

[54] CLOSEABLE CONTAINERS HAVING
MEANS FOR SUPPRESSING FIRE AND/OR
EXPLOSIONS

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[58] Field of Search 220/88 R, 63 R, 63 A, 3,
220/26, 88 A; 215/52, 53

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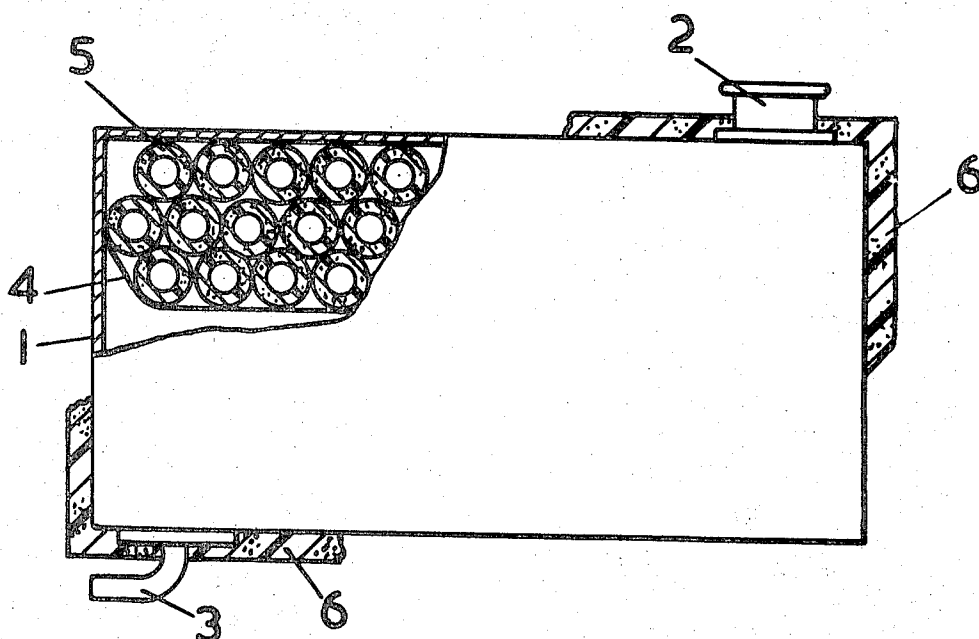
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Stowell & Stowell

[57] ABSTRACT

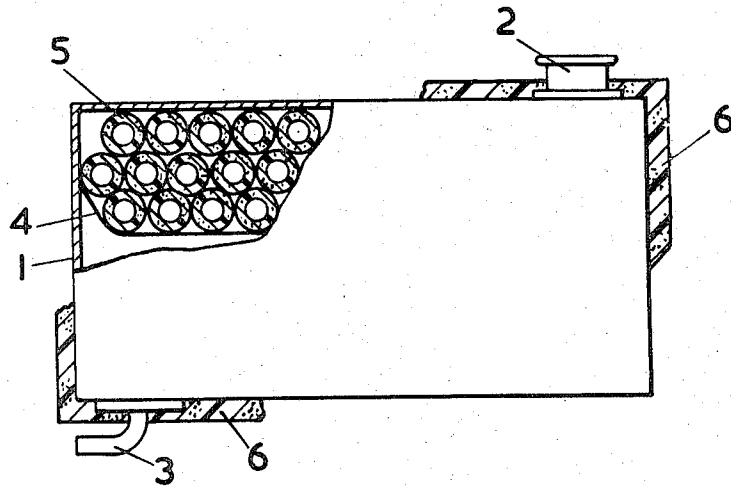
A closeable container having therein a plurality of foam balls having a porosity of 15–25 pores per linear inch, which balls together with the void spaces therein occupy the space within the container to an extent that there is left externally of the balls and within the container a volume equivalent to more than 50 per cent of the total interior space within the container, so that in the event of a fire within the container an unacceptable pressure rise therein may be prevented.

9 Claims, 1 Drawing Figure



PATENTED JUL 9 1974

3,822,807



CLOSEABLE CONTAINERS HAVING MEANS FOR SUPPRESSING FIRE AND/OR EXPLOSIONS

This invention relates to closeable containers having means for suppressing fire and/or explosion and in which there may be present in the ullage a flammable mixture which constitutes a potential fire and/or explosion hazard. It is concerned with the more effective use of balls of openly reticulated foam as a fire and/or explosion suppressing means in containers.

A container according to the present invention contains a plurality of balls of openly reticulated plastics foam having a porosity of 15-25 pores per linear inch which balls together with the void spaces within them occupy the container to an extent that there is left externally of and between the balls and within the container a volume equivalent to more than 50 percent of the interior volume of the container whereby in the event of a fire within the container an unacceptable pressure rise is prevented.

