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PRIMING DEVICE FOR BLASTING COMPOSITIONS

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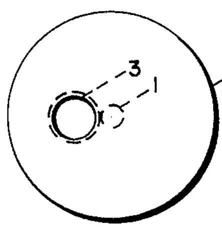


FIG. 1

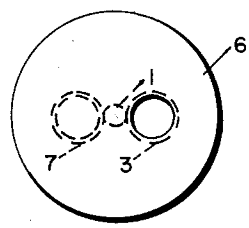


FIG. 3

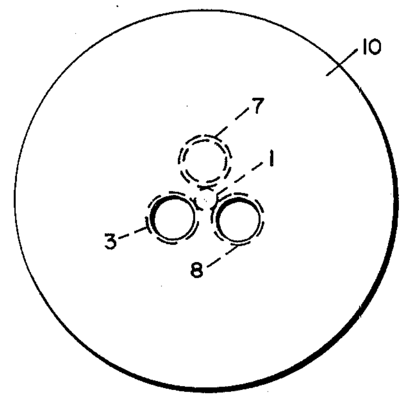


FIG. 5

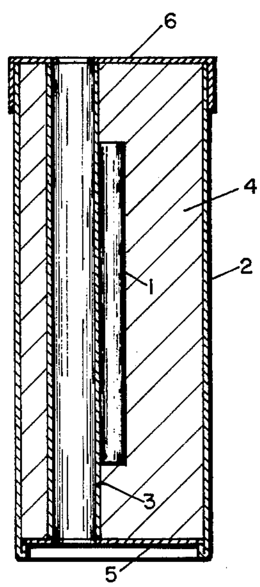


FIG. 2

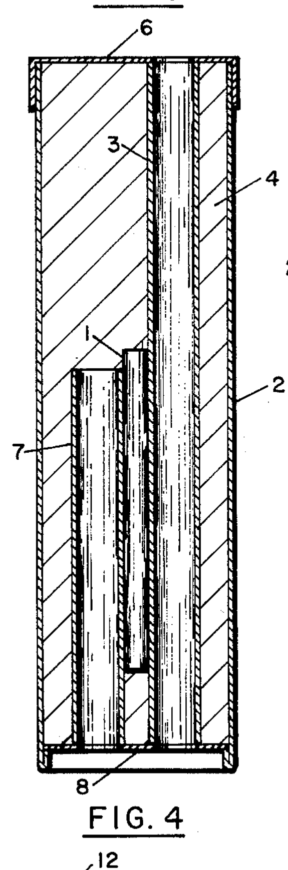


FIG. 4

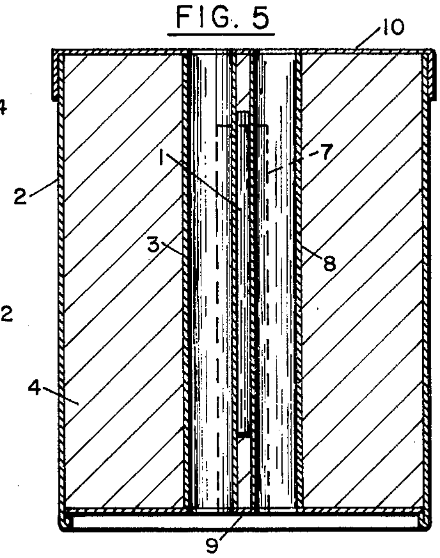


FIG. 6

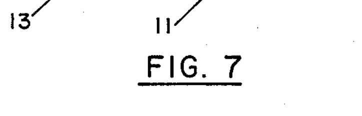


FIG. 7

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3,212,438
PRIMING DEVICE FOR BLASTING COMPOSITIONS

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This invention relates to priming devices for blasting compositions and in particular to priming devices adapted for use in explosive operations where relatively insensitive explosive or blasting agent is employed and especially where water conditions are encountered.

For a number of years there has been a decided trend toward the use of relatively insensitive blasting agents which contain little or no nitroglycerin or similar explosive oil and depend primarily for explosive strength on inorganic salts such as ammonium nitrate. Although such blasting agents, when brought to detonation, are characterized by adequate strength for most blasting operations, they are normally not detonatable by commercially available detonating fuse or blasting caps. In fact, the test employed to determine the sensitivity characteristics of these insensitive blasting compositions is usually one in which their resistance to detonation by either a No. 6 or a No. 8 blasting cap serves as a criterion.

