Sept. 17, 1968 G. L. GRIFFITH ETAL 3,401,632

PACKAGED BOOSTER EXPLOSIVE

Filed May 3, 1965

FIG. 1

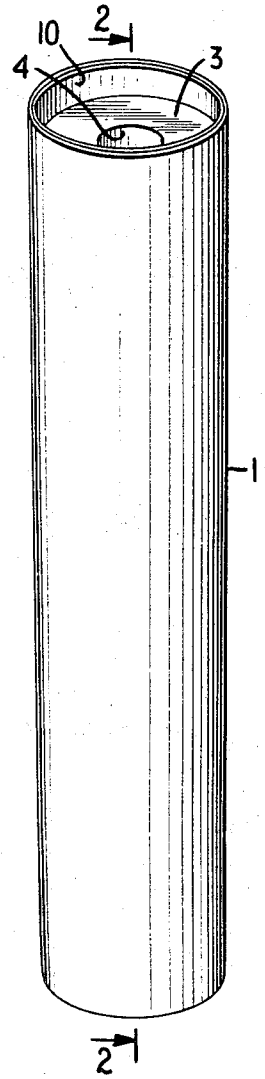


FIG. 2

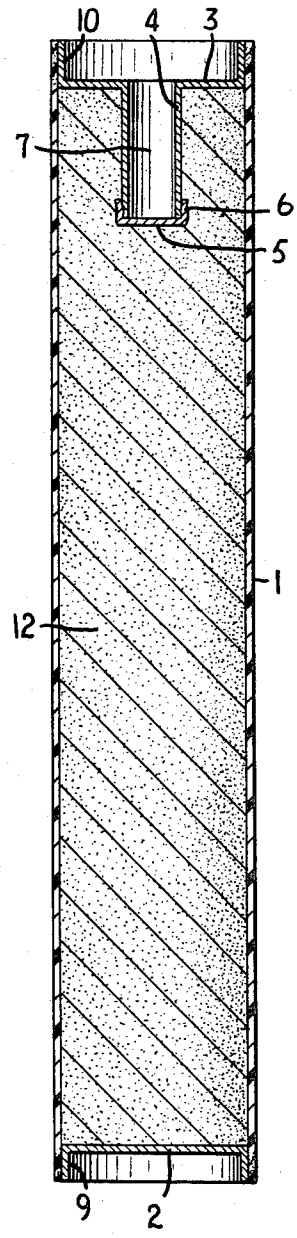
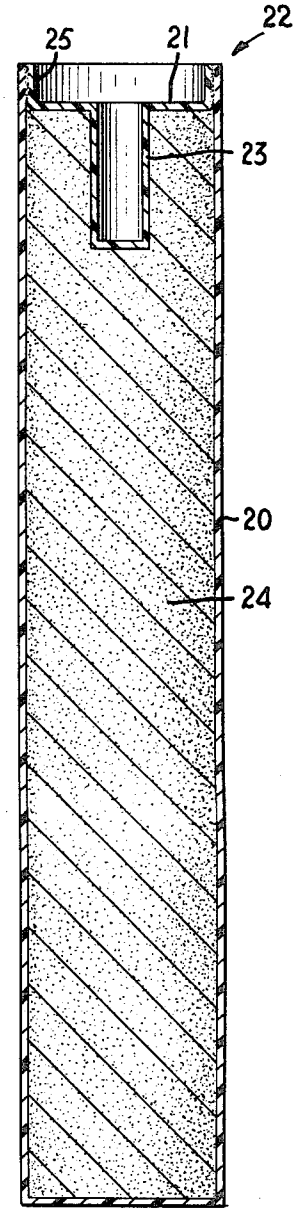


FIG. 3



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3,401,632

PACKAGED BOOSTER EXPLOSIVE

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This invention relates to packaged explosive boosters and more particularly, to booster cartridges made of synthetic plastic material, which will not turn over to detonation when exposed to burning.

Many explosives, such as nitrocarbonitrates, are sufficiently insensitive to require a booster to induce detonation. Boosters are explosive compositions of greater sensitivity which can be detonated with a fuse or with a blasting cap, and which will produce a sufficient shock to detonate the main body of explosive. Explosive charges which are useful as boosters are well known in the art, and include, for example, Pentolite and RDX (cyclonite).

Because they are more sensitive than the main explosive charge which is to be detonated, boosters pose even greater problems of storage and transport than explosive compositions. Boosters normally are packaged in metal or cardboard containers, as are most explosives. However, when subjected to high temperatures or exposed to flame, they will burn and turn over to detonation.

In accordance with the invention, packaged booster compositions are provided in which the booster explosive is enclosed within a package of synthetic plastic material. It has been found, surprisingly and unexpectedly, that such packaged booster compositions do not turn over to detonation when exposed to high temperatures or to flame, unless the conditions are such as to melt and disintegrate the package. In this respect, the plastic packages differ from metal containers. The reason for this is not understood.

Explosive compositions have been packaged heretofore in plastic materials. U.S. Patent No. 2,764,939, issued Oct. 2, 1956 to Phemister, discloses deformable plastic explosive packages in which the packaging material is made of plastic, such as polyethylene. This is a nonrigid material, and there is no suggestion that the packaging material be used for packaging boosters, but in any case, it would be unsuitable for this purpose, because of its flexibility.

