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Osborn, jr.

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[54] **SILO CLOSURE ACTUATION**

[75] Inventor: **Garland W. Osborn, jr.**, Fountain Valley, Calif.

[73] Assignee: **The United States of America as represented by the Secretary of the Army**, Washington, D.C.

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[52] **U.S. Cl.** **89/1.8**, 89/1.817

[51] **Int. Cl.** **F41f 3/04**

[58] **Field of Search** ..... 89/1.8, 1.815, 1.816, 1.817, 89/1.818, 1.819, 30, 31, 1.812; 252/478; 102/42 C

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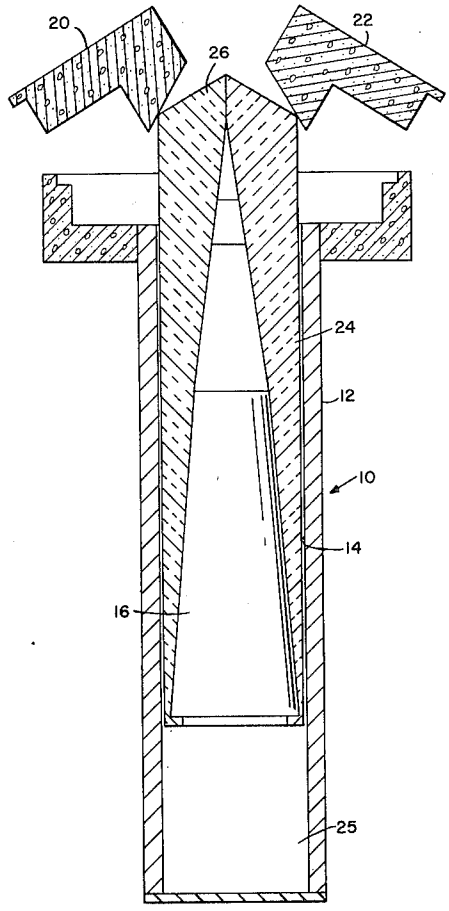
Primary Examiner—Samuel W. Engle

Attorney, Agent, or Firm—Lawrence A. Neureither; Leonard Flank; Harold W. Hilton

[57] **ABSTRACT**

A missile silo for enclosing the missile prior to launch. The silo includes a closure (door) which is hardened against nuclear induced overpressure, ground shock, and radiation to provide a massive structure, usually of concrete and steel construction. Silo closure actuation means is provided to open the door to permit launching of the missile. No source of power, other than missile propellant energy is required for opening the door.

