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Prior et al.

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[54] **DETONATOR DEVICE FOR EXPLOSIVE CHARGE EXHIBITING DETONATING EFFECT CAPABLE OF BRIDGING GAP BETWEEN SPACED CHARGES**

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[52] **U.S. Cl.** **102/70**, 102/86.5

[51] **Int. Cl.** **F42c 19/08**

[58] **Field of Search** 102/27–29, 45, 102/70, 86.5

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[57] **ABSTRACT**

A detonator for explosive charges, exhibiting a detonating effect which bridges a spacing between a primer charge and a relay or propagation charge, for example, for hollow charge primer chains, including a primer charge disposed within a case closed off at one end by a bottom member and a metallic insert disposed within the case, which insert has a configuration of a hollow cylinder with a bottom recessed in a conical manner, the base of the cone thus formed facing the bottom member of the case.

10 Claims, 3 Drawing Figures

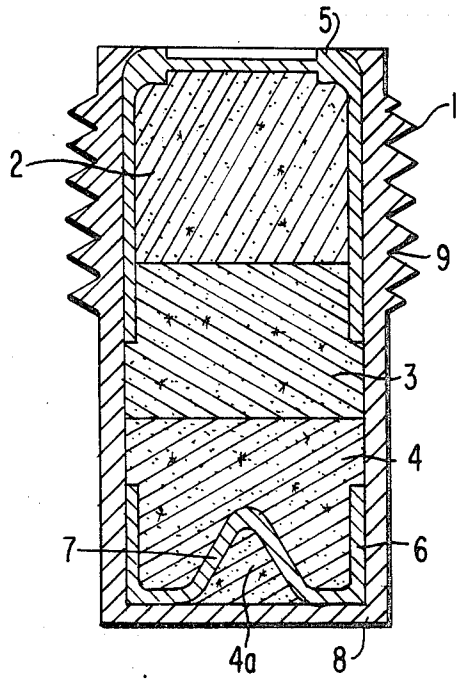


FIG. 1

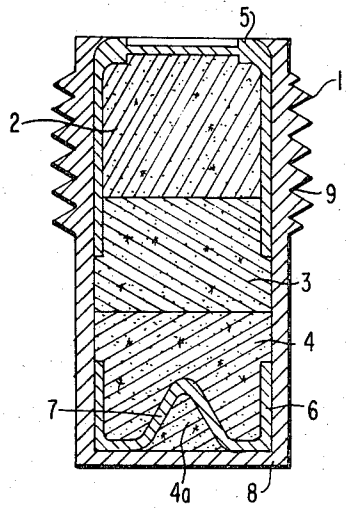


FIG. 2

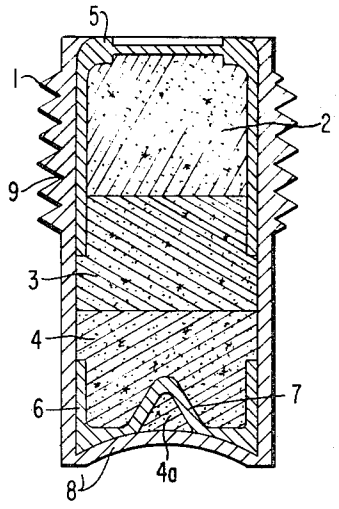
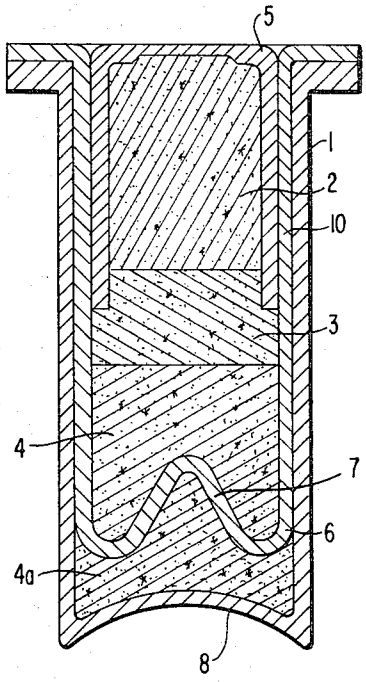


FIG. 3



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DETONATOR DEVICE FOR EXPLOSIVE CHARGE EXHIBITING DETONATING EFFECT CAPABLE OF BRIDGING GAP BETWEEN SPACED CHARGES

BACKGROUND OF THE INVENTION

The present invention pertains to a detonator having a detonating effect which bridges a gap present between a primer charge and a subsequently-disposed relay detonator or a subsequently-disposed propagation charge, for example, for hollow charge primer chains, having a primer charge disposed within a case closed off at one end by means of a bottom member.

