

May 21, 1929.

S. B. LARGE

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BOOSTER DETONATOR

Filed Feb. 23, 1927

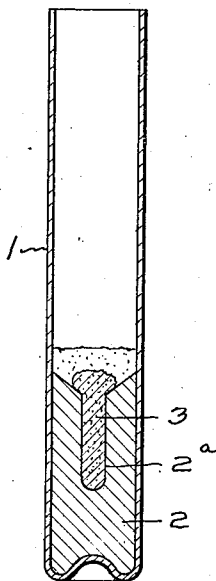
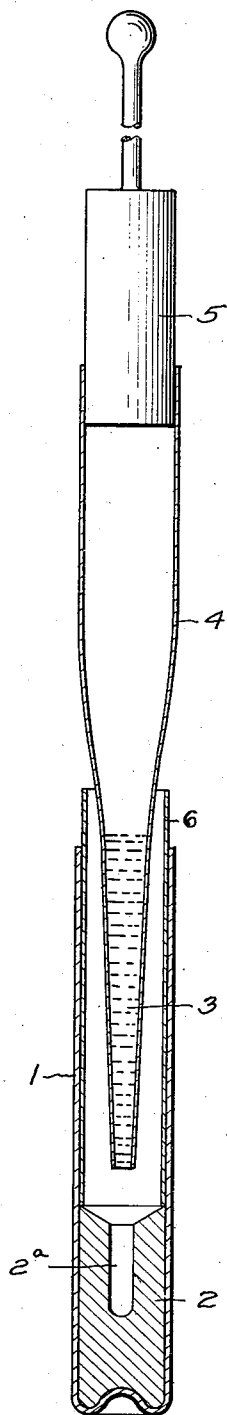


Fig. 2.

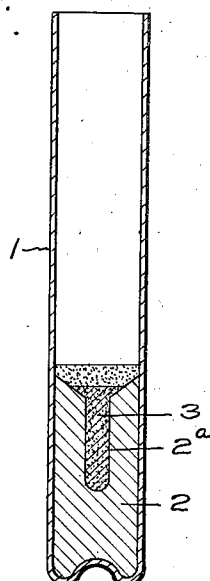


Fig. 3.

Fig. 1. *Sylvester B. Large*  
Inventor  
By *Samuel Henick*,  
Attorney

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# UNITED STATES PATENT OFFICE.

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## BOOSTER DETONATOR.

Application filed February 23, 1927. Serial No. 170,265.

My invention relates especially to the manufacture and general assembly of that type of detonator or blasting cap commonly known as the compound or booster type, though certain of its advantages may be applied to other types. It deals particularly with the promotion of safety in the handling, storage and use of such detonators, and makes possible the use in booster detonators, of initiators or primers, which might otherwise be too sensitive, though it provides greater safety in the manipulation of any type of primer. Its most convenient application is in connection with non-crystalline or finely crystalline masses which maintain suspension in water to a fair degree. These types are most difficult to handle by the methods heretofore employed. However, the invention may be applied to any type of primer by suitable manipulation within the scope of the invention.

It is generally agreed that a blasting cap or detonator of the compound or booster type, when properly made of proper materials, is an improvement over the usual fulminate-chlorate cap. Such a cap usually contains two or more separate charges, though it is possible to mix the booster material with the initiating material in some cases, as one charge. The booster charge is usually composed of such materials as tetryl, hexanitrodiphenylamine, picric acid, nitrostarch, nitromannite or nitrocellulose. The initiator may be fulminate of mercury, a heavy metal azide or explosives of their properties, or mixtures of such explosives. Generally, an explosive which will pass from combustion, through ignition, to maximum detonation in a very short time, and under slight confinement, may be considered as having possibilities as an initiator for compound detonators, or as a sole charge for detonators.

Fulminate of mercury has found much favor as an initiator because it has a relatively low ignition temperature, is easily made and, while very sensitive, can be manipulated in the dry state with a limited hazard. As an initiator, however, it is inferior to some other substances such as certain heavy metal azides, for instance. This is illustrated by the well-known fact that very much smaller charges of certain heavy metal azides, than of fulminate of mercury,

are required to detonate the secondary or base charge in compound detonators. Mercurous azide is an initiator of much greater effectiveness than fulminate of mercury, but, under certain forms of manipulation, is somewhat more hazardous. It is not to be inferred, however, that it can not be handled successfully in the dry state since this has been done commercially. Further, in a finished detonator, tests have shown it to be no more hazardous than fulminate of mercury.

In the accompanying drawing;

Fig. 1 is a sectional diagrammatic view illustrating a detonator in its initial stage of manufacture.

Fig. 2 is a like view illustrating an intermediate stage in the manufacture of the detonator; and

Fig. 3 is a like view illustrating the final form of the detonator.