2 Claims, 2 Drawing Figures



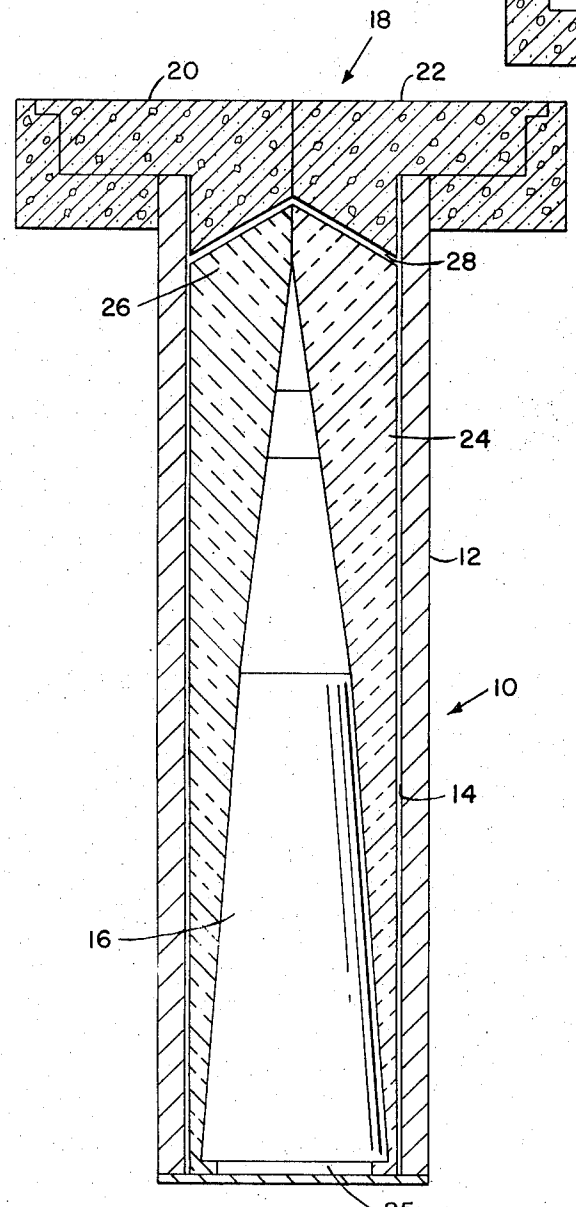


FIG. 1

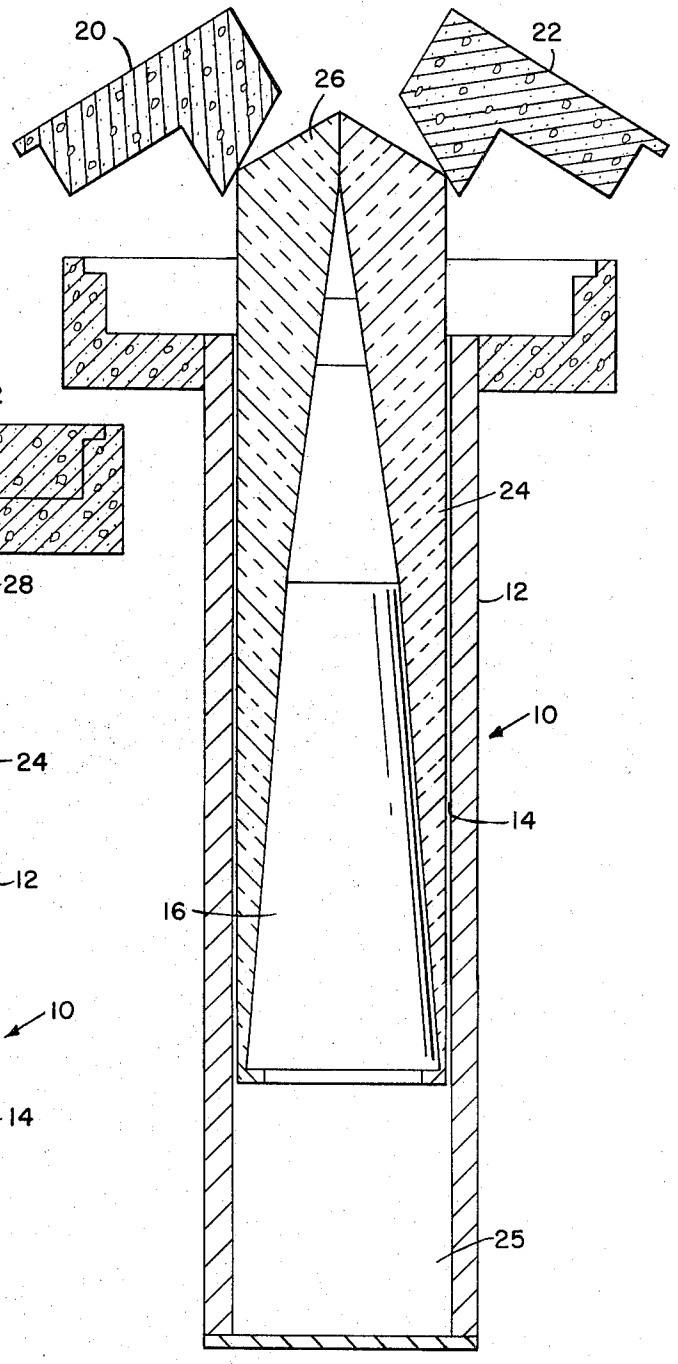


FIG. 2

SILO CLOSURE ACTUATION

BACKGROUND OF THE INVENTION

Hardened defense interceptors (and ICBMS) are protected by massive silo doors which shield against nuclear radiation and protect against overpressure. The time required to open the silo for launch is of great importance to the launch envelope and vulnerability of the missile when the site is under heavy attack. Present closures require large and costly mechanisms for opening and as presently designed, take many seconds, and often minutes to remove for launch.

