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Mackness et al.

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[54] **ARTICLE AND METHOD FOR PREVENTING ESCAPE OF PYROPHORIC MATERIAL**

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[51] **Int. Cl.**.....**C06b 21/02**

[58] **Field of Search**.....86/1; 431/267; 53/36, 14

[56] **References Cited**

UNITED STATES PATENTS

3,535,065	10/1970	Guenin	431/267
3,204,385	9/1965	Deremer et al.	53/36 X
3,377,955	4/1968	Hodgson	86/1 R X

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[57] **ABSTRACT**

A method and an article to be encapsulated in which a relatively small cartridge containing a substance which is spontaneously combustible is completely sealed and enclosed in the encapsulating material. The encapsulating material can be a polyamide mixture having a tear strip embedded therein whereby a sharp pull on the strip will quickly release the cartridge from the encapsulating mechanism.

12 Claims, 2 Drawing Figures

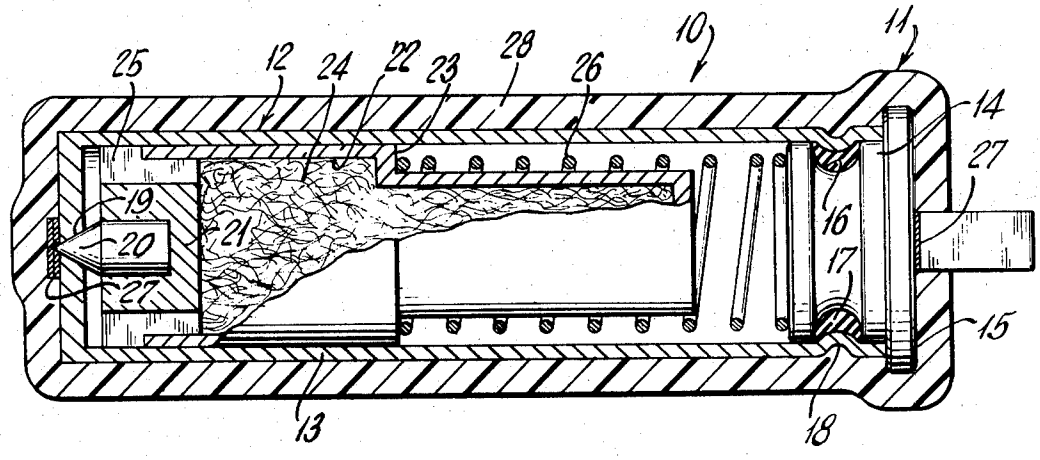

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Fig.1.

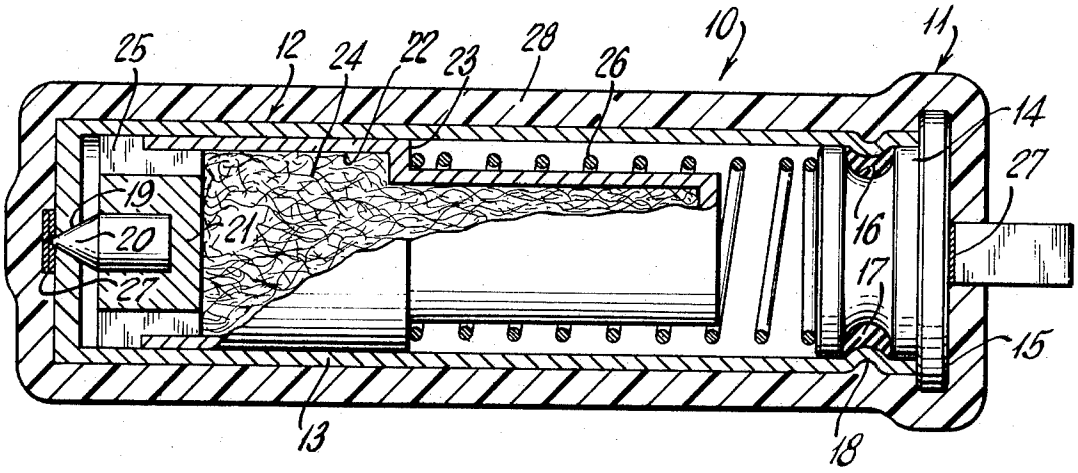
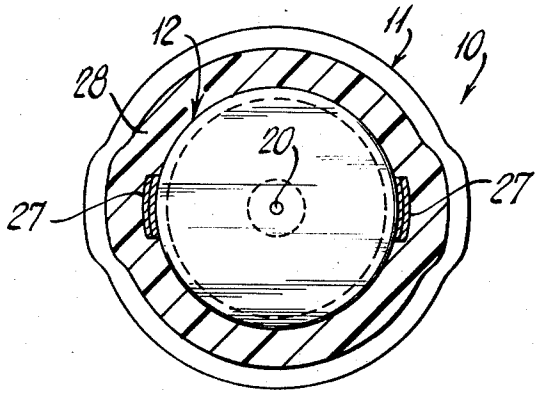


Fig.2.



