Oct. 28, 1958 F. R. SEAVEY ET AL 2,857,847

DETONATORS

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FIG. 1

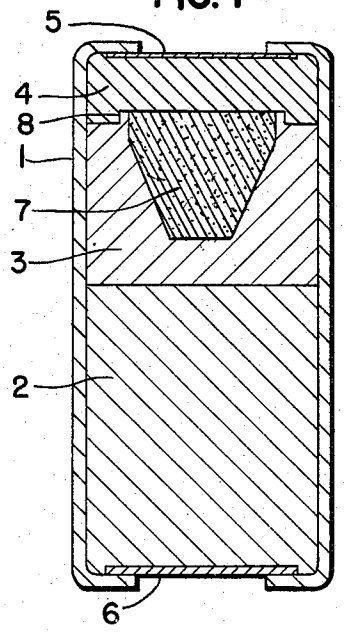

FIG. 2

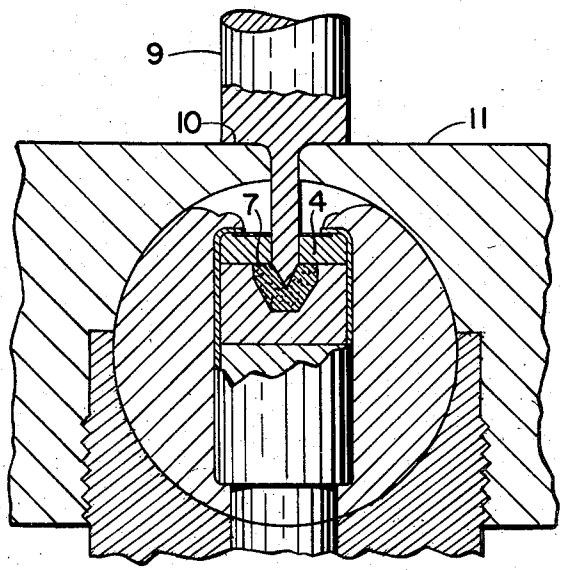

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FIG. 3

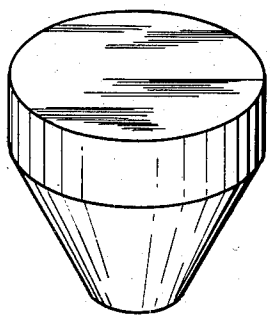


FIG. 4

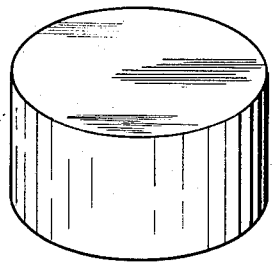


FIG. 5

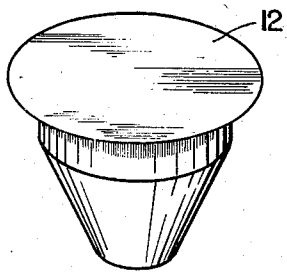
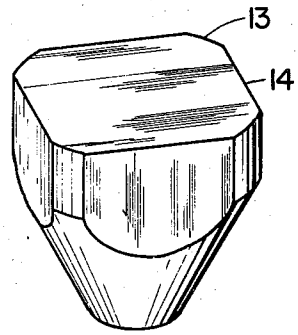


FIG. 6



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2,857,847

DETONATORS

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Application October 13, 1954, Serial No. 462,054

1 Claim. (Cl. 102—86.5)

This invention relates to detonators and particularly to the so-called combination detonator provided with a stab-type primer.

Such combination detonators are generally used to provide detonation of the base charge in high explosive shells and they are normally initiated by penetration of a firing pin into the primer. These detonators usually contain, in addition to the base charge, a delay or initiating charge and a priming charge. Under optimum conditions, the time interval between the penetration of the firing pin into the priming mix and the detonation of the base charge is consistent, and normally this delay is very short, that is, it is measured in microseconds. This short delay is essential to the proper operation of the high explosive shell in which the detonator is carried, for it provides time for the shell to penetrate into the body of the target before it is exploded. Under some circumstances, however, the firing pin penetrates completely through the priming mix and into the delay element of the detonator and in such instances the detonation of the base charge of the shell is practically instantaneous and the efficiency of the shell is largely lost due to its being exploded exterior to the target. It has been noted that there has been considerable variation in the firing time of the high explosive shells provided with such detonators that are activated on impact; and it has now been found that such variations are in a large part due to variations in the penetration of the firing pin into and through the priming mix of the detonator. Thus, extra heavy impacts tend to force the firing pin's point beyond the sensitive priming layer and into the initiating charge normally lying below the priming mix. Such excessive penetration causes instantaneous detonation or, at best, very short delays from assemblies which would produce useful delays with normal firing pin penetration.

It is therefore an object of this invention to provide a friction activated detonator having a more uniform firing time than previously known detonators of this type. It is also an object of this invention to provide a combination detonator in which the depth of penetration of the firing pin is controlled and in which penetration of the firing pin into the second charge of the detonator is effectively eliminated. Another object of this invention is to provide a novel stab-initiated detonator. A further object of this invention is to provide a stab-type detonator overcoming the disadvantages of the prior art detonators.

