Jan. 9, 1968 R. T. SCHERER ETAL 3,362,129

ALL-METAL SEAL AND METHOD OF FORMING SAME

Original Filed May 8, 1964

Fig. 1

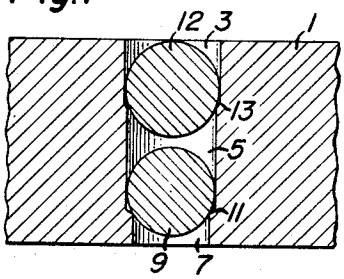


Fig. 2

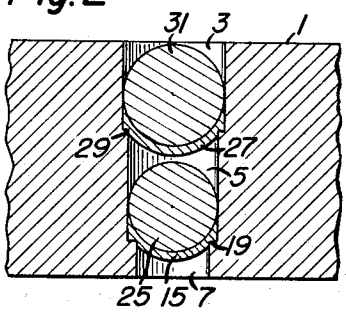


Fig. 3

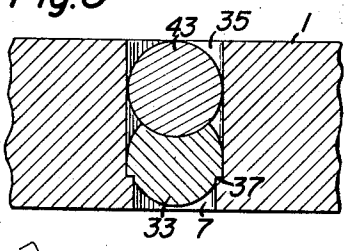
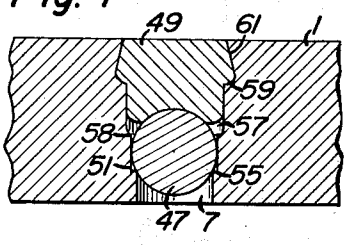


Fig. 4



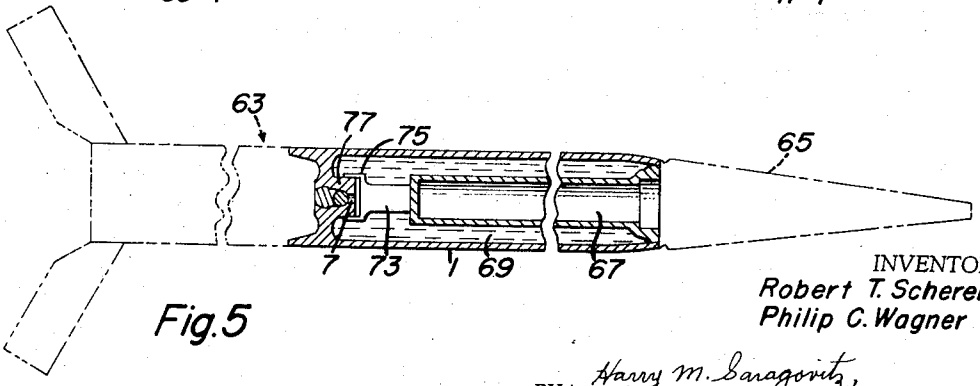


Fig. 5

INVENTORS
Robert T. Scherer
Philip C. Wagner

BY: Harry M. Saragovitz,
Edward J. Kelly,
Herbert Berl &
Benjamin G. Colley
ATTORNEYS.

United States Patent Office 3,362,129 Patented Jan. 9, 1968

3,362,129

ALL-METAL SEAL AND METHOD OF FORMING SAME

Robert T. Scherer and Philip C. Wagner, Baltimore, Md., assignors to the United States of America as represented by the Secretary of the Army

Continuation of abandoned application Ser. No. 366,201, May 8, 1964. This application Jan. 31, 1967, Ser. No. 613,042

10 Claims. (Cl. 53—43)

ABSTRACT OF THE DISCLOSURE

An improved chemical munition utilizing an aluminum ball sealing means and improved method whereby the munition filling orifice is effectively sealed.

This application is a continuation of application, Ser. No. 366,201, filed May 8, 1964, and now abandoned.

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 to us of any royalty thereon.