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ARTICLE AND METHOD FOR PREVENTING ESCAPE OF PYROPHORIC MATERIAL

A cartridge has been developed which contains a pyrophoric substance such as a spontaneously combustible compound therein such as aluminum borohydride. A cartridge of this type is depicted in U.S. Pat. No. 3,535,065 entitled "Igniter Cartridge" and granted on Oct. 20, 1970. Cartridges of this type have a small orifice through which a minute quantity of the pyrophoric substance is discharged when the cartridge is struck or otherwise actuated. In order to achieve this effect the cartridge contains an actuating mechanism which, in its inoperative condition, maintains the orifice sealed to prevent leakage. In use, this mechanism has been found to be completely reliable. However, should it be necessary to transport cartridges containing the pyrophoric substance by mail or by air, then it may be considered that the sealing of these cartridges is inadequate for postal or air freight rules and additional means may be required to insure that the pyrophoric substance will not be accidentally ejected.

Accordingly, the invention contemplates that such a cartridge be encapsulated in a material which is impervious and fire resistant to eliminate the possibility of the pyrophoric substance contacting the outside air. The material must not be easily removed by jarring but must be easily removable by authorized personnel. The material must be light in weight and small in bulk for shipping, packaging and storage purposes. In a preferred form the cartridge is encapsulated in a polyamide mixture having a melting point less than 150° C. but preferably between 90° C. and 120° C., in which the mixture includes at least one additive to render it fire resistant. Other additives impart to the mixture pliability enabling the encapsulation to be easily opened by hand and to prevent the mixture from bonding to the cartridge except by friction.

A tear strip can be embedded within the encapsulating mixture whereby the encapsulating body may be torn open to expose the cartridge housed therewithin when desired.

The objects and advantages of the present invention will become apparent as the following description proceeds and the features of novelty which characterize the invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the present invention, reference may be had to the accompanying drawings in which:

FIG. **1** is a cross section of the encapsulated cartridge, and

FIG. **2** is an end view thereof.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. **1** there is shown an encapsulated cartridge **10**. The cartridge **12** itself is wholly enclosed within an outer sheath **11**. The cartridge **12** is adapted to be used as an ignition mechanism to ignite a fuel such as butane. A housing **13** having an open interior forms the outer walls of the cartridge **12**. The housing **13** is closed at the rear portion by means of an end plug **14** which can have a flanged end **15** extending beyond

the periphery of the housing **13**. The end plug **14** has a groove **16** formed therein for the reception of an o-ring or other elastomeric seal **17**. End cap **14** is secured to the housing **13** by crimping the end of the housing thereby forming a circumferential detent **18** which firmly bears against the sealing member **17**. The front portion of the housing **13** has a tapered orifice **19** bored therein and sized to receive a correspondingly tapered orifice pin **20**. The pin **20** is secured to a plunger **21**.

The plunger **21** includes a hollow chamber **22** and a shoulder **23** formed on the exterior surface of the plunger. An absorbent material **24** which can be Kaowool or any other suitable absorbent material is packed into the plunger **21**. The absorbent is saturated with a spontaneously ignitable substance such as aluminum borohydride $Al(BH_4)_3$. Small passageways **25** in the plunger **21** allow the aluminum borohydride vapors to advance to the front of the cartridge and exit through the orifice **19** when the pin **20** is withdrawn. A coiled spring **26** has one end thereof resting on the shoulder **23** of the plunger and the other end bears against the end plug **14** such that the spring is under compression. The spring thereby urges the plunger **21** toward the front of the housing **13** and the pin **20** is forced to seat within the tapered orifice **19** and thereby seal the orifice.

To operate the cartridge **12** and thereby eject the pyrophoric substance an impact force is applied to the forward face of the cartridge. The plunger **21** is forced rearwardly by the mass of the plunger **21** further compressing the spring **26**. As the plunger **21** moves rearwardly, the pin **20** is withdrawn slightly from the orifice **19** and a minute amount of the pyrophoric substance is ejected which ignites spontaneously producing a flash of heat sufficient to ignite a fuel such as butane. The opening is quickly sealed by the pin **20** being forced into the orifice **19** by the spring **26**. Thus, the cartridge **12** can be placed in a butane cigarette lighter and the pyrophoric substance emitted therefrom can be used to ignite the fuel emanating from the burner valve in a cigarette lighter as shown and described in U.S. Pat. No. 3,360,965 entitled "Gas Lighter" and issued on Jan. 2, 1968.