Like numerals designate corresponding elements in all of the figures of the drawing.

In the drawing, 1 designates the detonator shell and 2, the base or booster charge, which, for purposes of convenience, I will hereinafter refer to as tetryl, though it is clear that any suitable material may be employed in this relation. In the initial pressing of the base charge 2 into the shell, a central indentation or depression 2<sup>a</sup> may be formed in the charge in the manner disclosed in my copending application Serial Number 164,802, filed on the 31st day of January, 1927. However, it is to be understood that this base charge may be formed with any lesser degree of indentation up to a perfectly flat surface. I prefer the large indentation because less initiating charge is then required, owing to the increased area of contact between the initiating charge and the base charge. Further, with some initiating charges, it may be desirable to maintain portions of the initiating charge out of contact with the shell wall, and in such case the central indentation is of utility for that purpose.

In Fig. 1, the initiating charge 3 is shown as being contained in a tube 4. A plunger 5 is adapted to operate within this tube. The charge 3 may, and preferably will, consist of mercurous azide. Mercurous azide may be made by combining sodium azide and a mercurous salt in aqueous solution. It precipitates as a very fine white mass, which cakes on drying, and exists as a dusty

white powder on breaking up the cake. In my procedure the precipitated azide is washed by decantation, then run on to a suction filter and reduced to a moisture content most conducive to convenience in subsequent operations. It may, in this wet condition, be stored indefinitely in rubber bags. The described wet azide is placed in a suitable container and the tube 4 is made to contain the desired quantity of azide by immersion in the wet mass of the same in the container. This proper quantity may be obtained by immersion of the tube to the proper depth and the action of capillarity, or by the regulated action of the plunger 5. It is, of course, obvious that other means of tube loading might be resorted to, without departure from the invention. After the tube is loaded, it is inserted in the detonator shell. A protective tube or sleeve 6 may be used to prevent any possibility of smearing the side walls of the shell with the azide. However, the invention is not limited to the use of a protective tube of this character. After the tube 4 has been inserted in shell 1, to the proper depth, a slow movement of the piston 5 serves to eject the wet mercurous azide on to the tetryl and into the indentation 2<sup>a</sup>. The tube is then removed for reloading and for a repetition of the operation. It will be understood that any reasonable number of tubes may be operated at the same time.

Following the foregoing, the wet azide in the shell may be partially dried or the shell may pass immediately to the next operation. This consists in charging a dry explosive, which may be an ignition transmitter, such as lead trinitroresorcinat, or a combined ignition transmitter and partial initiator as fulminate of mercury. Upon subsequent pressing of the entire assembly, the moisture in the azide charge penetrates the upper dry charge sufficiently to desensitize it materially, yet by a reasonable control of the amount of moisture in the azide, the upper charge does not become sufficiently moist at its upper surface to smear the press points. The detonators so made are very insensitive through subsequent operations and until they are finally packed in their ultimate containers. At this stage they may be dried out by subjection to warmth or warmth and reduced pressure.

It will be obvious that when the dry top charge (fulminate of mercury, for example), is pressed on the wet intermediate charge (mercurous azide, for example), it tends to mix partially with it, yet no azide penetrates entirely to the surface. Thus, even if a very sensitive intermediate initiator is used, it is entirely covered up by the less sensitive fulminate or other top charge. This promotes safety in use without sacrificing the advantages resulting from the use

of more effective initiators than mercury fulminate.

An example of a satisfactory charge for commercial detonators made under this process is: (1) a base charge of 0.4 grams tetryl; (2) an intermediate initiator charge of 0.10 grams (40-60) mercurous azide-water; and (3) a top ignition and initiation aid charge of 0.3 grams fulminate of mercury.

While for purposes of illustration, I have described the charges as consisting of tetryl, upon the one hand, and fulminate-mercurous azide, upon the other hand, it is to be understood that the principle involved and which forms the real substance of the invention, goes far beyond the use of any particular explosive materials. I have already recited a number of explosive substances which may be utilized as the base charge and I wish to make it clear that any suitable initiating charge, such as fulminate-chlorate mixtures, fulminate-mercurous azide mixtures, fulminate-lead azide mixtures, or any other suitable combined charge recognized in the art as applicable in this relation, may be employed. Furthermore by the use of the term "mixtures", I intend to include either the actual intermixing of the substances of which the initiating charge is composed, or the superimposing of one of these substances upon the other, as herein disclosed. I have chosen mercurous azide as the example to be stressed because it serves excellently to present the idea involved. The application of mercurous azide is materially aided by my invention. Some other possible initiators are so sensitive and hazardous when dry, that they can hardly be used without the employment of this invention.

