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[54] **OUTGASSING TECHNIQUE**

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[58] **Field of Search** ..... 102/103, 24, 2, 90, 102/56, 38, DIG. 8, 101

[56] **References Cited**

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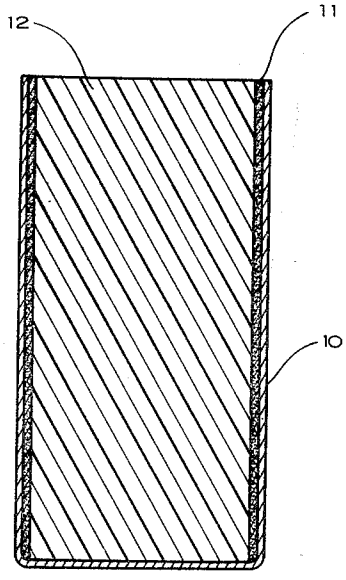
[57] **ABSTRACT**

An outgassing technique which comprises providing a chemical liner for a casing or container which will decompose into a gas with sufficient pressure to rupture the casing when the container is subjected to a high heat source. This allows release of any material within the container.

5 Claims, 1 Drawing Figure



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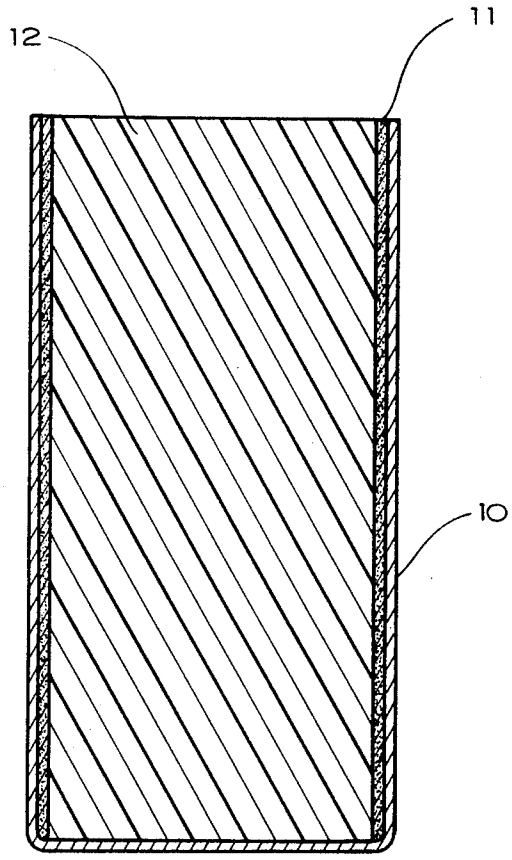

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OUTGASSING TECHNIQUE

BACKGROUND OF THE INVENTION

The present invention relates to an outgassing technique; more specifically, the placing of a gas producing chemical liner in a container which when subjected to a heat source creates sufficient pressure to rupture the container.

Various methods for rupturing containers such as warhead casings, bomb housings and other sealed vessels adapted for retaining explosives, pyrotechnics, propellants, pellets, antipersonnel material, etc., are known. However, means for causing rupture at a predetermined temperature has presented a problem. In the ordnance field detonation on the fast cook-off of a warhead or possibly a bomb creates a hazardous situation. Various techniques have been used to achieve the basic result which is to split the casing of the warhead or bomb open and permit the explosive contained therein to burn unconfined. A gas generating chemical formulation added to the high explosive has been utilized. The present invention provides a method of outgassing whereby the liner inside the container or casing consists of a gas generating chemical and/or binder which will decompose into a gas with sufficient pressure to rupture the casing when the casing is subjected to heat.

DESCRIPTION OF THE DRAWING

The single FIGURE shows a container which uses the outgassing chemical liner in accordance with this invention.

DESCRIPTION OF THE INVENTION

The present invention is for an outgassing technique or method illustrated in the single FIGURE which comprises covering the inside walls of container or casing **10** (which can be adapted to be hermetically sealed) with a chemical mixture to form a liner**11** of predetermined thickness. Liner **11** consists essentially of a gas generating chemical compound blended into a compatible binder for ease in painting, dipping, or otherwise suitably coating the inside of the desired container. When the container is subjected to heat, the liner decomposes into a gas with sufficient pressure to rupture the container and allow the contents to spill out. In the single FIGURE of the present invention a bomb casing **10** is shown loaded with high explosive, designated **12.** When the casing breaks the explosive deflagrates and burns in an unconfined condition. Warheads were also lined with the chemical blend, filled with explosive, and heated until the gas pressure created by decomposition of the liner ruptured the warhead releasing the explosive. The common problem to both warhead and bomb devices is the possibility of a detonation occurring during a gasoline or similar fire. The present invention is primarily concerned with preventing a detonation by creating sufficient excess pressure in the liner to split open a given bomb or warhead casing and allow the explosive to deflagrate and burn in an unconfined condition. It should be noted that not all explosives just burn when in an unconfined state; some detonate and set off a chain reaction of detonating bombs or warheads stored or stock-piled. This invention postulates that a thick liner with a gas generating chemical compound added could increase the time to open the case by a pressure rupture. Study of the problem indicated that the chemical compound used in such a liner should