The foam pieces may comprise balls of foam and may be hollow comprising a foam layer surrounding a hollow interior. Preferably, hollow balls of diameter 1-6 inches and wall thickness $\frac{1}{2}$ -1 inch may be employed, the preferred wall thickness depending on the hardness of the foam as much as the size of the ball.

Preferably polyurethane foam material is used having a density of 12-30 Kg/m³, a porosity of 15-25 pores per linear inch, and being over about 95 percent void by volume.

Experiments show that the ignition of an explosive propane gas/air mixture or a mixture of air and evaporants from aviation fuel in a hollow container may result in a pressure rise of 100 lb/sq in.

In the case of aircraft fuel tanks their ability to withstand internal pressure rises may vary from as low as 2 lb/sq in for civil aircraft to as high as 60 lb/sq in for current military aircraft.

The use of polyurethane foam balls in either solid or hollow form and having a porosity of 15-25 pores per inch which occupy a container to an extent that there is left externally of and between the balls and the interior of the container a volume equivalent to 50 percent of the tank volume, leads to a consistent and repeatable pressure rise of not more than 25 lb/sq in following ignition of an explosive mixture in the tank.

Similarly if the foam volume used is reduced so that the volume left is 60 percent and 70 percent then the pressure rise following ignition is reduced to 40 and 60 lb/sq in, respectively. Thus the maximum volume left in current conditions may be about 70 percent.

It is found that if the foam used has a porosity of less than 15 pores per linear inch its effectiveness is reduced as it does not provide the desirable refuge volume within it for the advancing pressurised gases which result following ignition of the mixture. Also, if a higher porosity than 25 pores per linear inch is used the drainage rate of fuel from the foam may be too slow.

To be effective the balls must be in the ullage and for a container which remains stationary the balls are arranged to occupy at least the upper region of the container. Thus as the contents are drained off any ullage formed will contain foam balls. For containers liable to movement and possible inversion, as in the case of an aircraft fuel tank, the balls will be supported within the containers so that whatever its position some at least of

the balls will be present in the ullage as it is formed. For example, balls may be supported adjacent the inner side walls of a container in a netting support.

The actual diameter of the pores in the foam will vary both as between pores in a given type of foam and between different types of foam. However, ideally the type of foam used is such that the skeletal strands of material which surround and define the pores are as small as possible. Thus, in the case of a typical polyurethane foam having 15 pores per linear inch, diameter of the individual pores was in general in the range of 0.06-0.064 inches with some smaller and some larger pores as is common with this type of foam material. The preferred density of the foam is of the order of 12-15 Kg/m³.

The container may also be provided with a layer of openly reticulated foam, of similar plastics material but with a porosity of 70-100 pores per inch, covering at least part of its external surface.

An embodiment of the invention will now be described, by way of example, with reference to the accompanying drawing which is a part sectioned diagrammatic representation of a fuel tank in accordance with the invention.

As shown in the drawing the tank 1 has an inlet and closure assembly 2 and an outlet 3. A net 4 attached to the sides of the tank carries a plurality of hollow polyurethane foam balls 5. The tank is enclosed in a 2 inch layer of reticulated polyurethane foam 6 having a porosity of 80 pores per linear inch.

We claim:

1. A closeable container defining an interior space for contents, closure means for closing the container, and a plurality of balls of openly reticulated plastics foam within the container which together with the void spaces within the pieces occupy the space within the container to an extent that there is left externally of the balls and within the container a volume equivalent to from more than 50 percent up to about 70 percent of the total interior space within the container, and the balls having a porosity of about 15-25 pores per linear inch.

2. A container as claimed in claim 1 and wherein at least some of the balls are hollow and comprise a foam layer surrounding a hollow interior.

3. A container as claimed in claim 1 and wherein the hollow balls are 1-6 inches in diameter and comprise a foam layer $\frac{1}{2}$ -1 inch thick and surrounding a hollow interior.

4. A container as claimed in claim 1 and wherein the foam has a density of about 12-15 Kg/m³ and is at least 95 percent voids by volume.

5. A container as claimed in claim 1 and wherein the foam is a polyurethane ester foam.

6. A container as claimed in claim 1 and having therein net means retaining some at least of said balls in a normally upper part of the container.

7. A container as claimed in claim 1 and having a layer of openly reticulated plastics foam covering at least part of its exterior surface.

8. A container as claimed in claim 7 and wherein the foam layer has a porosity of 70-100 pores per linear inch.

9. A container as claimed in claim 7 and wherein the foam layer comprises polyurethane ester foam.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,822,807 Dated July 9, 1974

Inventor(s) John Angus MacDonald et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Cover page, item [75] "MacDonald" should read
--Macdonald--; after item [21] insert
--[30] Foreign Application Priority Data
Mar. 15, 1971 Great Britain 6862/71--.

Signed and sealed this 8th day of October 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents