

- [54] **PRIMER COMPOSITION OF
NITROMETHANE, POLYMERIC FOAM,
AND HOLLOW SPHERES**
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- [58] **Field of Search** 149/2, 21, 89, 90, 97,
149/19.4; 102/27 R

- [56] **References Cited**
- UNITED STATES PATENTS**
- 3,697,668 10/1972 Campbell 149/2 X
- Primary Examiner*—Stephen J. Lechert, Jr.
Attorney, Agent, or Firm—Robert H. Dewey; Howard
E. Post

- [57] **ABSTRACT**
- A primer adapted to initiating detonation of nitro-
methane by strong shock comprising an open-celled
polymeric foam containing about 15–85 percent by
weight of glass bubbles.

6 Claims, No Drawings

PRIMER COMPOSITION OF NITROMETHANE, POLYMERIC FOAM, AND HOLLOW SPHERES

This is a division, of application Ser. No. 333,845, filed Feb. 20, 1973.

BACKGROUND OF THE INVENTION

This invention relates to an explosive combination. In a particular aspect this invention relates to a primer adapted to initiating detonation of nitromethane by strong shock.

Nitromethane is a very stable liquid but it can be detonated under extraordinary conditions. When it does detonate, it is extremely powerful and is useful in many special applications. However the difficulty in initiating detonation has long been a problem, often requiring expensive primers and boosters.

It is known from Minnick, U.S. Pat. No. 3,338,165 that insoluble air-entrapping materials, such as resin balloons, can be uniformly suspended in gelled nitromethane and thereby render it sensitive to detonation by strong shock. It is necessary to gel the nitromethane because otherwise the air-entrapping material will segregate whereupon the composition loses its sensitivity to strong shock and does not detonate when the initiator is fired.

The compositions disclosed by Minnick are satisfactory when freshly prepared but they suffer from several disadvantages. For field use, it is inconvenient, if not impossible, to gel the nitromethane at the site of use and uniformly mix in the air-entrapping material. It is possible to prepare the composition ahead of time and transport it to the site, but it has been found that the composition loses its sensitivity on aging, possibly due to displacement of the entrapped air by nitromethane. Also it is risky to transport a shock-sensitive explosive mixture under field conditions. Furthermore, once the composition has been prepared, it cannot be easily desensitized if it is not used promptly.

Accordingly, there is a need for an improved method for detonating nitromethane.

SUMMARY OF THE INVENTION

It is an object of this invention to provide an explosive composition.

It is another object of this invention to provide a primer adapted to initiating detonation of nitromethane by strong shock.

Other objects of this invention will be apparent to those skilled in the art from the description herein.

It is the discovery of this invention that a combination of an open-celled polymeric foam having microspheres of entrapped air dispersed therein, including embedded on the surface thereof, and placed in intimate contact with nitromethane provides an explosive system sensitive to strong shock by detonation. The foam having the microspheres dispersed therein comprises a primer for detonating nitromethane and provides a method for priming nitromethane to detonation by strong shock to which it would otherwise be stable.

DETAILED DESCRIPTION

According to the present invention, when nitromethane is to be detonated, the polymeric foam containing microspheres of entrapped air is placed in intimate contact with a suitable shock-producing device, e.g. an electric blasting cap. The cap and foam is then placed in intimate contact with the nitromethane, e.g. by im-

mersion, or by placing in a capwell or tube and then immersing. When the cap is fired, it results in detonation of the nitromethane.

The primer of the present invention is particularly advantageous because the nitromethane remains highly stable until the primer is immersed therein. Furthermore, the primer can be easily removed prior to detonation if desired. The primer is also easily produced.

The microspheres of entrapped air suitable for the practice of this invention can be the resin balloons, i.e., phenol-formaldehyde or urea-formaldehyde, as described by Minnick in U.S. Pat. No. 3,338,165 which is incorporated herein by reference thereto. Preferably however, the microspheres are made of glass, ceramic or other materials impermeable to nitromethane. Suitable grades are commercially available from, e.g. 3M Corporation, Minneapolis, Minnesota, and Emerson-Cuming Corporation, Canton, Massachusetts.

The polymeric foam can be any open-celled foam which is impermeable to nitromethane. Polyethylene foam is unsatisfactory, as is foamed carborundum ceramic foam (which is not a polymeric substance, of course). The preferred polymeric substance is a polyurethane foam.

The polyurethane foam suitable for the practice of this invention is preferably an open-celled foam having a density of about 0.02 to about 0.04 g/cc. The foam density is primarily controlled by the volume of frothing agent used in making the foam. The term "open-celled" is intended to mean that the walls of some of the cells are discontinuous so that a portion, but not all, of the air entrapped therein can be replaced by liquid when the foam is immersed in a liquid. The closed cells constitute microspheres so that, to a limited extent, the foam itself can serve as the primer of the present invention. However it is not reliably so, because attempts to detonate nitromethane with the foam alone frequently fail. The polymeric foam itself is not therefore a satisfactory primer.

