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ARTICLES PROTECTED AGAINST ENVIRONMENTAL EFFECTS

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Fig. 1

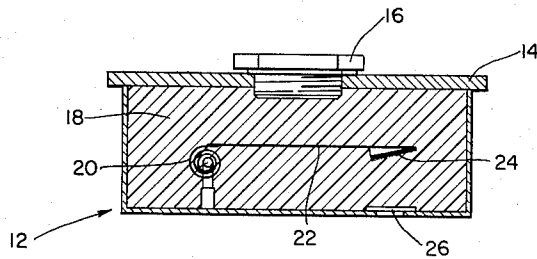


Fig. 2

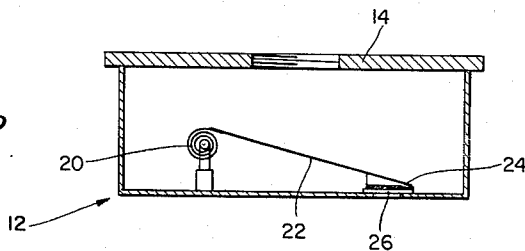
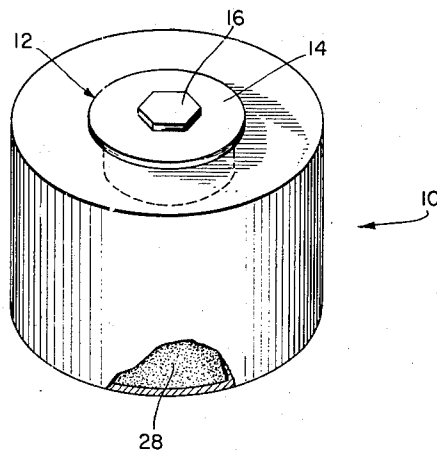


Fig. 3



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5 Claims. (Cl. 102-8)

This invention deals with a method for controlling the effects of environment. More particularly, this invention relates to protecting articles against mechanical, electrical and chemical change due to their environment and also provides means for actuating such changes when desired. In essence, this invention provides environmental control by temporarily isolating the article to be protected with a plastic, innocuous, solid substance that can be removed when desired simply by sublimation.

One embodiment of this invention comprises the protecting against mechanical change and damage (e.g., shock damage) of delicate objects such as timing devices, instruments and their parts, electrical circuits, electronic apparatus, sensitive cam and gearing devices and the like. In the past, such objects were carefully packaged in special wrapping materials such as excelsior, vermiculite, paper wadding, foam compositions and the like. Removal of such packaging and protecting means is frequently difficult and time consuming and often requires that the article be disassembled, cleaned, reassembled, and tested or restandardized. In some cases no completely satisfactory method of packaging exists.

A second embodiment of this invention involves protection of articles and substances against chemical change and damage due to corrosion effects, toxicity effects, moisture, oils, grease, oxidation processes, etc. Formerly, protection against chemical change has been accomplished by a variety of methods, many of which are difficult or cumbersome to employ. Multiple wrapping of the article to be protected is a common protective means. Coating with, or immersion, in various materials such as oils, greases, etc. Is also often used. Use of desiccants, chemicals, special wrapping material and the like is also frequently employed. Each of these methods has its disadvantages usually due to the contamination and the subsequent cleaning required when the protection is removed or to package bulk, weight and cost.

Still further embodiments of this invention reside in the prevention of accidental activation of mechanisms which might occur due to environmental conditions. Another embodiment is in triggering devices which may be used to start and stop chemical, electrical and mechanical systems. Further embodiments and variations will be obvious from the description of the invention which follows.