The manner in which these and other objects are accomplished by this invention will be fully understood when the following description thereof is read in connection with the drawing, in which:

Figure 1 is a sectional view illustrating an embodiment of this invention;

Figure 2 is a fragmentary view partially in section showing a detonator made in accordance with this invention in firing position in a projectile fuze; and

Figures 3, 4, 5 and 6 are perspective views of detonator components utilized in accordance with this invention.

In accordance with this invention, generally stated,

these and other objects are accomplished by providing a detonator of the stab or impact initiated type in which a tablet or pellet of relatively inert or friction-insensitive material is positioned between the initiating charge and the point of entry of the firing pin into the detonator. This is most readily achieved by providing a friction or stab-initiated detonator in which the top, or priming charge, of the detonator is separated at least in the area of the firing pin penetration from the second or initiating charge of the detonator by the friction-insensitive or inert tablet or pellet. The tablet or pellet of friction-insensitive material is so positioned between the priming charge and initiating charge so as to absorb any excess penetration of the firing pin and prevent it from entering into the initiating charge. Thus, the priming and initiating charges are separated from one another at least in the central portion of the detonator by the pellet of consolidated friction-insensitive material. Such a tablet can extend to the periphery of the charges, but is preferably centrally located and has a diameter between about 40% and about 75% of the diameter of the detonator. The thickness of the tablet can vary within wide limits and it is only necessary that the tablet be sufficiently thick to absorb any excess penetration of the firing pin, while not preventing the transmission of the flame or explosive wave between the charges.

Tablets of widely divergent configurations can be utilized in accordance with this invention. Suitable shapes include conical, cylindrical, rectangular and the like.

The composition of the tablet which is used in accordance with this invention to prevent by-passing the explosive stimulus through the priming mix may vary appreciably. It is only essential that it be made up of friction-insensitive or inert materials. The tablet or pellet can, for example, be composed of nylon, wood pulp, talc, chalk, polyethylene, rubber, neoprene, starch or rosin, and mixtures thereof, as well as other minerals and natural and synthetic resins. Explosive materials incapable of initiation by the action of the firing pin can also be employed in the pellet. Suitable explosive compounds include, for example, trinitrotoluene, cyclonite, tetryl, pentaerythritol tetranitrate, and ammonium nitrate. This tablet can be prepared by ordinary consolidating methods and is preferably prepared in conventional pelleting equipment. Alternatively, the tablets can be prepared by subdividing extruded plastic or resinous resilient bodies into appropriate shapes.

The terms "friction-insensitive" and "inert" as used in this specification and in the appended claims are synonomous and denote compounds or compositions incapable of violent decomposition or chemical reaction caused by normal penetration by the firing pin.

This tablet can be imbedded in the priming mix, in the uppermost portion of the initiating charge, or a portion of the tablet may be located in one charge while the remainder of the tablet extends into the other charge. In those cases where it has been found desirable to separate the priming and initiating charges with a foil of paper or metal such as aluminum, the tablet of this invention is more securely positioned in the detonator by cementing it to the foil. In such instances, the tablet is of course contained entirely within the priming charge or the initiating charge and the foil serves the two-fold purpose of separating the adjacent explosive charges and of positively positioning the tablet.

The explosive train of the detonator forms no part of the present invention and any suitable explosive ingredients can be used with equal efficiency, provided only that the inert pellet is positioned above the initiating charge so as to serve as a cushion for any severe impact by the firing pin. Thus, the primer charge can be any of the

standard percussion priming mixes, for example, lead styphnate, tetracene, and/or mercury fulminate, together with suitable fuels, oxidizers and abrasives, or mixtures of potassium chlorate, antimony sulfide and lead sulfocyanate, and the like; while the initiating charge can, for example, be lead azide, diazodinitrophenol with or without potassium chlorate, or mercury fulminate, and mixtures thereof. Any suitable base charge such as trinitrotoluene, cyclonite, PETN, hexanitromannite, tetryl, and the like can be utilized.

In order that the invention may be further clarified and more fully understood, the following is a detail description of a preferred embodiment thereof.

As shown in Figure 1 of the drawing, the detonator is provided with a metal case 1, preferably aluminum, which is loaded with a base charge 2 of cyclonite and initiating charge 3 of lead azide and a priming charge 4 consisting of normal and basic lead styphnate, aluminum, antimony sulfide, and barium nitrate. These charges are consolidated and loaded at pressures between about 10,000 and 20,000 pounds per square inch and are retained in place by means of aluminum discs 5 and 6 at either end of the case. The tablet 7 in this example is composed of consolidated talc and is imbedded in the initiator charge so as to protect it from any possible excess penetration of the firing pin. This modified truncated conical pellet is centrally located and has a diameter greater than one-half of the diameter of the detonator itself. In accordance with the preferred embodiment of this invention, the pellet is seated in a depression 8 in the priming mix, and extends through a major portion of the initiator charge. The thickness of the tablet is not at all critical and it will be readily appreciated that it is only necessary for the tablet to be sufficiently thick so as to extend beyond the maximum possible point of penetration of the firing pin.