Detonators are employed as the initial link of primer chains, for example, in fuzes for projectiles of various types. These detonators can be ignited by means of striking, shock, flame or heat. The initial impulse thus obtained causes a detonation of propagation or booster charges connected with the primer charge. Generally, primer chains composed of individual charges immediately adjacent one another or at least spaced apart by distances of only a few millimeters can be detonated, in most case, directly as a result of the initial impulse. Thus, the igniting effect of the first charge within the chain is generally sufficient to effect detonation so long as the various charges within the chain are not spaced from one another by distances greater than a few millimeters. Accordingly, an initial impulse effected by a detonator constructed in the form of a cap with a flat bottom is sufficient for the detonation of a booster charge composed of relatively insensitive secondary explosives, such as tetryl, for example.

In other types of primer chains, wherein the initial primer charge of the chain and the next-disposed propagation charge are spaced apart by a distance up to several decimeters, such as, for example, in hollow charge primer chains, the initial impulse emanating from the first charge is often insufficient for igniting the propagation charge spaced therefrom. In primer chains of this type, it is necessary to have the first detonator followed by a second detonator, provided as a relay. The gap or interstice present between the first detonator and the so-called relay detonator must then be bridged by the initial impulse, i.e., by the shock wave produced by the first detonation.

In order to achieve this bridging effect, the so-called hollow-charge effect is conventionally employed. This hollow-charge effect is obtained in detonators by hollowing out, in a conical form, the base of the detonator case and, simultaneously, the explosive charge contained therein. In this manner, a narrowly-focused energy or mass stream is produced by the detonation, the propagation velocity of this stream being substantially higher than the normal detonation propagation velocity for the particular explosive employed. In particular, a high-density energy stream is produced when a metallic detonation case is employed.

As a result of this focusing of the kinetic detonation energy, it is possible to exert considerable mechanical effects even over larger distance, whereas an otherwise identical detonator without the hollow-charge effect produces either no mechanical effects or only minor mechanical effects over similar distances.

This focusing of the energy stream, which is generally so advantageous, can nevertheless become a disadvantage for the ignition of hollow-charge projectiles when the hollow-charge stream is deflected, even

to a minor extent, from a direct line between the primer detonator and the relay detonator; such deflection often results in a failure to detonate the relay detonator. Such deflection occurs, for example, when the relay detonator is disposed after the hollow charge of the projectile at the end of the narrow neck of a funnel oriented with its major diameter in the direction of the primer detonator.

The aforementioned disadvantage can be overcome, at least partially, by enlarging the focused hollow-charge energy stream emanating from the primer detonator by appropriately dimensioning the geometrical configuration of the bottom of the primer detonator effecting the hollow-charge effect. However, this procedure necessarily entails a reduction of the number of impingements of mass particles per unit area, i.e. , a reduction of the energy density. Thus, it should be apparent that resorting to a widened focus of the energy stream often destroys the hollow-charge effect, resulting in failure of the detonator chain.

Accordingly, it is an objective of the present invention to provide a detonator incorporating the conventional hollow-charge effect, thus exerting an ignition effect which bridges a spacing between adjacent charges, but which avoids the disadvantages inherent in detonators in use heretofore.

Further, it is an objective of the present invention to provide a detonator of the type described above which effectively bridges relatively large gaps between adjacent charges and which is, nevertheless, relatively simple in construction and inexpensive to produce.

SUMMARY OF THE INVENTION

The aforementioned objectives are accomplished, in accordance with the present invention, by reducing the degree to which the energy stream is focused, while simultaneously increasing the number of mass particles impinging per unit area. This is accomplished structurally by providing, within the outer case in the region of the secondary explosive charge, a metallic insert constructed in the form of a hollow cylinder with a bottom recessed conically, the base of the cone thus formed facing the bottom of the outer case. In this manner it is possible to increase the statistical impingement probability, as compared to conventional detonators employing the hollow-charge effect, and also to substantially improve the functional safety of primer chains of hollow-charge projectiles.

In accordance with an additional feature of the present invention, the metallic insert, provided with a conically-recessed bottom, is constructed as a unilaterally open cup for the reception of explosive charges and is pressed into the outer case containing a proportion of the secondary explosive charge. Additionally, it is contemplated by the present invention to construct the bottom of the outer case with an inwardly-curved or dished configuration.

BRIEF DESCRIPTION OF THE DRAWINGS

The aforementioned objectives, features and advantages of the present invention will become more readily apparent from a consideration of the detailed description hereinbelow, when considered in conjunction with the accompanying drawings, wherein:

FIG. 1 represents a section view of a detonator constructed in accordance with the present invention;

FIG. 2 represents a modification of the detonator illustrated in FIG. 1; and

FIG. 3 represents another detonator constructed in accordance with the present invention, incorporating a cup inserted therein.

