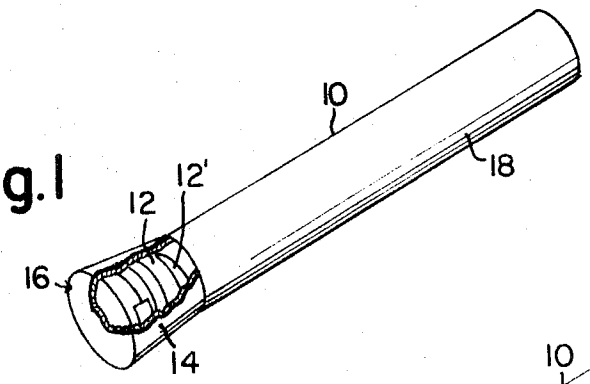
Sept. 2, 1969 S. WASSERMAN ET AL 3,464,356

SELF-STABILIZING ROD PENETRATORS

Filed Dec. 28, 1967

Fig. 1



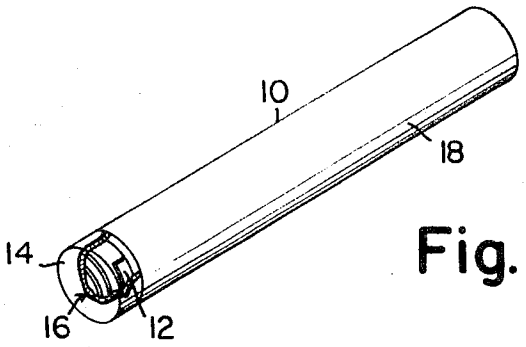


Fig. 2

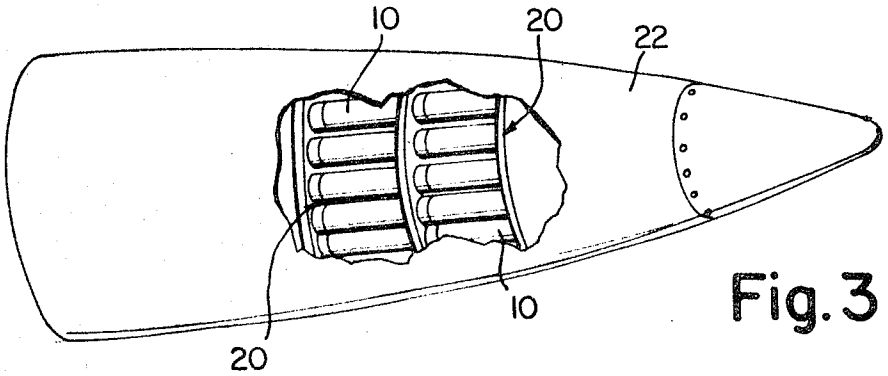


Fig. 3

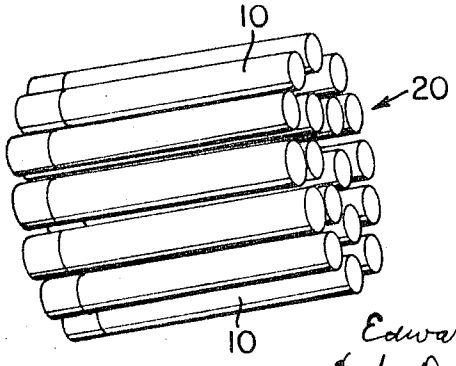


Fig. 4

INVENTORS
SAUL WASSERMAN
ROBERT SALZMAN
WALTER O'KEEFE
BY Harry M. Saragovitz
Edward J. Kelly, Herbert Berl
& S. Dubroff ATTORNEYS

United States Patent Office

3,464,356
Patented Sept. 2, 1969

3,464,356

SELF-STABILIZING ROD PENETRATORS

Saul Wasserman, Rockaway, N.J., Robert Salzman, Arlington, Va., and Walter C. O'Keefe, Landing, N.J., assignors to the United States of America as represented by the Secretary of the Army

Filed Dec. 28, 1967, Ser. No. 694,188
Int. Cl. F42b 25/08
U.S. Cl. 102—67 3 Claims

ABSTRACT OF THE DISCLOSURE

A rod for penetrating enemy target which includes a collapsible flared section on its rearward end, for permitting denser packing and aerodynamic stabilization.

The invention relates to a rod penetrator and more particularly to a rod penetrator having a collapsible flared section on its rearward end.

Rods of high length/diameter ratios have been found to be excellent penetrators. To effect penetration, the rods must contact their targets headon, which requires precise stability in flight.

Stability in flight may be achieved gyroscopically or aerodynamically the latter presenting fewer problems due to the elimination of any elaborate mechanisms needed for spin-up.