The usual methods for detonating such insensitive compositions have involved the use of various priming devices wherein a well or conduit extends into or through the priming device and is adapted to receive a commercial detonating fuse or cap. Thus, the commercial detonating fuse or cap is utilized to initiate the priming device which in turn detonates the explosive composition. For ease of manufacture and economy, many of these priming devices have been made of commercial detonating fuse-sensitive and cap-sensitive cast explosive where in some instances a casing or sheathing of less sensitive explosive is cast or otherwise provided to encase the more sensitive inner cast explosive which is adapted to receive the commercial detonating fuse or cap. However, it has been found that cast primers of this type fail to detonate reliably when utilized for shooting in holes containing water. This is apparently due to the fact that the cast explosive surrounding the well or conduit which accommodates the fuse or cap is porous and water-pervious and thus becomes desensitized.

Now in accordance with the present invention, there has been developed an economical priming device for initiating insensitive blasting agents and explosives generally which detonates reliably in holes containing water and even under extremely high water pressure conditions. Moreover, the priming device of this invention requires a very small amount of fuse and cap-sensitive explosive and provides a facile arrangement for utilization of commercial fuses or caps therewith.

Generally described, the present invention provides a composite priming device especially adapted for initiating detonative blasting compositions and having a cast cylindrical body of commercial detonating fuse-insensitive and cap-insensitive explosive, in which the improvement comprises a water-impervious elongated pressure-resistant tube disposed substantially coaxially with and cast within said cast cylindrical body, said tube containing a charge of commercial detonating fuse-sensitive and cap-sensitive crystalline high explosive, and at least one conduit juxtaposed with the said tube and extending entirely through the said cast cylindrical body, said conduit being adapted to receive either a commercial detonating fuse or cap.

Representative embodiments of the invention have been chosen for purpose of illustration and description and are



shown in the accompanying drawings wherein reference symbols refer to like parts wherever they occur:

FIGURES 1, 3 and 5 are plan views, and FIGURES 2, 4 and 6 are elevational, half sectional views of FIGURES 1, 3 and 5, respectively, depicting priming devices in accordance with this invention. FIGURE 7 is an elevational, half sectional view depicting the water-impervious elongated pressure-resistant tube containing explosive which is illustrated in connection with all the other views.

With reference to FIGURES 1 through 6, a series of priming devices were made in which a water-impervious elongated pressure resistant metallic tube **1**, in each instance, was disposed coaxially in a container **2**. In FIGURES 1 and 2, a conduit **3** was juxtaposed with the tube **1** and an explosive **4** was cast into the container **2**. The container **2** had a bottom disc **5** with one aperture therein and had a top pressed cap **6** with one aperture therein, both apertures being in alignment with the conduit **3** for permitting the passage of detonating fuse entirely through the priming device or the insertion of a blasting cap therein. In FIGURES 3 and 4, a conduit **3** and a conduit **7** were oppositely juxtaposed with the tube **1** and an explosive **4** was cast into the container **2**. The container **2** had a bottom disc **8** with two apertures therein in alignment with conduits **3** and **7**. Conduit **7** extended only partially through the device from the bottom thereof to permit the insertion of a blasting cap therein. Accordingly, a top pressed cap **6** with one aperture therein in alignment with the conduit **3** was provided to permit the passage of detonating fuse downwardly and entirely through the priming device and the tying of a knot in the end of the fuse. In FIGURES 5 and 6, a conduit **3**, a conduit **7** and a conduit **8** were equidistantly juxtaposed with the tube **1** and an explosive **4** was cast into the container **2**. The container **2** had a bottom disc **9** with three apertures therein in alignment with conduits **3**, **7** and **8**. Conduit **7** extended only partially through the device from the bottom thereof to permit the insertion of a blasting cap therein. Accordingly, a top pressed cap **10** with two apertures therein in alignment with conduits **3** and **8** was provided to permit the passage of detonating fuse downwardly and then upwardly entirely through the priming device and the tying of a knot about the fuse itself.