The plastic booster containers in accordance with the invention are made of rigid form-retaining plastic material normally shaped in cartridge or shell form. The containers can be and usually are tubular, although they can have any configuration according to the requirements in use. They may, for example, be polygonal, square, or irregularly shaped in cross-section. They can be molded in cartridge or shell form adapted to be closed off with a cap after filling with the booster explosive. The container can also be made of a length of tubing which is cut to the required size, and then capped at one end for filling with booster, and finally closed off by capping at the other end.

Inasmuch as a booster cartridge is to be detonated by a blasting cap or fuse, the container will be provided with means for attaching a fuse or blasting cap

in sufficiently close proximity to the booster charge to enable detonation thereof by the blasting cap or fuse. Since the booster explosive will not turn over to detonation through the walls of the booster, it is normally necessary to bring the blasting cap or fuse into close contact with the booster explosive, and for this purpose, a well can be formed in one of the caps at one end of the booster. For this purpose, the cap can be formed with a well made of plastic material or made of cardboard to protect the booster explosive from atmospheric conditions until used.

The cap material preferably is of the same type as the container material, so that it can be securely bonded thereto in closing off the booster package. For this reason, it is preferred to employ as the plastic packaging material a solvent-soluble synthetic plastic, such as a thermoplastic synthetic resin or thermoplastic cellulose derivative. In this way, the cap can be bonded to the container by application of a solvent for the plastic at the joint therebetween, thus dissolving the plastic in the joint. Thereafter, upon removal of the solvent, an integral bond is formed between the cap and the container wall which is leakproof, preventing penetration of the water into the package, for example, as well as preventing loss of any of the contents of the container.

Typical synthetic plastic materials which can be employed in the booster containers of the invention include cellulose acetate, cellulose acetate butyrate, cellulose propionate, cellulose acetate propionate, cellulose butyrate, polyvinyl chloride, polyethylene, polypropylene, polyamides, polyvinyl butyral, polystyrene, polyacrylonitrile, copolymers of vinyl chloride and vinyl acetate, polymethylmethacrylate, and thermoplastic synthetic rubbers.

The booster containers of the invention can be filled with any type of booster explosive, such as Pentolite (a mixture of pentaerythritol tetranitrate (PETN) and trinitrotoluene), ammonium dynamite, nitroglycerine dynamite, nitroglycerine, semi-gelatin and gelatin dynamites, composition B, RDX (Cyclonite or cyclotrimethylenetrinitramine), Tetryl, Beta-HMX and pentaerythritol tetranitrate, alone.

The booster explosive can be powdered, but it is normally preferable to employ a cast booster charge, which is filled into the container while molten and allowed to set in the container. The welled cap is, of course, inserted in the container to close off the open end before the explosive has set, in which case the cast explosive aids in retaining the cap.

Surprisingly, it has been found sufficient to achieve the nondetonatable properties of the booster packages of the invention if the package shell is made of rigid plastic. The cap can be made of metallic material or of any suitable material, such as cardboard and paper. The well is normally made of the same material as the cap, but it need not be, and both the well and cap can be made of nonplastic material. Thus, a perfectly satisfactory container is obtained if the shell portion is made of rigid plastic material, the cap of metal, and the well portion of cardboard. Apparently, the fact that the shell portion, which constitutes the major surface area of the package, is made of plastic, is sufficient to prevent the booster from turning over to detonation when exposed to high temperatures or flame. The caps which provide only relatively small surface area do not trans-

mit a sufficient amount of heat to the charge. However, as indicated previously, it is preferable to form the caps of plastic, so that they can be better bonded to the shell, particularly where waterproofness is desirable.

The drawings show preferred embodiments of the invention:

FIGURE 1 is a perspective view of a booster in accordance with the invention;

FIGURE 2 is a longitudinal section taken along the lines 2—2 of FIGURE 1; and

FIGURE 3 is a longitudinal section through another type of booster in accordance with the invention.

The booster shown in FIGURE 1 is composed of a tube **1** of synthetic plastic material, in this case, cellulose acetate butyrate, prepared by cutting four inch lengths from a longer tube. The tube is ½ inch in diameter. The tube is closed off at one end by a metal disk **2**, and at the other end by an annular metal disk **3** formed with an inwardly extending flange **4** constituting a well **7**, the open bottom of which is closed off by a cap **5**, the edges **6** of which are crimped over the lower end of the well. The well is of sufficient length and width to receive a blasting cap when the booster is to be detonated.

It will be noted that each of the end caps is formed with an outwardly extending flange **9**, **10** fitting closely within the inner walls of the tube. The caps are sealed to the tube by softening the plastic with the aid of a solvent for the plastic, thus ensuring a tight fit as well as a seal tending to retain the caps within the tube.

The boosters shown are filled with a cast booster charge **12**, in this case, Pentolite, but other booster explosive charges can be used, such as RDX.