SUMMARY OF THE INVENTION

The above noted difficulties are overcome by apparatus of the present invention which utilizes missile propellant energy for silo closure actuation, thus permitting great reductions in opening time and silo cost. A foam material is disposed for encasing the missile during storage thereof in the silo. The foam material encases the missile and extends upwardly therefrom in proximity of the door. The foam-encased missile pushes against the segmented silo door as it rises in the first travel of launch. As the door clears the silo portal (and covering debris), its segments are deflected aside from the foam covering. The foam remains around the missile until the door has been cleared.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an elevational view, partially in section, of a foam encased missile in a silo.

FIG. **2** is an elevational view, partially in section, similar to FIG. **1**, showing the initial movement of the missile opening the silo door.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in the figures, a silo **10** includes an annular wall **12** forming a chamber **14** having a missile **16** therein. A closure member **18** having a pair of segments **20** and **22** is disposed atop the silo for sealing the missile therein. A foam material **24** encases missile **16** and extends upwardly in proximity of closure member **18.** A portion of the foam is disposed between the nose of the missile and the closure member. A gap **28** is left between the upper end **26** of foam **24** and the underside of closure member **18,** to provide a "rattle-space" for accommodating nuclear-induced ground shock.

The foam material **24** may be comprised of a pair of semi-cylindrical sections placed around the missile and held in place by annular wall **12** of the silo.

As seen in the Figures, the underside of the closure segments **20** and **22** are tapered upwardly to the line of contact between the segments. The sections of foam material **20** are provided with upper surfaces which are tapered in parallel relation to the tapered surfaces of the closure segments. The tip of the missile is aligned with the line of contact of the closure segments.

The silo closure (door) is hardened against nuclear induced overpressure, ground shock, and radiation, resulting in a massive structure, usually of concrete and steel construction. The closure is restrained in place to the surrounding silo portal by electro-explosive attachments such as explosive bolts (not shown). When the signal to launch the missile is received, these attachments are released freeing the closure segments from the silo portal and from each other.

Concurrently, the launch tube plenum chamber **25** (beneath the missile) is pressurized by igniting a gas generator or by igniting the main propellant motor(s). In the latter case, the burning area of the propellant grain is reduced by thrust inhibiting material. This reduces the total mass flow of the burning missile propellants sufficiently so that the missile acceleration does not exceed the allowable compressive stress of the foam material between the missile and the closure. When a gas generator is used, its burning rate is designed to provide an increasing mass flow to coincide with the expanding plenum chamber volume created as the missile rises.

At launch, the missile and the column of foam rises in response to the expanding plenum chamber volume to contact the underside of the closure and to subsequently raise the closure segments clear of the surrounding silo portal (FIG. **2**). Once clear of the portal, the closure segments are free to separate and fall clear of the foam/missile.

The foam remains around the missile until the launch tube is nearly cleared, providing protection to the missile from debris which might cover the silo door prior to launch. The foam might be compounded from polyethylene and polyurethane which gives additional protection against fast neutrons, resulting from nuclear detonations in the vicinity of the silo. Secondary gamma rays are absorbed by boron additives in the foam and within the door shielding material.

The rate of missile acceleration is determined by the strength of the foam material and the allowable unit pressures transmitted to the skin of the missile. This acceleration rate is constrained by the density of the foam, the mass of the closure, and the weight of debris which might be present on the top of the closure. The mass flow of the ejecting gasses must be tailored to these conditions to achieve a minimum exit time without exceeding the foam and missile allowable forces.

The closure is segmented to reduce the time required to clear the missile flight path and to reduce the side-force applied to the foam surrounded interceptor. The contacting foam and the underside of the closure are angled away from the separation joint between the segments to aid segment separation.

I claim:

1. In a silo enclosing a missile, said silo having massive segmented closure members provided with underside surfaces tapered upwardly to the point of juncture of said closure members, means for rapidly opening said closure members comprising: foam means carried around said missile and extending upwardly between the nose of the missile and said closure members, said foam means having upper surfaces tapered in parallel relation to said tapered surfaces of said closure members and disposed in spaced relation with said closure members; and, means for propelling said missile upwardly whereby said tapered surfaces of said foam material engages said tapered surfaces of said closure members for displacement thereof.

2. Apparatus as in claim **1** wherein said foam means is provided with boron additives for absorption of secondary gamma rays.

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