The containers, conduits, bottom discs and top caps heretofore described were all made of paper, although other material such as metal or plastic is suitable for this purpose. All conduits were approximately .344 inch inside diameter which is a satisfactory diameter for receiving either commercial detonating fuse (Primacord—60 grain) or blasting caps (No. 6). The blasting cap conduits were uniformly 3 inches in length and extended from the bottom into the cast explosive that distance. The length of the detonating fuse conduits, of course, was dependent upon the length of the priming device, where the devices depicted in FIGURES 1, 2, 3 and 4, and 5 and 6, were approximately 1.55"D x 3.78"L, 1.55"D x 5.56"L, and 2.75"D x 3.75"L, respectively, with cast explosive weights of approximately 140, 205 and 475 grams, respectively. Other priming devices were made similar to FIGURES 1 and 2 and these were approximately 1.55"D x 3.78"L with cast explosive weights of approximately 134 grams. Still other priming devices were made similar to FIGURES 5 and 6, and these were approximately 2.32"D x 3.75"L and 5.06"D x 5.25"L with cast explosive weights of approximately 329 and 2366 grams, respectively.

All devices heretofore described were manufactured using aluminum shells **11** containing crystalline high explosive **12**; more particularly depicted in FIGURE 7. The shells **11** were 0.275 inch in diameter with a wall thickness of about 0.006 inch and had a slightly indented bottom. The shells **11** were charged to a height of approximately 2.03 inches with crystalline pentaerythritol tetranitrate (PETN) which constituted a charge weight of approximately 2.28 grams pressed in increments to an average charging density of about 1.45 grams per cc. A solid waterproof plug **13** having a diameter compatible with the inside of the shell **11** was inserted upon the explosive charge **12** and about 0.05 inch of shell metal **11** was rolled over the upper edge of the plug **13** to insure a water-impervious seal. The plug **13** was made of thermosetting resin and had a length of about 0.41 inch, and the overall completed tubular device **1** had a length of about 2.50 inch. Although the shells **11** were made of aluminum, other metals such as bronze or other materials such as plastics may be used providing they are capable of meeting the requirements of safety, internal charging pressures and external water pressures. Furthermore, although the plugs **13** were made of thermosetting resin, other materials such as rubber, thermoplastic resins and the like may be used providing they insure a water-impervious seal.

As previously stated, the shell **11** was charged with crystalline PETN; however, other commercial detonating fuse-sensitive and cap-sensitive compositions known to the art and suitable for this purpose include cyclonite or cyclotrimethylene-trinitramine (RDX), and mannitol hexanitrate (nitromannite) and any mixtures of these with each other or additional explosive compositions having sufficient sensitivity. PETN, RDX and nitromannite are the preferred crystalline explosives. These explosives are utilized in particulate form for charging into the shell **11**, preferably in increments to obtain a density of about 1.45 g./cc. It is desirable to utilize these fuse-sensitive and cap-sensitive explosives in minimum necessary amount, generally, from about 2 to about 5 grams with adjustment of the shell **11** in size to accommodate the minimum necessary amount.

All devices heretofore described were manufactured using composition "B" as the casting explosive **4**. Composition "B" consisted essentially of 59.5 cyclonite, 39.5 trinitrotoluene and 1.0 wax percent by weight and had a density of about 1.58 to 1.60 grams per cc. It is a commercial detonating fuse-insensitive and cap-insensitive explosive. However, other casting explosives meeting these requirements of insensitivity may be utilized and include trinitrotoluene and other cast casing or sheathing explosives such as those disclosed in U.S. 2,965,466 to Alpheus M. Ball. However, in casting such compositions about the tube **1** and the conduits **3**, **7** and/or **8** as the case may be, it is important that the conduit **7**, which is adapted to receive a blasting cap, be juxtaposed to and extended to be substantially coextensive with the tube **1** as shown in the drawings. This insures proper positioning of the blasting cap within the conduit **7** adjacent to the tube **1**. In order to achieve this, particularly in priming devices of considerable length, all devices herein described had the tube **1** disposed substantially coaxially and spaced about 0.63 inch from the bottom of the cast explosive with the conduit **7** extending into the cast explosive from the bottom thereof a distance substantially coextensive with the tube **1**.

Priming devices manufactured in accordance with this invention passed the rifle bullet test with both .22 caliber hollow point and 30.06, 150 grain ball and passed the burning test without detonation. Additionally, production primers in accordance with this invention were tested and detonated reliably at a rate of 7500 m./s. after seven days' immersion in water at 300 p.s.i. where in comparison with other cast commercial primers, failures were encountered under these conditions and in some instances, after only two hours immersion in water. Furthermore, production primers in accordance with this invention were field tested in conjunction with various cap-insensitive explosives, such as, prilled ammonium nitrate-fuel oil sensitized, aqueous slurry ammonium nitrate-TNT sensitized, and aqueous slurry ammonium nitrate-smokeless powder sensitized, in which all holes tested fired normally and completely. Production primers in accordance with this invention were also tested in conjunction with low cost cap-sensitive explosives and were found to give the maximum rate of detonation for these explosives.