The main object of the invention is to provide a method through which various munition containers such as rockets, bombs, shells, etc., containing toxic chemical warfare agents are permanently sealed. Preferably, the seal is effected by means of two aluminum alloy balls. The opening to be sealed generally is provided with one or more annular shoulders in a manner set forth below. The aluminum balls are inserted and press-fitted against said shoulders of the opening or filling orifice of the aluminum container within the chemical munition; thus, providing a leakproof seal. The press for accomplishing the sealing operation of pressing the aluminum balls into the filling orifice of a container may be of the type as that which is described and shown in the patent to McKinley et al., No. 3,057,131. During the pressing operation, the container is held in a special fixture which grips the container by a circumferential groove on the exterior of the container arially located at or near the filling orifice. This is done to prevent deformation of the container since the pressure exerted during the sealing operation would deform the container if it were merely placed on its forward end. The aluminum alloy balls are generally in the range of one and one-half to two and one-half thousandths of an inch oversize. The preferred diameter of the balls is two thousandths of an inch oversize in order to provide a proper press fit.

The present method of inspecting closures of this type for leakage are based on the use of helium as a tracer. In general, the void space of the container is evacuated after filling with chemical agents, and helium is flowed into the said void space before closure. The helium usually is under atmospheric pressure, and in case of a leak in the seal, it is immediately detected by a commercial helium leak detector (Beckman Instruments, Inc.). The ball seal described herein has undergone leakage tests with the helium sealed into the munitions at 200 p.s.i.g. The munitions had a leakage rate less than 1×10^{-9} cc./sec. under the above test conditions. This is far in excess of the arbitrary maximum rate which is set at 1×10^{-6} cc./sec. of helium under 15 p.s.i.g.

In the past, the sealing of the filling orifice in munition containers has been done by means of threaded pipe plugs, gaskets, and by welding various types of plugs within the orifice. All of the closures of the latter type showed leakage when they were subjected to the previously mentioned commercially available helium leak detector, after extended storage periods during temperature conditions that varied from arctic to tropic conditions, which munitions of this type are subjected to during test conditions or actual use.

Other objects, features, and advantages of the invention will become apparent from the following description, and claims taken in connection with the accompanying drawing, in which—

FIG. 1 is a fragmentary cross section of a container showing the basic design of two hardened aluminum balls inside of a filling orifice of a chemical munition.

FIG. 2 is a fragmentary cross section of a container showing two hardened aluminum balls and two soft aluminum inserts inside of a filling orifice.

FIG. 3 is a fragmentary cross section of a container showing a hard and a soft aluminum ball and the deformation the lower soft aluminum in a modified filling orifice.

FIG. 4 is a fragmentary cross section of a container showing a hard and a soft aluminum ball and the deformation of the upper soft ball in a modified filling orifice.

FIG. 5 is a fragmentary cross section of a rocket employing our new seal.

The basic structure of our invention as shown in FIG. 1 comprises an aluminum container 1 having an outer bore 3, an intermediate bore 5, and an inner bore 7. A metal ball 9 made of hard aluminum (17S–T4) is press-fitted into the bore 5 by a hydraulic ram (not shown) against an annular shoulder 11 sealing the inner bore 7. A second metal ball 12 made of the same alloy as the first ball 9 is similarly press-fitted into the outer bore 3 against an annular shoulder 13. The second ball serves as a secondary seal which further assures a leakproof closure in the filling orifice of the container.

In FIG. 2 a soft metal insert 15 in the form of a disc made of aluminum alloy (2S–0) is loosely inserted into the intermediate bore 5. This insert is seated on an annular shoulder 19 covering inner bore 7 of a container 1. A hard metal ball 25 made of aluminum alloy (17S–T4) is then press-fitted against said insert 15 causing deformation of same around the annular shoulder 19. A second insert 27 made of the same alloy as the first insert 15 is seated on an annular shoulder 29. A second hard metal ball 31 made of the same alloy as the first ball 25 is similarly press-fitted against the insert 27, causing deformation of the latter around the annular shoulder 29. It is to be understood that after the whole sealing operation is completed, the metal balls themselves, as well as the inserts, are tightly lodged in their respective bores.