As indicated, the invention provides environmental control by isolating the article to be protected from its environment with a plastic, innocuous solid material which can be removed when desired by evaporation at ordinary temperatures. Because of its unique combination of desirable properties, this invention uses highly fluorinated cyclohexanes as the plastic solid. The term "highly fluorinated cyclohexane" refers to cyclohexane containing a near theoretical amount of fluorine, say from 72% to 76% by weight. Such highly fluorinated cyclohexanes may be prepared by fluorination of benzene (e.g., Bigelow and Fukuhra, J.A.C.S. 63 2792 (1941)) and are transparent plastic amorphous solids. Examples of such compounds are perfluorocyclohexane C_6F_{12} (sealed tube B.P. $51^\circ C.$), C_6HF_{11} (sealed tube B.P. $62^\circ C.$), and the somewhat less fluorinated compounds boiling at about $80^\circ C.$ (sealed tube).

Preparation of these compounds by the above or alter-

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nate processes usually leads to mixtures of highly fluorinated compounds (sealed tube B.P. 53° to $78^\circ C.$) and such mixtures may also be used in this invention. These compounds have very desirable properties such as low heat of vaporization, good electrical insulation properties, no or little solubility in water and many organic solvents, resistance to attack by many reactive chemicals and elements, resistance to the vapors of many organic solvents, water and reactive liquids, resistance to many reactive gases, inertness and stability to chemical decomposition (as in hydrolysis), non-toxic properties, and in combination with these other desirable properties, these polyfluorocyclohexanes sublime rapidly at ordinary room temperatures.

Use of these highly fluorinated cyclohexanes to control environmental effects on articles is quite simple. When an article is to be protected against mechanical damage (e.g., damage due to motion or shock) the article is simply imbedded in the fluorocompound. This imbedding is accomplished readily by placing the solid fluorocompound around the article or, preferably, by distilling the fluorocompound into the cavity containing the article to be protected where it solidifies into a clear, colorless, amorphous or glassy solid. If the imbedded article is to be held this way for any length of time, it is cased (i.e., enclosed) to prevent premature loss of the fluorocyclohexane. After the thus protected article is shipped, stored, and ready for use, the casing is either partly or completely removed and the polyfluorocyclohexane evaporates rapidly, leaving the clean, undamaged article. Due to the plastic nature of the fluorocyclohexane, the mechanical shocks and strains to which the package is subjected during transport are absorbed and not transmitted to the protected article.

In like manner, articles are protected against environmental chemical changes by surrounding the article with the highly fluorinated cyclohexane.

When it is desired to prevent accidental activation of mechanical, electrical or chemical devices, the activating mechanism involved is isolated from the activating environment with the fluorocyclohexane. To illustrate, an electronic device is set to activate a series of events by the activation of a relay. The device is protected against premature use by inserting the fluorocyclohexane between the relay contacts and sealing the relay unit. If the relay activating switch is pushed accidentally, no activation occurs because of the open contacts. Activation of the unit by the switch and relay is readily made possible, however, by opening the seal and vaporizing the fluorocompound. Similarly, when a trigger device is desired, the fluorocyclohexane is simply inserted between normally closed contacts of the device to be triggered. Thus, the contacts are isolated from their environment which tends to keep them closed. When the fluorocyclohexane evaporates, their environment causes the contacts to close, and the device is activated. This technique is useful for time devices, and time delay may be controlled by the amounts of the fluorocyclohexane between the contacts. Similar triggering techniques involve use of the fluorocyclohexane as a mechanical support in various devices which are actuated by volatilization of the fluorine compound. The following examples illustrate some specific uses:

(a) In war heads, to activate them in flight by the removal of the polyfluorocyclohexane supporting medium; for example, by removing a seal before firing the projectile, or by a frangible disk which ruptures as the internal pressure due to frictional warming of the projectile increases, after which the supporting medium freely escapes and the war head is activated.

(b) In land mines, where the detonating material or mechanism is held inactive by the supporting medium which, on placing the mine and removing the seal, vapor-

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izes without trace or clue to the method of timing employed, leaving the mine in a state to be detonated and impossible to again inactivate.

(c) In electrical timing devices, in which advantage is taken of the electrical insulating properties of the supporting material to prevent premature current flow between electrical contacts.

(d) In detonators in which the fulminate or other shock or friction-sensitive materials are inactivated by dispersing them in the fluorocyclohexane and are again activated when the medium is removed.