The booster is fabricated by first cutting off the required length of tubing and then fitting in the bottom end cap **2**, which is bonded to the plastic by dipping the end of the tube and cap in a solvent bath for a few moments. After the assembly has been withdrawn from the bath, the solvent dries, so that the plastic again hardens, but is now firmly bonded to the end cap.

The thus-formed open-ended container is then charged with molten booster explosive and filled nearly to the top. A welled top cap **3** is then applied to the open end of the container, the well displacing a portion of the explosive, and any trapped air escaping between the unsealed outer flange of the cap and the plastic. The resulting package is then inverted, and the cap end immersed in the solvent bath, as before, to soften the plastic and seal this cap to the container. The resulting assembly is as shown in FIGURES 1 and 2.

This container is readily detonated by inserting a blasting cap or primercord fuse in the well.

The solvent used can be any solvent for the plastic material, such as acetone, in the case of cellulose acetate butyrate. The solvents are well known, and form no part of the invention.

The booster package shown in FIGURE 3 is formed of a molded plastic container **20**, open at one end, prepared by injection molding of a synthetic resinous material, in this case polystyrene, but other plastics such as polyvinyl butyral and nylon can also be used. The end cap **21** closing off the open end **22** of the container is also made of the same plastic material, and is formed with an integral well **23**. The upwardly extending flange **25** of the end cap **21** fits within the container **20** in a press fit, and is bonded to the end **22** of the container by dipping the inverted container in a solvent bath for the resin after filling with booster explosive. The solvent as shown in the drawings has fused the plastic container wall and end top flange together, so that they have become one piece, in which the seam which formerly existed is now indistinguishable. The container is filled with a cast booster **24**, in this case with 50/50 Pentolite. This booster package is also adapted to be used by inserting a blasting cap or primercord in the well **23**.

The following experiment demonstrates the resistance to explosion of the plastic-packaged boosters of the invention, as compared to two available metal-packages boosters.

Three bundles of six boosters each of each type were used in this test. These boosters were composed of:

(1) Boosters as shown in FIGURES 1 and 2.

(2) Commercially available boosters sold under the trademark Water Work (RDX and PETN combination).

(3) Commercially available boosters sold under the trademark Giant Seismic (PETN).

Each of the boosters' wells was plugged with rubber stoppers, to insure that any pressure developed during burning was not exhausted by the well plug popping open. This insured that if the booster had any tendency to turn over to detonation it would do so.

The three bundles of boosters were each ignited. The first bundle, composed of the boosters in accordance with the invention, burned but did not detonate. The Water Work boosters burned, and then turned over from burning to explosion. The Giant Seismic boosters popped the rubber stoppers on the cap wells a distance of approximately ten feet from the boosters. The test then was repeated, with the stoppers securely bound to the wells. The boosters first burned, and then turned over from burning to detonation.

The tests were repeated under a variety of burning conditions with the same results.

Plastic containers of this invention were charged with the explosive material used in the Water Work and Giant Seismic boosters as well as with RDX alone. These explosives in the plastic containers were then tested as above. The plastic-packaged boosters burned but did not turn over to detonation.

The test data accordingly show the improved resistance to detonation imparted by the plastic package in accordance with the invention.

In addition to resistance to detonation, the plastic booster packages of the invention will not corrode, if subjected to salt spray, or if stored under hot humid conditions for extended periods of time. Moreover, they can be made sufficiently leakproof to resist extraordinarily high water pressures, and for this reason, are well-adapted for use at considerable water depths.

Having regard to the foregoing disclosure, the following is claimed as the inventive and patentable embodiments thereof:

1. A packaged booster explosive which will not turn over to detonation when exposed to flame comprising, in combination, a container of rigid thermoplastic solvent-soluble synthetic plastic material filled with a booster explosive which when subjected to high temperatures or exposed to flame will burn and turn over to detonation, one wall of the container being formed with a well for insertion of a means for detonating the booster charge.

2. A packaged booster explosive in accordance with claim **1** wherein the container is formed of a tubular shell having two open ends each closed off by end caps.

3. A packaged booster explosive in accordance with claim **2** wherein one of the end caps is formed with the well.

4. A packaged booster explosive in accordance with claim **2** wherein the end caps are made of metallic material.

5. A packaged booster explosive in accordance with claim **2** wherein the end caps are made of the same plastic material as the tube.

6. A packaged booster explosive in accordance with claim **2** wherein the end caps are formed with flanges extending about their outer periphery.

7. A packaged booster explosive in accordance with claim **6** wherein the flanges extend outwardly.

8. A packaged booster explosive in accordance with claim **6** wherein the end caps are bonded to the tube by a solvent-formed bond.

9. A packaged booster explosive in accordance with claim **1** wherein the plastic material is a thermoplastic synthetic resin.

10. A packaged booster explosive in accordance with claim 1 wherein the plastic material is a thermoplastic cellulose derivative.

11. A packaged booster explosive in accordance with claim 10 wherein the cellulose derivative is cellulose acetate butyrate.

12. A packaged booster explosive in accordance with claim 1 wherein the booster explosive is a cast explosive.

13. A packaged booster explosive in accordance with claim 12 wherein the explosive is Pentolite.

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