Aerodynamic stabilization of rods by means of a non-collapsible flared section on the rearward end thereof poses two major disadvantages, namely, (1) high drag and (2) low packing density. The flared section offers high drag resistance and quickly acts to reduce the velocity of the rod. This is not a serious problem, however, where distances of intercept are short or air densities are relatively low. In these two instances, the velocity of the rod will not decay substantially below that required to effect a kill.

The second disadvantage, that of low packing density, is of major importance since the number of lethal mechanisms capable of being carried by a warhead is directly related to hit probability.

One method of packing rods having flared sections would be to place the rods in a nose-to-tail fashion, thus, while desirably increasing the density of packing, would suffer the disadvantage of having one-half the rods launched backwards with obvious stability or aerodynamic drawbacks.

It is therefore an object of the present invention to provide a rod penetrator having a flared section on its rearward end for aerodynamic stabilization.

Another object is the provision of a rod penetrator having a collapsible flared section on its rearward end permitting denser packing than heretofore achieved.

The above objects as well as others together with benefits and advantages of the invention will be apparent upon reference to the detailed description set forth hereto wherein:

FIG. 1 is a perspective view with parts broken away, of the invention in its open position.

FIG. 2 is a perspective view with parts broken away, of the invention in its closed position.

FIG. 3 shows a pluralty of inventive devices as placed in a warhead.

FIG. 4 shows an enlarged view of a plurality of inventive devices.

As seen in the drawings, a rod penetrator **10** has a volute spring **12** secured to one end thereof. The spring is secured at its closed end **12'** to the rear of the rod penetrator **10** by the use of an epoxy resin. The spring **12** is covered by an elastic membrane **14** also secured by epoxy to the rod **10**. When the spring **12** is contracted, the rod **10** has the configuration as illustrated in FIG. 2. In this closed position the flared section **16** is contracted to the diameter of the solid cylindrical rod body portion **18** of rod penetrator **10** thereby enabling easy packing of the rod penetrators **10** into a dense matrix **20** (FIGS. 3 and 4). When the rods are packed in a matrix bundle **20**, the spring **12** of each rod **10** is held in compressive restraint by the adjacent rods, however when this restraining force is released by the breaking up of the matrix bundle **20**, the spring **12** expands, as shown in FIG. 1. The volute spring **12** has the unique property of expanding in width as well as length upon release. This expansion provides a supporting skeleton framework for the membrane **14** which is attached to the ends of the spring and which, upon the spring's expansion, stretches to its full length and width. The smooth surface of the membrane produces the outer assemblance of the frusto-conical configuration of aerodynamic contour, as shown in FIG. 1.

As an alternate method of construction the turn of the volute spring in expansion could be tight enough to provide a continuous aerodynamic surface without the need of a membrane.

In packing the matrix bundle **20** (FIG. 4) into a warhead **22** the flared section **16** of each rod penetrator would have to be held in such as way as to prevent the spring **12** from unwinding. Once the particular rod penetrator has been inserted into the matrix bundle **20** then each adjacent rod penetrator would prevent of its spring unwinding.

We claim:

1. A rod penetrator comprising:

a solid cylindrical rod,

a volute spring having an open end and a closed end and secured at its closed end to a rearward portion of said rod,

said volute spring being expandable from a constrained position in which it is cylindrical and of substantially the same diameter as said rod to an unconstrained position in which it expands axially and radially thereby to assume a frusto-conical configuration in which the forward base of the spring is contiguous with the rearward end of said rod and is smaller in diameter than said rod and the rearward base of the spring is larger in diameter than said rod, to maintain aerodynamic stability in flight of said rod penetrator.

2. A rod penetrator of the type described in claim **1** having an elastic membrane covering said volute spring.

3. In combination with a warhead having a matrix of rod penetrators, each rod penetrator including:

a solid cylindrical rod,

a volute spring having an open end and a closed end,

an elastic membrane covering said volute spring,

said volute spring secured at its closed end to a rearward portion of said rod and held in a constrained position in which it is cylindrical and of substantially the same diameter as said rod by the adjacent rod penetrators in said matrix whereby upon release of said matrix said rod penetrator will separate from said matrix and said volute spring will expand axially and radially thereby to assume a frusto-conical configuration in which the forward base of the spring is contiguous with the rearward end of said rod and is smaller in diameter than said rod and the rearward base of the spring is larger in diameter than said rod, to maintain aerodynamic stability in flight of said rod penetrator.

References Cited

UNITED STATES PATENTS

1,305,967	6/1919	Hawks	102—67
2,368,258	1/1945	Manson et al.	102—4
2,671,398	3/1954	Peck	102—4
3,081,703	3/1963	Kamp et al.	102—4
3,114,315	12/1963	Trump	102—4

FOREIGN PATENTS

550,001	12/1942	Great Britain.

BENJAMIN A. BORCHELT, Primary Examiner

J. FOX, Assistant Examiner

U.S. Cl. X.R.

102—4