United States Patent

[11] 3,578,767

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[21] Appl. No. **782,886**
[22] Filed **Dec. 11, 1968**
[45] Patented **May 18, 1971**

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[54] **SAFETY AND ARMING DEVICE**
4 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **102/70.2,** 200/153T
[51] **Int. Cl.** **F42c 15/32**
[50] **Field of Search** 102/70, 70.2, 76; 200/61.04, 153.19

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ABSTRACT: A safety and arming device activated by contact with a liquid activator and armed by the evaporation of the liquid. An element of the device expands when contacted by the liquid activator and contracts when the liquid evaporates; the expansion of this element collapses a member and the element's subsequent contraction activates a switch which arms the device.

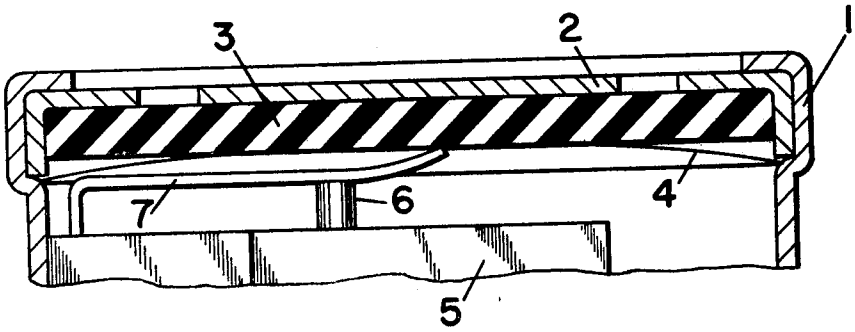


FIG. 1

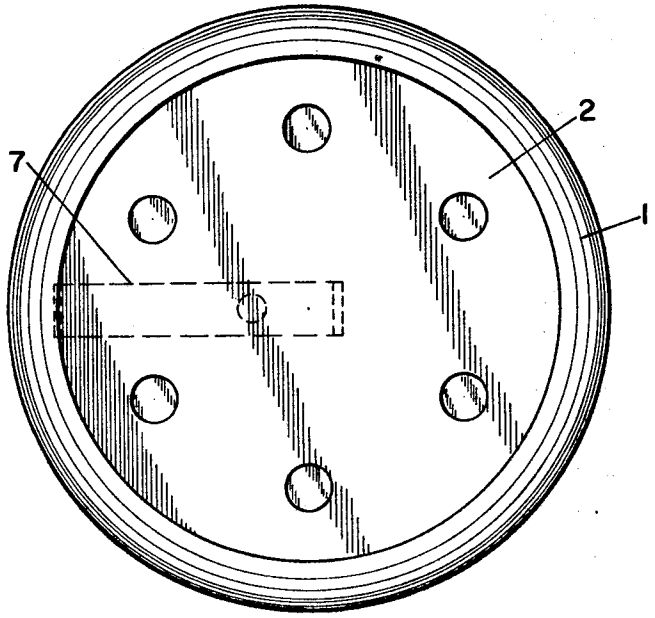


FIG. 2

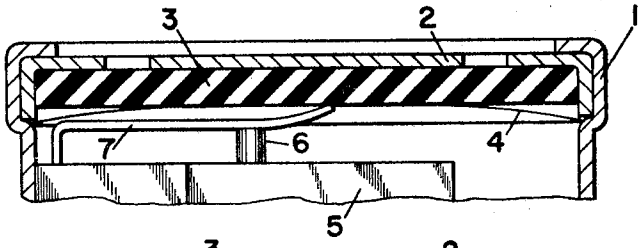


FIG. 3

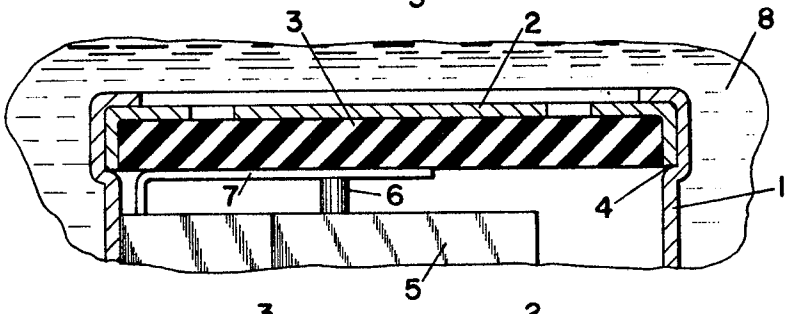
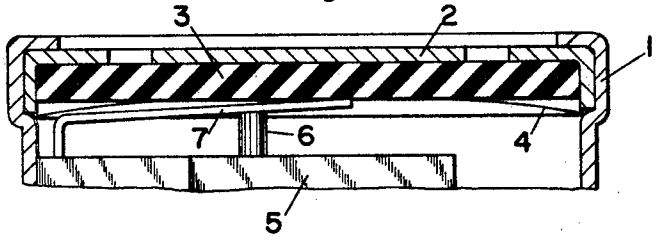


FIG. 4



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SAFETY AND ARMING DEVICE

This invention relates to a safety and arming device. Specifically, it relates to a safety and arming device which is activated by contact with a liquid activator and is armed by the evaporation of the liquid.

Small bombs or warning detonators are sometimes stored in liquid Freon or in other liquids. This prevents accidental explosions since the charge used is desensitized by the liquid. However, it limits the range of charge materials that can be used to materials which are desensitized by a particular liquid.