(e) In devices which depend for their function on changing the center of gravity, which change is accomplished by the volatilization of the fluorocyclohexane.

This invention is further illustrated by the following specific examples:

Example I

A D'Arsonval galvanometer (described as Model 27 on page 36 of the 1960 catalogue of Newark Electric Co., Chicago, Ill.) is packaged by imbedding it in a vapor tight box containing perfluorocyclohexane and sealing the box with adhesive tape to prevent loss of the supporting medium. After rough handling of the package the seal is removed and the supporting medium volatilizes in a few minutes leaving the undamaged galvanometer ready for use.

Example II

A land mine is constructed to be triggered by movement of a hair spring assembly. During manufacture, the hair spring assembly is deactivated by imbedding it in perfluorocyclohexane and the inactivated assembly is located in a small cylindrical hole formed in the mine casing. The hole with its contents is closed from the atmosphere by a threaded cap. In this condition, the mine is safely handled, shipped and stored. For use in the field, the mine is positioned and the threaded cap removed. The perfluorocyclohexane vaporizes, exposing the hair spring assembly to activation by any near-by movement.

A land mine and trigger device as described in this example is shown in the drawing. FIGURE 1 shows the assembled trigger device in the inactivated position. As shown by this drawing this device 12 is comprised of a container 14 fitted with a threaded cap 16. Inside the container 14 is a lever 22 having one end affixed to a hair spring 20. The other end of the lever has abrasive grains 24 affixed to it and is held above explosive primer 26 by solid perfluorocyclohexane 18 which fills the container 14. FIGURE 2 shows the trigger device in the activated position. This position is achieved by simply removing the threaded cap 16 and allowing the perfluorocyclohexane to vaporize. The abrasive grains now rest on mercury fulminate or other primer 26 and any movement of the device causes movement of the hair spring 20 which amplifies movement of the lever 22 and the abrasive grains 24 at its end which, in turn, sets off the primer 26. FIGURE 3 shows a completed land mine 10 containing explosive 28. The trigger device 12 is located in a cylindrical hole in the mine casing and is activated after positioning in the field by removing the threaded cap 16.

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In lieu of perfluorocyclohexane in the above examples, undecafluorocyclohexane (C_6HF_{11}) may be used with equivalent results. Likewise, mixtures of perfluorocyclohexane and undecafluorocyclohexane may be used without change.

Because of the insert nature of the highly fluorinated cyclohexanes, their use in this invention is particularly desirable in those applications where environments of a corrosive or chemically active nature are encountered. Thus, this invention is of particular value in applications of outer space technology, the chemical industry, under weathering conditions, for military usage and the like.

It will be understood that many variations and uses may be made of this invention and accordingly the above description and examples are not to be considered as limiting the invention in any way.

I claim:

1. An article protected against the effects of its environment comprising a sealed container, the article to be protected and a solid highly fluorinated cyclohexane in contact with said article to prevent physical and chemical change of said article.

2. A land mine comprising a casing, a charge of explosive and a trigger device to detonate said explosive, said trigger device held in an inactive position by a solid highly fluorinated cyclohexane.

3. A land mine, in combination with a triggering mechanism sealed from, but optionally open to the atmosphere, said mechanism having a first deactivated position and a second activated position, a mechanical element maintained in said first position by a solid highly fluorinated cyclohexane, said mechanical element adapted to move automatically to said second position when said highly fluorinated cyclohexane is vaporized by opening said sealed mechanism to the atmosphere at ambient temperature.

4. A land mine as in claim 3, wherein the solid highly fluorinated cyclohexane is perfluorocyclohexane.

5. A triggering device comprising a mechanism sealed from, but optionally open to the atmosphere, said mechanism having a first deactivated position and a second activated position, and an element held in said first position by perfluorocyclohexane, said element adapted to move automatically to said second position when said highly fluorinated cyclohexane is vaporized by opening said sealed mechanism to the atmosphere at ambient temperature.

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