contain certain basic properties such as (a) an endothermic decomposition, (b) a high density, (c) ability to decompose completely into a gas having a low molecular weight, (d) decomposition should not start until a predetermined temperature and then gas release should be immediate, (e) mole ratio of gas generated to chemical should be high, and (f) chemical compound must be compatible with the explosive or other material to be used.

One liner composition used successfully as a bomb casing liner such as shown in the single FIGURE consisted essentially of a mixture of about 10 pounds ammonium oxalate and 1.6 pounds of hot melt; another composition used consisted essentially of about 10 pounds of ammonium oxalate mixed with 2 pounds of black cavity paint. The cavity paint is a bituminous mixture either liquid or semiliquid at room temperature and the hot melt is a mixture of bitumens which occur in nature such as asphalt. The following Table I gives the results of fast cook-off obtained on a bomb containing standard Composition B explosive.

TABLE I. FAST COOK-OFF MK 82 (NO FUSE)

Test	Date	Explosive	Liner (100 mils)	Results
1	Aug. 1969	Composition B	Hot melt + AO See Note 1	Open case, deflagration 2 min. 25 sec.
2	Aug. 1969	Composition B	Black cavity paint + AO. See Note 2	Explosion (see Note 3) 3 min. 35 sec.

AO = ammonium oxalate

Notes:

1. About 10 pounds of ammonium oxalate mixed with about 1.6 pounds of melt was used for the liner in the bomb. This bomb may have been defective, the weld had a break present before the test.
2. About 10 pounds of ammonium oxalate mixed with 2 pounds of black cavity paint was used for the liner in these two bomb tests.
3. Four pounds overpressure at 20 feet.

Other binder materials may be used such as polyurethane and polybutadiene.

A deflagration is desired and an explosion is tolerated. The main objective of this invention is to avoid detonation of explosives in the container. The minimum cook-off reaction time is 5 minutes.

Warheads and bombs contain various high explosives. Composition B is used extensively in bombs. It was developed by the British during the period between World Wars I and II and was standardized by the United States in World War II. It consists of 55.2 percent RDX (cyclotrimethylenetrinitramine), 40 percent TNT (trinitrotoluene), 1.2 percent polyisoluctylene, and 0.6 percent wax.

A series of quick cook-off tests have been made with a modern warhead. The work was done to determine the reaction of the warhead when subjected to an enveloping flame. The enveloping flame for the quick cook-off test was produced by burning 450 gallons of aviation gasoline in a shallow-steel pan, which had about 150 gallons of water for leveling. The pan was one foot deep and 9 – 10 feet wide by 15 feet long, with the pan size depending on the pan used in a particular test. The thermocouple leads were protected from direct contact with the flame by the use of insulating material, although this was not always successful. The warhead in each test was suspended from a railroad rail by a chain and lugs about 3 feet above the gasoline. The gasoline was ignited remotely, using a flare for each test. The flames usually completely enveloped the warhead and

part of the supporting rail. Results of tests using general liners are listed in Table II below:

TABLE II.—FAST COOK-OFF DATA ON WARHEAD

Explosive	Booster	Liner material	Thickness (mils)	Test results
PBXN-101	Yes	Red cavity paint	20 (est.)	Detonation; 3 minutes, 0 seconds.
Composition B	Yes	Black cavity paint	20 (est.)	Detonation (Note #1); 5 minutes, 20 seconds.
Do	No	Black cavity paint with AO.	20 plus ½ inch bead	Case opened, deflagration; 4 minutes, 25 seconds.
Do	Yes	do	~100	Case opened, deflagration; 5 minutes, 0 seconds.
Do	Yes	do	~100	End opened, deflagration; 5 minutes, 15 seconds.
Do	No	Hot melt	100-175	Case opened, deflagration; 2 minutes, 20 seconds.
Do	No	do	100-200	Case opened, deflagration; 2 minutes, 0 seconds.