I have invented a safety and arming device which is manufactured and shipped in a safe position, which can be activated by placing it in a conventional liquid storage tank, and which is armed by the evaporation of the liquid. Thus, my device need not be shipped or stored in a liquid, and no special charge materials are needed since the charge can be sealed off from the liquid in which it is eventually placed for activation. The device may be used to arm warning detonators, bombs, or other instruments.

The accompanying drawings help to explain my invention by illustrating a specific and presently preferred embodiment of it.

FIG. 1 is a plan view, partially in phantom, of my safety and arming device.

FIG. 2 is a partial side view of the device in the safe position.

FIG. 3 is a partial side view illustrating the device after it has been activated by being placed in a liquid activator.

FIG. 4 is a partial side view of the device after it has been armed by the evaporation of the liquid activator.

In the drawings, a can 1 holds the safety and arming device in addition to other components (not shown) of the bomb, warning detonator, etc. The can is open at the top, and a perforated plate 2 is fitted into the rim of the can. Immediately below plate 2 is a liquid-sensitive element 3 which is held in place by flexible metal diaphragm 4. Fixed relative to element 3 is switch 5 which is operated by switch plunger 6. A collapsing member 7 is in pressure contact with both switch plunger 6 and, by way of diaphragm 4, element 3.

Referring specifically to FIG. 2, where the device is shown as manufactured in its safe position, member 7 is uncollapsed and keeps switch 5 unactivated by keeping plunger 6 down.

In FIG. 3, the device has been submerged into a liquid activator 8. The liquid has flowed through the perforations in plate 2 contacting element 3 causing it to swell. The swollen element presses diaphragm 4 against member 7 collapsing it by permanently flattening it. Plunger 6 is still down and the switch has therefore not been activated.

In FIG. 4, the device has been removed from the liquid and, after a period of time, the liquid has evaporated from element 3 causing it to contract. Because of this contraction, diaphragm 4 has moved up and plunger 6 has pushed up collapsed member 7, thus activating switch 5. The device is now armed and may be fired by a trembler switch, timer, or other means (not shown).

The liquid-sensitive element is a substance which has the properties of expanding when contacted by a particular liquid, and of contracting when the liquid evaporates from the element. The expansion must be sufficient to collapse the collapsing member, and the subsequent contraction must be sufficient to permit the switch to be activated.

The liquid-sensitive element must, of course, be used in conjunction with a liquid to which it is sensitive. Examples of such elements include almost any cross-linked elastomeric material such as cross-linked polybutadiene which expands in most hydrocarbon solvents including aromatic solvents such as benzene. Thiokol and GRS rubbers also may be used in conjunction with hydrocarbons, ketones such as acetone, ethers, etc. Polyurethane may be used with polar solvents such as alcohols and ketones. Nonelastomers may also be used such as radiation cross-linked polyethylene with various hydrocarbons.

I have found that silicone rubber and Freon products are particularly useful because the amount of expansion of silicone rubber is very large and the rubber returns to its original size when the Freon evaporates. Freon products are safe and commonly used liquids for storing bombs, warning detonators, etc. Freon is a trademark for fluorine-containing halogen derivatives of lower hydrocarbons to C_4. Examples of various Freon products include trichlorofluoromethane, chlorotrifluoromethane, bromotrifluoromethane, dibromotetrafluoroethane, octafluorocyclobutane, tetrachlorodifluoroethane, etc.; trichlorotrifluoroethane (Freon-113) is preferred.

The element and liquid may be selected so as to obtain a desired rate of expansion or evaporation; thus, one may control both the degree of contact with the liquid necessary to collapse the member as well as the amount of time before the device is armed after removal from the liquid. The rate of evaporation can also be controlled by the degree to which the element is exposed to air.

The collapsing member may be in almost any form and may be made of any suitable material such as plastic or a metal, for example, dead-soft copper. The member must be of sufficient strength to withstand the pressure necessary to keep the switch unactivated when the device is in the safe position. However, the member should collapse permanently when the pressure on it is increased because of the expansion of the liquid-sensitive element. Also, when the member collapses, it should collapse in such a way that the switch is not activated; that is, if the liquid-sensitive element is expanding very slowly as is usually the case, the member should not collapse so suddenly as to activate the switch before the liquid-sensitive element has expanded enough to keep the switch unactivated.

The switch can be of any type which is kept unactivated by pressure thereon and which is activated by the lessening of this pressure. The element and the switch must be positioned so that the element, when expanded, will continue to keep the switch unactivated even though the member has collapsed. Yet, the element must be sufficiently distant from the switch to permit the activation of the switch when the element has contracted.

I claim:

1. A safety and arming device comprising:
   a. an element which expands when contacted by a liquid activator and which contracts when said liquid activator evaporates therefrom;
   b. a switch fixed relative to said element and activated by a release of pressure on said switch; and
   c. a permanently deformable member positioned between and in pressure contact with both said element in unexpanded condition and said switch, said pressure being sufficient to maintain said switch in an unactivated position, said member being capable of withstanding said pressure but having the property of permanently collapsing under the additional pressure of said element when expanded by said liquid activator, said collapsing being insufficient to activate said switch until said element has contracted.

2. The safety and arming device of claim 1 wherein said element is comprised of a cross-linked elastomeric material.

3. The safety and arming device of claim 2 wherein said cross-linked elastomeric material is silicone rubber and said liquid activator is a fluorine-containing halogen derivative of a lower hydrocarbon to C_4.

4. The safety and arming device of claim 3 wherein said fluorine-containing halogen derivative of a lower hydrocarbon to C_4 is trichlorotrifluoroethane.