The advantages of the invention are multifold including the following: the priming device is sensitive to a fractional cap, thus insuring detonation if the cap is not completely positioned; it is versatile for accommodation of fuse or caps; it is extremely resistant to high pressures of water; and it eliminates the possibility of desensitizing voids being formed in the fuse-sensitive and cap-sensitive charge body such as is encountered if the charge body is cast and water enters the voids.

Since further modifications of the invention will be apparent to those in the art, it is intended that the invention be limited only by the appended claims.

What I claim and desire to protect by Letters Patent is:

**1.** In a composite priming device especially adapted for initiating detonative blasting compositions and having a cast cylindrical body of commercial detonating fuse-insensitive and cap-insensitive explosive, the improvement comprising

(a) a water-impervious longitudinal pressure-resistant metallic tube disposed coaxially within the cast cylindrical body, said tube being of small diameter and containing from about 2 to about 5 grams of a charge of commercial detonating fuse-sensitive and cap-sensitive crystalline high explosive pressed to an average charging density of about 1.45 grams per cc.,

(b) two conduits oppositely spaced from each other and juxtaposed with the tube, one of said conduits extending entirely through the cast cylindrical body and having a diameter such as to accommodate a commercial detonating fuse, the other of said conduits being a cap conduit extending partly through the cast cylindrical body and having a diameter and length such as to accommodate a commercial blasting cap, and

(c) the tube being positioned on one side of the conduits only with its length extending therebetween and adjacent thereto so that upon insertion of a commercial blasting cap into the cap conduit the cap and the said tube are substantially coextensive.

**2.** In a composite priming device especially adapted for initiating detonating blasting compositions and having a cast cylindrical body of commercial detonating fuse-insensitive and cap-insensitive explosive, the improvement comprising

(a) a water-impervious longitudinal pressure-resistant metallic tube disposed coaxially within the cast cylindrical body, said tube being of small diameter and containing from about 2 to about 5 grams of a charge of commercial detonating fuse-sensitive and cap-sensitive crystalline high explosive pressed to an average charging density of about 1.45 grams per cc.,

(b) three conduits equidistantly spaced from each other and juxtaposed with the tube, two of said conduits extending entirely through the cast cylindrical body and having a diameter such as to accommodate a commercial detonating fuse, the other of said conduits being a cap conduit extending partly through the cast cylindrical body and having a diameter and length such as to accommodate a commercial blasting cap, and

(c) the tube being positioned on one side of the conduits only with its length extending therebetween and adjacent thereto so that upon insertion of a commercial blasting cap into the cap conduit the cap and the said tube are substantially coextensive.

**3.** The priming device according to claim **1** wherein the tube is aluminum and the crystalline high explosive is pentaerythritol tetranitrate.

4. The priming device according to claim 1 wherein the tube is aluminum and the crystalline high explosive is cyclonite.

5. The priming device according to claim 1 wherein the tube is aluminum and the crystalline high explosive is nitromannite.

6. The priming device according to claim 1 wherein the tube is aluminum and the crystalline high explosive is approximately 2.3 grams of pentaerythritol tetranitrate and the cast cylindrical body is from about 100 to 300 grams of a composition consisting essentially of 59.5 cyclonite, 39.5 trinitrotoluene, and 1.0 wax percent by weight.

7. The priming device according to claim 2 wherein the tube is aluminum and the crystalline high explosive is pentaerythritol tetranitrate.

8. The priming device according to claim 2 wherein the tube is aluminum and the crystalline high explosive is cyclonite.

9. The priming device according to claim 2 wherein the tube is aluminum and the crystalline high explosive is nitromannite.



10. The priming device according to claim 2 wherein the tube is aluminum and the crystalline high explosive is approximately 2.3 grams of pentaerythritol tetranitrate and the cast cylindrical body is from about 300 to about 2500 grams of a composition consisting essentially of 59.5 cyclonite, 39.5 trinitrotoluene, and 1.0 wax percent by weight.


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