NOTE.—AO=Ammonium oxalate; No. 1 reaction started in approximately 2 minutes rupturing both end plates.

Several chemical compounds can be used due to their decomposition mechanism. Ammonium oxalate has been used and tested successfully because of its availability. The overall mechanism is listed below for several compounds mixed with black cavity paint or a hot melt consisting essentially of bituminous which occur in nature.

1. Ammonium oxalate (AO, 230° – 250° C.):
$NH_4OOCCOONH_4 \cdot H_2O \xrightarrow{\Delta} 5H_2O + NCCN$
2. Oxalic acid (150° C.):
$HOOCCOOH \xrightarrow{\Delta} CO_2 + CO + H_2O$
3. Oxamide (230° – 250° C.):
$NH_2OCCONH_2 \xrightarrow{\Delta} 2\,H_2O + NCCN$
4. Urea oxalate (178° – 234° C.):
$CO(NH_2)_2 \cdot C_2H_2O_4 \cdot H_2O \xrightarrow{\Delta} 2CO_2 + NH_3 + H_2O + CO$

Urea oxalate is very promising since its gas pressure is not based solely on the amount of water produced.

Other outgassing chemicals which cover the approximate range of 103° – 375° C. which may be used include ammonium formate, 5-amino-1H-tetrazole, oratic acid, semi-oxamazide and 1-formyl-3-thiosemicarbazide (which exhibit endothermic decomposition) and nitroguanidine, guanidine nitrate, oxalohydroxamic acid, ammonium nitrate and ammonium perchlorate (which exothermically decompose). For higher temperature (200° – 1,000° C.) outgassing chemicals the following may be used depending upon their compatibility with the explosive and liner binder:

oxalates: sodium, potassium, magnesium, calcium, aluminum and titanium;
carbonates: lithium, sodium, potassium, magnesium, calcium;
formates: magnesium, aluminum and sodium;
acetates: sodium, potassium, magnesium and calcium; and iodic acid.

The method comprises coating or lining the inside of a warhead, bomb casing or other desired container with an outgassing mixture consisting essentially of a gas generating chemical compound blended into a binder which is compatible with both the compound and the material which substantially fills the container, such as explosive, propellant or pyrotechnic. The coating or liner is generally about 20 to 100 mils thick. When the lined warhead or bomb for example, is subjected to an external high heat source, the liner will decompose into a gas with sufficient pressure to rupture the casing or container and allow the explosive to deflagrate or to burn.

One procedure for lining a bomb casing comprises pouring the mixture into the casing and then pouring out the mixture. This gives a smooth surface such as obtained in lining "small cans".

Another means for lining a container which is well known to the art comprises pouring a predetermined amount of the gas producing mixture into the preselected container, then rolling the container until the interior walls are evenly coated.

Lining bomb and warhead casings as described herein will alleviate the hazards of fire on the flight deck of an aircraft carrier caused by existing airborne weapons and stock piles. This invention will aid in delaying and in minimizing the damaging effects of cook-off.

What is claimed is:

1. A method for preventing a sealed vessel which contains an explosive from detonating on fast cook off of said explosive, said method comprising placing a liner between the explosive and the interior walls of the vessel which, when exposed to a temperature of a predetermined magnitude, will produce gases; heating the vessel to decompose the liner; and rupturing the vessel by gases produced by the decomposing of said liner to permit the explosive to burn without exploding.

2. The method in accordance with claim **1** wherein said liner comprises a binder consisting essentially of bitumens which occur in nature and a chemical compound which will decompose into gases when subjected to heat from a source outside said vessel.

3. The method in accordance to claim **2** wherein said chemical compound exhibits endothermic decomposition into gases and is selected from the group consisting of ammonium oxalate, oxalic acid, oxamide, urea oxalate, ammonium formate, 5-amino-1H-tetrazole; orotic acid, semioxamazide, and 1-formyl-3-thiosemicarbazide.

4. The method in accordance with claim **2** wherein said chemical compound exhibits exothermic decomposition into gases and is selected from the group consisting of nitroguanidine, guanidine nitrate, oxalhydroxamic acid, ammonium nitrate and ammunium perchlorate.

5. The method in accordance with claim **2** wherein said chemical compound decomposes into gases at a temperature between 200° and 1,000°C and is selected from the group consisting of the oxalates of sodium, potassium, magnesium, calcium, aluminum, and titanium, the carbonates of lithium sodium, potassium, magnesium, and calcium, the formates of magnesium, aluminum, and sodium, the acetates of sodium, potassium, magnesium, and calcium and iodic acid.

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