deflector lies with the cylindrical surface of the inner wall of said casing.

4. Hollow charge warhead according to claim **1**, wherein the distance between the large basis of said deflector and the apex of said conical liner is at least equal to half the outer diameter of said casing.

5. Hollow charge warhead according to claim **1**, wherein the axial length of said deflector is comprised between half the inner diameter and half the outer diameter of said casing.

6. Hollow charge warhead according to claim **1**, wherein said pin-point detonator is housed in a metal case having a cylindrical section extended by frusto-conical section, the latter being seated in a corresponding recess of said explosive charge.

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