The preferred primer comprises an open-celled polyurethane foam containing 15-85 percent of glass or ceramic microspheres, preferably 30-85 percent. The primer can be conveniently prepared by mixing a liquid monomer, or mixture thereof, with the microspheres at a concentration of about 15-85 percent by weight. The foaming agent and catalyst are then added, the mixture is heated and the foam with microspheres more or less uniformly dispersed therein is thereby produced. The production of polymeric foams is well-known in the art and it is not intended that the invention be limited to any particular method or formulation.

Another convenient and preferred method of preparing the primer is to shake or tumble relatively thin pieces or shreds of the foam with the microspheres, which thereby become embedded, or enmeshed, in the foam at the surface. When the combination is so prepared it may contain as much as 85 percent by weight of microspheres at a surface density of about 0.5 g. microspheres per square inch.

In use, a portion of about 1-3 cubic inches of the polymeric foam with microspheres is attached to a detonating device, e.g. a detonating cord or a blasting cap, e.g. by threading it on the cap; or it can be packed into an aluminum tube or a capwell, then the cap or detonating cord is inserted. When the cap or cord is fired, the nitromethane detonates.

The invention will be better understood with reference to the following examples. It is understood, however, that the examples are intended for illustration only and it is not intended that the invention be limited thereby.

EXAMPLE 1

A polyurethane foam containing glass bubbles was prepared by thoroughly mixing the following materials:

Polyol	100 g
Water	3
Stannous Octoate	1
Blowing Agent	10
Bubble size controller	2
Toluene diisocyanate	38.3
Glass bubbles	25
Total	179.3

The mixture was then placed in a 300°F oven for about 5 minutes thereby producing the polyurethane foam having glass bubbles dispersed therein.

The polyol used was a triol having a molecular weight of 3500 and a hydroxyl number of 3514. It is marketed by Jefferson Chemical under the designation Thanol F-3514.

The blowing agent used was a liquid mixture of fluoro-chloroalkanes marketed by Union Carbide Corporation under the designation Propellant 11.

The bubble-size controller was a silicone surfactant marketed by Dow-Corning Corporation under the designation DC-193.

The glass bubbles are marketed by 311 Corporation under the designation B-40-B. These bubbles are described as having an average true particle density between 0.30 and 0.40 g/cc and bulk density of about 0.23/cc. The size of the particles is between 20 and 100 microns.

In the above formula, the 3 g of water reacts to form 7.3 g of carbon dioxide and the propellant is volatile. The total weight of the glass bubbles and the foamed polyurethane is therefore 169.3 g. The percentage of weight of glass bubbles was about 15 percent. The density of the foam was 0.0246 g/cc.

About 3 oz. of commercial-grade nitromethane was transferred to a 4-oz. paper cup. A one-inch cube of the polyurethane foam was pierced with a sharp object and a No. 8 electric blasting cap was inserted therein. The cap and foam were then immersed in the nitromethane, and the foam was squeezed lightly to insure wetting of the foam with nitromethane. When the cap was fired, the nitromethane detonated. The test was repeated four more times with identical results. When the foam was not used, the nitromethane did not detonate.

The test was repeated in all essential details except that the glass bubbles were omitted. In five tests with the foam only, unsatisfactory partial detonations were obtained each time.

EXAMPLE 2

A polyurethane foam containing glass bubbles was prepared as follows:

Polyol F-3514	100 g
Water	3
Triethylenediamine	6
Bubble size controller	7

-Continued

Dimethylaminoethanol	2
Methylene chloride	25
Glass Bubbles	30
Total	173

In the above formula, the methylene chloride is volatile and did not become a permanent part of the foam. The percentage by weight of glass bubbles based on the foam was 21.3 percent. The density was not measured, but the foam was open celled, comparable to that of Example 1.

A 1-inch cube of foam was pierced and a No. 8 blasting cap was inserted therein. The cap and foam were immersed in about 3 oz. of nitromethane and the foam was squeezed lightly to insure wetting of the foam with the nitromethane. The nitromethane detonated when the cap was fired. The test was repeated two more times with identical results. In three trials with nitromethane without the foam, the nitromethane failed to detonate.

The test was repeated in all essential details except that the glass bubbles were eliminated. In three trials with the foam alone, containing no glass bubbles, the nitromethane detonated partially in two and failed to detonate in the third.

EXAMPLE 3

The experiment of example 1 was repeated in all essential details except that 30 g of glass bubbles were used in place of 25 g. The percentage in the foam was 17.2 percent. It was observed that the foam was not of uniform quality throughout and the results of detonation tests reflected the inconsistency.