In FIG. 3 a soft metal ball 33 made of aluminum alloy (2S–0) is loosely dropped into bore 35, seating itself on an annular shoulder 37, covering inner bore 7 of a container 1. It is to be noted that the diameter of this ball 33 is of somewhat smaller diameter than the outer bore 35 so that it falls freely therein but substantially larger than the inner bore 7. A hard metal ball 43 made of aluminum alloy (17S–T4) is then press-fitted into the outer bore 35 where it encounters the ball 33 and causes deformation of the latter around the annular shoulder 37. Although a ball 43 is shown which distributes force evenly to ball 33, other forms and shapes such as a cylinder having a hemispherical end (not shown) may be used in lieu of the hard metal ball 43.

FIG. 4 shows the preferred embodiment of our invention which actually is a modification of the seal shown in FIG. 3. In this particular instance, the filling orifice of a container 1 has a hard metal ball 47 made of aluminum alloy (17S–T4) on the bottom, while a soft metal ball 49 made of aluminum alloy (2S–0) is on the top. The hard metal ball 47 forms a press-fit in the lower intermediate bore 51 sealing inner bore 7. This hard ball further is seated on an annular shoulder 55 which acts as a stop and which allows the soft metal ball 49 to be deformed

within an upper intermediate bore **57**. The soft metal ball **49** is further deformed around an annular shoulder **59** adjoining an outer bore **61**, but not down to the annular shoulder **58** and around the upper surface of the hard metal ball **47**. To withstand higher pressure, the wall of the bore **61** is tapered inwardly. This taper has been somewhat exaggerated in the drawing for the purpose of greater clarity. The preferred form of double ball seal as shown in FIG. 4, with the hard metal ball on the bottom, is much more desirable, since the hard ball is less susceptible to chemical attack than is the soft ball.

FIG. 5 shows a typical use of the final ball seal in a rocket generally shown at **63** with a nose cone **65** containing the fuze and arming mechanism, a burster tube **67**, the chemical agent **69**, the aluminum container **1**, burster support **73** with its support ring **75**, and sealed filling orifice **7**. It is to be understood that the burster **67** is attached to the forward end of the rocket by welding before filling, and to the rearward end of the rocket by the support ring **75** which is press-fitted to the filling boss **77**. The sealing of the orifice **7** can be accomplished by any of the methods shown in FIGS. 1–4.

Since the burster support **73** is mounted to the boss **77** by the support ring **75**, the chemical agent flows into the agent compartment through elongated slots in the support ring which are not shown for purposes of clarity.

The shoulders **11, 13, 19, 29, 37, 55, 59** are provided by drilling and counterboring the rotating containers on an appropriate machine tool such as a turret lathe. In the case of FIG. 4, the tapered bore **61** is provided by an operation using a special stationary boring tool.

While we have described our invention in some detail, we do not, of course, limit ourselves to the exact construction or details shown and these may be varied without a departure from the principles and scope of the invention.

We claim:

1. The method of sealing a filling orifice in an aluminum agent compartment of a chemical agent munition which comprises the steps of providing the orifice with two spaced annular shoulders, thereby providing an outer, an intermediate, and an inner bore, pressing into said orifice a first aluminum ball of a diameter slightly greater than the intermediate bore, and pressing into said orifice a second aluminum ball of a diameter slightly greater than said outer bore.

2. The method of sealing a filling orifice in an aluminum agent compartment of a chemical agent munition which comprises the steps of providing the orifice with two spaced annular shoulders, thereby providing an outer, an intermediate, and an inner bore, positioning in said orifice a first soft aluminum disk at the bottom of said intermediate bore, deforming said disk into place with a first hard aluminum ball of a diameter slightly greater than said inner bore, positioning in said orifice a second soft aluminum disk at the bottom of said outer bore, and deforming said second disk into place with a second hard aluminum ball of a diameter slightly greater than said outer bore.