It is obvious that cartridges of this type must be handled relatively carefully because they can be made to produce a small flame when they are mishandled. In order to insure against the hazards which can result from mishandling the cartridge, it is completely immersed in a sealing substance which is fireproof, impervious to air and can be readily removed by the consumer and also gives the added advantage of shock proofing the cartridge. To accomplish encapsulation of the cartridge **12**, a mixture is initially prepared comprising a polyamide chosen from a group having a flexible molecular chain. A chlorinated diphenyl is added followed by the addition of ester wax and then n-butyl stearate. The mixture is then heated so as to form a slurry in the following proportions: 54% Polyamide, 32% Chlorinated Diphenyl, 11% Ester Wax and 3% n-Butyl Stearate.

The mixture is preferably maintained at a temperature between 95° C. and 100° C. The cartridge **12** is completely immersed in the viscous slurry for approximately 1 to 2 seconds and the coating **11** is then allowed to cure at room temperature for approximately

15 to 20 seconds during which the coating **11** solidifies to a fairly uniform thickness of between 1/16 to ⅛ inch and has a plastic or rubber-like texture. A more rapid setting time can be obtained if the cartridge is chilled prior to immersion in the slurry. Chilling also reduces the risk of any harmful effects by heat on the cartridge.

If it is desired to imbed a tear strip in the coating **28**, to facilitate the removal of the coating from the cartridge, a strip of glass fiber-self-adhesive tape **27** can be wrapped around the cartridge prior to dipping the cartridge in the slurry. The tape **27** is wrapped around the cartridge one to three times and the end is left extending about one-half inch beyond the periphery of the cartridge. This portion of the tape **27** will not be imbedded in the slurry and the user of the device merely pulls on the free end of the tape to tear open the covering on the cartridge when the coating has cured.

While there has been shown and described a particular embodiment of this invention, it will be obvious to those skilled in the art that various changes and modifications can be made therein without departing from the invention, and therefore, it is intended in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

We claim:

1. An encapsulated cartridge containing a pyrophoric substance therein comprising,

a. a housing having a closed end and having an orifice bored in the opposite end,

b. actuating means in said housing for selectively opening and closing said orifice,

c. a pyrophoric substance within said housing located such that it can pass through said orifice in a minute quantity when the actuating means opens the orifice,

d. a relatively thin impervious-removable-encapsulating sheath closely surrounding said housing so as to prevent the egress of any pyrophoric substance which may escape from the housing.

2. A cartridge as defined in claim **1** in which said pyrophoric substance is aluminum borohydride.

3. A cartridge as defined in claim **1** in which said means for selectively opening and closing said orifice is a plunger, a tapered pin on the end of said plunger which reciprocates within the open end of the housing to selectively open and close said opening and spring means within said housing biasing said plunger and pin into closed position.

4. A cartridge as defined in claim **1** in which said encapsulating sheath wholly encloses said cartridge.

5. A cartridge as defined in claim **1** in which said encapsulating sheath is a polyamide.

6. A cartridge as defined in claim **1** in which said encapsulating sheath is comprised of a mixture of approximately 54 percent polyamide, 32 percent chlorinated diphenyl, 11 percent ester wax and 3 percent n-butyl stearate.

7. A method for encapsulating a cartridge comprising the steps of

a. filling a cartridge with a pyrophoric substance, which can be ejected from said cartridge,

b. preparing a slurry so as to form an encapsulated material which is impervious to air and moisture and is fireproof,

c. immersing said cartridge in said slurry until the slurry coats the surface of the cartridge,

d. removing the cartridge from the slurry and,

e. allowing said encapsulating material coating the cartridge to cure.

8. A method for encapsulating a cartridge as defined in claim **7** in which the pyrophoric substance is aluminum borohydride.

9. A method for encapsulating a cartridge as defined in claim **7** in which the slurry is comprised of approximately 54 percent polyamide, 32 percent chlorinated diphenyl, 11 percent ester wax and 3 percent n-butyl stearate.

10. A method for encapsulating a cartridge as defined in claim **7** including the step of maintaining the cartridge in the slurry for approximately 1 to 2 seconds.

11. A method for encapsulating a cartridge as defined in claim **7** including the step of securing a tear strip to the cartridge to facilitate the removal of the cured encapsulating material.

12. A method for encapsulating a cartridge as defined in claim **7** including the step of chilling the cartridge prior to immersing the cartridge in the slurry.

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