The detonator as described in the above embodiment was prepared by inverting the detonator case 1 and closing one end thereof with the thin aluminum disc 5, the priming charge 4 was then weighed and pressed into position at a pressure of about 20,000 pounds per square inch. In the preferred embodiment shown, it will be noted that the priming charge 4 was stepped at 8 so as to provide a cylindrical recess to accommodate the pellet 7 of inert material. This recess is not essential to the invention but it does provide one convenient means of positively positioning the pellel and preventing its migration during the subsequent loading operations. After the priming mix had been pressed into place, the pellet 7 was positioned as shown with its base resting in the recessed portion of the priming mix. With the pellet in place, the initiating charge 3 was loaded into the detonator case about and around the pellet and was then pressed at about 20,000 pounds per square inch. In like manner, the base charge 2 was then placed in the case and was also consolidated at the same pressure. The case was then closed by placing the aluminum base plate 6 in position and then crimping the end of the detonator case over it.

Figure 2 of the drawing shows a detonator prepared in accordance with this invention in firing position in a typical projectile fuze. As shown in this figure, the firing pin 9 has penetrated completely through the priming mix 4 and into the inert pellet 7. Under normal conditions the penetration of the firing pin would not be so great, but under severe impact or in instances where the tolerances are accumulative it has been found that with the ordinary stab-initiated detonator the firing pin often penetrates into the initiating mix and thus a negligible delay or instantaneous detonation will result. As particularly well illustrated in this figure, however, such excess penetration is effectively eliminated by the inclusion of the inert pellet 7 into the detonator. Since, as is the case in practically all impact initiated projectiles, the extent of the penetration of the firing pin is limited by the shoulder 10 of the pin coming in contact with the housing 11, the introduction of the pellet in the path of the firing pin will prevent premature activation of the initiating charge resulting from inadvertent penetration of the firing pin.

Figures 3, 4, 5 and 6 serve to illustrate some of the modifications that can be made in the shape of the inert pellet used to obtain the benefits of this invention. As shown in Figure 3, the pellet can be in the form of a truncated cone whose lower portion has been modified so as to form a cylinder. Such a modification is not critical and an unmodified truncated cone can be used provided that measures are taken to prevent breakage of the edges around its base. In some instances it may be preferable to use a cylindrical pellet as shown in Figure 4.

When it is essential or desirable to prevent intermixing of the initiating and priming charges, such intermixing can be eliminated by means of a foil betwen the charges and in such instances the inert pellet is advantageously cemented to the foil prior to its insertion into the detonator. Thus, the foil serves not only as a separating means but also as a positioning element for the pellet. Such an assembly is illustrated in Figure 5 in which the pellet has been cemented to a thin aluminum foil 12.

It will be noted that the pellet of Figure 6 does not have a cylindrical base but rather it is provided with a substantially square base having rounded edges. When this type of a pellet is used, it is preferred that the rounded edges 13 contact the inside wall of the detonator case while the flame or explosive wave from the priming mixture is transmitted to the initiating charge through the spaces occurring between the straight portions 14 in the base of the pellet and the shell wall. In this way, the inert tablet is maintained in an operative position while a path for the transmission of the explosive wave through the detonator is preserved.

The detonator as illustrated hereinbefore provided substantially uniform firing times regardless of the degree of penetration by the firing pin into or through the priming mixture. When the firing pin penetrates completely through the priming mix, the premature initiation of the initiating charge 3 is prevented by the cushioning pellet 7 and in all instances the explosive stimulus must necessarily be transmitted from the priming charge to the initating charge.

While the above embodiment depicts a detonator provided with a metal case and a particular explosive train, it is not to be inferred that this invention is limited to such details. On the contrary, detonators having plastic or metal cases containing a great variety of explosives can be utilized to achieve the desirable results of this invention; and it is to be understood that the features of this invention can be advantageously applied to all types of detonators that are initiated by impact or stab action.

From the foregoing, it is evident that this invention accomplishes its objects in providing a novel stab-initiated detonator in which variations in the delay period are minimized or prevented by limiting the effect of variable depths of penetration of the firing pin.

Since various modifications within the spirit of this invention may be made within the specific embodiment, the detail descrption is to be considered as illustrative and not limiting the invention except in accordance with the appended claim.

What is claimed is:

A stab-initiated detonator comprising a priming charge, a cushion pellet of inert material and an initiating charge adapted to be activated by the priming charge, the priming charge being positioned above the initiator, the pellet being positioned below the priming charge and above that portion of the initiator located in an extrapolation of the normal path of the firing pin, the

combined thickness of the priming charge and of the pellet being in excess of the normal maximum penetration by the firing pin into the detonator.

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