3. The method of sealing a filling orifice in an aluminum agent compartment of a chemical agent munition which comprises the steps of providing the orifice with an annular shoulder located near the interior of said compartment, thereby providing an inner bore and an outer bore, positioning in said outer bore a soft aluminum ball of a diameter slightly greater than said bore, press-fitting a hard aluminum ball in said orifice and deforming said soft aluminum ball into sealing relationship with said bore with said hard aluminum ball of a diameter slightly greater than said outer bore.

4. The method of sealing a filling orifice in an aluminum agent compartment of a chemical agent munition which comprises the steps of providing the orifice with three spaced annular shoulders, thereby providing an inwardly tapered outer, an upper intermediate, a lower intermediate, and an inner bore, pressing into said lower intermediate orifice a hard aluminum ball of a diameter slightly greater than said bore, deforming a soft aluminum ball of a diameter slightly greater than said upper intermediate bore into said bore so that said ball substantially fills said upper intermediate and said outer bore.

5. A chemical munition having an aluminum agent compartment with a filling orifice wherein the improvement in combination therewith comprises said orifice having at least one annular shoulder, and two aluminum balls being in sealing relationship with said orifice, said balls being superimposed on each other; the lower ball being hardened and the upper ball being soft.

6. A chemical munition having a filling orifice wherein the improvement in combination therewith comprises said orifice having at least one annular shoulder, two aluminum balls of a diameter slightly greater than said orifice located within said orifice in sealing relationship, said balls being superimposed on each other; the lower ball being hardened and the upper ball being soft.

7. A chemical munition having a filling orifice wherein the improvement comprises said orifice having two spaced annular shoulders, an outer bore, an inner bore, an intermediate bore, a first aluminum ball having a diameter slightly greater than said intermediate bore located within said intermediate bore, a second aluminum ball having a diameter slightly greater than said outer bore located within said outer bore, both balls being in sealing relationship with said orifice.

8. A chemical munition having a filling orifice wherein the improvement comprises said orifice having two spaced annular shoulders, an outer bore, an inner bore, an intermediate bore, a first soft aluminum disk at the bottom of said intermediate bore, a hard aluminum ball having a diameter slightly greater than said intermediate bore located within said intermediate bore, said first aluminum disk being deformed into place with said hard aluminum ball, a second soft aluminum disk being positioned in said orifice at the bottom of said outer bore, a hard aluminum ball having a diameter slightly greater than said outer bore located within said outer bore, said second disk being deformed into place with said hard aluminum ball.

9. A chemical munition having a filling orifice wherein the improvement comprises said orifice having an annular shoulder, an outer bore, an inner bore, said shoulder being located betwen said bores, a soft aluminum ball having a diameter slightly smaller than said outer bore located within said outer bore and on said shoulder, a hard aluminum ball having a diameter slightly greater than said outer ball located within said outer bore and above said soft aluminum ball, said soft aluminum ball being deformed in place by said hard aluminum ball.

10. A chemical munition having a filling orifice wherein the improvement comprises said orifice having three spaced annular shoulders, a tapered outer bore, an upper intermediate bore, a lower intermediate bore, an inner bore, a hard aluminum ball having a diameter slightly greater than said lower intermediate bore located within said lower intermediate bore, said hard aluminum ball being press-fit into said lower intermediate bore, a soft aluminum ball having a diameter slightly greater than said upper intermediate bore located within said upper intermediate bore, said soft aluminum ball being deformed so that said soft aluminum ball substantially fills said upper intermediate and said outer bores.

References Cited

UNITED STATES PATENTS

1,100,439	6/1914	Mauran	53—324
1,827,573	10/1931	Fraser	220—24
3,057,131	10/1962	McKinley et al.	53—88

TRAVIS S. McGEHEE, *Primary Examiner.*