The tests were conducted using 18-oz. samples of commercial grade nitromethane containing a minimum of 95 percent by weight nitromethane. A block of foam, usually 1 × 1 × 2 inches but in a few tests 2 × 2 × 8 inches, was immersed in nitromethane and squeezed lightly. It was then inserted in the capwell and a blasting cap was inserted in the capwell, which was then immersed in the nitromethane.

The first test using an Atlas (A) 16 cap and a 1 × 1 × 2-inch block of foam failed.

In the second and third tests using a 2 × 2 × 8-inch block of foam from a different batch than the first, the nitromethane failed to detonate with a duPont (D) 6 and an A-10 cap.

In a fourth and fifth test using a 1 × 1 × 2-inch block of foam from the same batch as the second and third tests, the nitromethane failed to detonate with an A-8 cap, but did detonate with an A-16 cap.

In tests 6, 7, and 8, a 1 × 1 × 2-inch block of foam from a third batch was threaded onto a cap which was then immersed in the nitromethane, and squeezed lightly. In the sixth test using an A-6 cap, the nitromethane failed to detonate, but in tests 7 and 8 using a D-6 and an A-10 cap respectively, detonations occurred.

The foregoing experiment was repeated in all essential details except that the glass bubbles were eliminated from the foam.

In the first test, the nitromethane failed to detonate using an A-10 cap but did detonate with an A-16 cap. In the second test, using foam from a different batch than the first, the nitromethane failed to detonate with a D-6 cap, but detonated with an A-10 cap. In the fourth test the nitromethane failed to detonate with an A-8 cap, but did detonate with an A-16 cap. In tests 6,

7 and 8, using foam from yet a different batch than either of the foregoing, the nitromethane failed using a D-6 and an A-8 cap, but detonated with an A-10 cap.

EXAMPLE 4

A sheet of commercially-available, open-celled polyurethane foam, $\frac{1}{2}$ inch thick, was obtained on the open market and was cut into $1\frac{1}{2} \times 3$ -inch pieces, weighing about 1.2 g each, and having a total surface area of about 13.5 inches. The density was 0.032 g/ml. Each piece was shaken with ceramic microspheres until it was determined that a maximum amount had been embedded in foam. About 7 g was so embedded on the surface of the foam, giving a composition containing about 85 percent microspheres at a surface density about 0.5 g/in².

A piece of foam so treated was inserted into a thin-walled aluminum tube, closed by crimping at one end, of the type used for toothpaste etc. An Atlas No. 16 blasting cap was inserted therein and the assembly was immersed in nitromethane. When the cap was fired, the nitromethane detonated.

The experiment was repeated in all essential details except that instead of shaking the foam with the microspheres an adhesive was used to secure them to the foam. The nitromethane failed to detonate.

EXAMPLE 5

The experiment of example 4 was repeated in all essential details except that an Atlas No. 10 cap was used. When it was fired, the nitromethane detonated.

EXAMPLE 6

The experiment of example 4 was repeated in all essential details except that 100 grain pentaerythritol tetranitrate detonator cord was substituted for the blasting cap. When the cord was fired the nitromethane detonated. The experiment was repeated using 60 grain

cord. The nitromethane detonated.

EXAMPLE 7

The experiment of example 4 was repeated in all essential details except that shredded polyurethane foam sold commercially for pillow stuffing was substituted for the sheet foam. The shreds were about $0.5 \times 0.5 \times 0.5$ inches and about 1.2 g was used per test. As in example 8, about 7 g of microspheres were embedded in the surface of the foam. When the combination was used with an Atlas No. 16 or No. 10 blasting cap, or with 100 grain or 60 grain detonator cord, detonations of nitromethane occurred without fail.

I claim:

1. A primer adapted to initiating detonation of nitromethane by strong shock consisting essentially of the combination of an open-celled polymeric foam having dispersed therein from about 15 to about 85 percent by weight of hollow thin-walled microspheres containing entrapped air said foam being in intimate contact with nitromethane.

2. The combination of claim 1 wherein said polymeric foam is polyurethane having a density of from about 0.02 to about 0.04 g/ml.

3. The combination of claim 1 wherein said microspheres are of phenol-formaldehyde, urea-formaldehyde, glass or ceramic.

4. The combination of claim 3 wherein said microspheres are glass bubbles of about 20 to 100 microns and have a true particle density between 0.3 and 0.4 g/cc.

5. The combination of claim 1 wherein said microspheres are dispersed throughout the polymeric foam including the surface.

6. The combination of claim 1 wherein said microspheres are embedded at the surface of said polymeric foam.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,902,933 Dated September 2, 1975

Inventor(s) O. Wayne Chandler

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

Column 3, line 33, "311 Corporation" should read -- 3M Corporation --.

Column 5, line 11, "unit1" should read -- until --.

Signed and Sealed this

Seventeenth Day of May 1977

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks

UNITED STATES PATENT OFFICE
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