DETAILED DESCRIPTION OF THE DRAWINGS

In the embodiment illustrated in FIG. 1, the detonator, which can be suitably employed, for example, as the initiating link of a hollow-charge primer chain, includes a cylindrical outer case 1 having an external threaded portion 9 and a flat bottom 8. Within the case 1 are disposed, in series, a primer charge 2 which, depending upon the type of ignition desired, may comprise a charge sensitive to impact, shock, heat or flame, and initiating explosive 3, for example, lead azide, and a secondary explosive charge 4, for example, tetryl, cyclonite or penthrite. The several charges 2, 3 and 4 are retained within the case 1 by a cover cap 5 which seals the open end of the case 1. The cover cap 5, at its outer surface, includes a central zone of reduced wall thickness to facilitate ignition. A metallic insert 6 is disposed within the explosive charge 4. The insert 6 is constructed in the form of a hollow cylinder with a bottom 7 recessed in a conical or funnel-like manner. The metallic insert 6 is introduced into the case 1 so that a portion 4a of the explosive charge 4 is disposed within the region delineated by the recessed bottom 7 of the insert 6, between said insert 6 and the bottom 8 of the outer case 1. The serially-disposed charges 3 and 4 of the detonator are caused to ignite by the ignition of the primer charge 2. The ignition of the partial explosive charge 4a within the funnel-like area 7 occurs in the manner of a penetration detonation.

By virtue of the arrangement of the metallic insert 6 within the case 1 and, more specifically, within the explosive charge 4, in accordance with the present invention, a less intense focusing of the shock wave produced by the detonation is achieved, in contrast to the conventional detonators employing the hollow-charge effect by constructing the bottom of the outer case in the form of a conical recess. However, the arrangement contemplated by the present invention further serves to substantially increase the number of impinging mass particles, so that the desired enhanced functional reliability in the ignition of primer chains, for example, for hollow-charge projectiles, is also achieved.

The embodiment illustrated in FIG. 2 represents a slight modification of the detonator represented in FIG. 1. In this embodiment, the bottom 8 of the outer case 1 is curved inwardly. This slight curvature of the bottom 8 serves to further increase the effect of the metallic insert 6.

Another embodiment of the detonator contemplated by the present invention is illustrated in FIG. 3. In this embodiment, the metallic insert 6 is constructed in the form of a cup 10 having an upwardly-extended rim. The cup 10 is provided with the secondary charge 4, the initiating explosive charge 3 and the primer charge 2. The primer charge 2 and the end which is open at the front surface are covered by means of a cover cap 5. The outer case 1 of the detonator, provided with an inwardly-curved bottom 8, as in the embodiment according to FIG. 2, contains a portion 4a of the secondary explosive charge 4. The cup 10, filled with the additional charges 2, 3 and 4, is pressed into the outer case 1 in such a manner that the portion 4a of the charge 4 is pressed, upon introduction of the cup 20 into the case 1 into the area defined by the funnel-like recessed bottom 7.

While the present invention has been described with reference to the specific details of three embodiments, it is to be clearly understood that the scope of the invention is not limited to the specific details of these illustrative embodiments, but is susceptible of numerous changes and modifications, as would be apparent to one with normal skill in the pertinent technology.

What is claimed is:

1. A detonator device exhibiting a detonating effect bridging a gap between a primer charge and a subsequent charge, comprising:

primer charge means, secondary charge means, substantially cylindrical case means sealed off at one end with a bottom member and accommodating said primer charge means and said secondary charge means therein, and

metallic insert means constructed to produce a shaped-charge effect and having a substantially hollow, cylindrical configuration with a lower end closed by a bottom portion having a funnel-shaped recess formed therein, said metallic insert means being disposed with said case means in the region of said secondary charge means with the relatively wider end of said funnel-shaped recess disposed in the direction of said bottom member of said case means and constructed to be destroyed upon detonation of said secondary charge means.

2. A detonator device according to claim 1, wherein a portion of said secondary charge means is disposed below said bottom portion of said metallic insert means within said recess formed therein and the remainder of said secondary charge means is disposed above said bottom portion of said metallic insert means.

3. A detonator device according to claim 2, wherein said bottom member of said case means is curved inwardly.

4. A detonator device according to claim 2, wherein the cylindrical surface of said case means is provided with an externally-threaded portion.

5. A detonator device according to claim 2, wherein said metallic insert means is provided in the form of a cup open at one end and has a length sufficient to accommodate therein at least said primer charge means and said remainder of said secondary charge means.

6. A detonator device according to claim 5, further including additional charge means disposed within said metallic insert means, between said primer charge means and said secondary charge means.

7. A detonator device according to claim 5, wherein said metallic insert means further includes outwardly-turned flange means at said open end thereof.

8. A detonator device according to claim 5, wherein said bottom member of said case means is curved inwardly.

9. A detonator device according to claim 5, wherein the cylindrical surface of said case means is provided with an externally-threaded portion.

10. A detonator device according to claim 7, wherein said bottom member of said case means is curved inwardly.

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