It is commonly recognized in the art that the wet loading of initiators and their consequent desensitization, during their subsequent handling in other operations, is highly desirable. However, the charging of wet initiators has presented great inconvenience and difficulty because a condition of wetness, sufficient to properly desensitize the detonators, resulted in wetting the press points during the pressing operation. If the loose primer is moist before pressing, it is almost sure to wet the press points and cause the explosive to adhere to and cake on them during the pressing operation. Upon the other hand, initiators which are of a fine, dusty nature when dry, are almost impossible of application in the dry state.

Another advantage of this invention is that when a mercury fulminate-lead azide initiating charge is employed, the lead azide may be maintained, by the presence of the tetryl, out of actual contact with the wall of the shell, only the mercury fulminate actually contacting with the wall of the shell, after the final pressing of the charge. This is of importance, for the reason that the

usually employed, copper or gilding metal shells, which are cheap and easily drawn, are not practically resistant to lead azide, while they are resistant to fulminate of mercury. Thus by my method all of the advantages of wetting and desensitizing are had, with the additional advantage that deterioration of the shell, due to the presence of lead azide, is prevented.

10 My invention accomplishes the following important points. It combines convenience and low cost with the desired safety resulting from wet loading and wet subsequent handling; it reduces to a minimum the amount of dry initiator necessary in a factory; and it makes possible the application of initiators which, on account of physical condition or great sensitiveness, are not practical in dry methods.

20 While I have described a form of my invention in detail, and have given a specific example and sketch, it will be understood that many changes may be made therein without departing from the spirit of my invention. The detonator shell may be of any metal suitable to the base and initiating charges it is desired to use; the loading tubes may be of glass, rubber, metal, celluloid, etc., depending upon the particular situation involved; the tubes may be charged and discharged in many ways; and there is a very wide range of explosives which may be used as base charge, intermediate wet charge and top dry charge. My invention, generally, does not involve materials but methods, and these methods have been clearly explained.

Further, it is within the scope of my invention, and it is here so stated, that I may apply my procedure to detonators which contain only one initiating charge on top of the base charge or contain only one charge altogether. In the former case, I might desire to apply a dry initiator only, in the charging operation, but have lowered sensitiveness in subsequent operations. I would then load the base charge normally, add the proper amount of water on top of it, and charge the initiator thereon. In the later case, I would add the proper amount of water to the empty shell and charge, in one charging, part or all of the detonator composition. Equally the liquid could be introduced with the base charge in a compound detonator.

It is obvious also that water is not the only moistening agent. I might mention alcohol, acetone, butyl acetate and, in fact, any suitable volatile liquid which does not react chemically with my compositions.

Having described my invention in detail, what I claim and desire to secure by Letters Patent is:

1. The herein described method of manufacturing booster detonators which consists of loading a base charge into a shell, then

loading on top of the base charge a moist charge of a substance of initiating power and then loading a dry charge of easily ignited explosive material upon the moist charge, and permitting the moisture from the moist charge to penetrate the dry charge to desensitize the same, for a limited period of time.

2. The herein described method of manufacturing booster detonators which consists of loading a base charge into a shell, loading a moist charge of a substance of initiating power upon the base charge, and finally loading a dry charge upon the base charge and pressing the whole, while maintaining the moist charge out of contact with the wall of the shell at all times.

3. The herein described method of manufacturing booster detonators which consists of loading a base charge into a shell and forming a cavity in said base charge, loading a charge of a moist initiatory explosive into the cavity of the base charge and then loading a charge of dry ignition material upon the moist initiatory material and pressing the whole in place.

4. The herein described method of manufacturing booster detonators which consists of loading a base charge into a shell, then loading a charge of a moist initiating material into a cavity formed in said base charge, said initiatory material being of a nature to attack the metal of the shell and then loading a charge of ignition material upon the moist initiatory material, permitting the moisture from the initiatory material to penetrate said dry material and desensitize the same for a limited period of time.

5. The herein described method of manufacturing booster detonators, which consists of loading one part of the charge thereof into a shell in a moist state and thereafter pressing a substantially dry charge thereon, the moisture from the first named part of the charge penetrating said dry charge and desensitizing the same during subsequent pressing operations.

6. The herein described method of manufacturing booster detonators, which consists of ejecting a moist charge into a blasting cap shell from a tubular container of a nature to enter said shell and deposit said moist charge without smearing the sides of said shell with said moist charge, and then pressing a dry charge upon said moist charge.

7. The herein described method of manufacturing blasting caps, which consists of placing a paste like moist charge in a tubular container having an open end of a size adapted to enter a blasting cap shell, entering said tubular container into said shell a sufficient distance to permit the moist charge to be ejected at a low point in the shell without smearing the sides of said shell with

said moist charge, then depositing a dry charge upon the moist charge and then compressing the whole.

8. The herein described method of manufacturing blasting caps, which consists of placing a paste like moist charge in a tubular container having an open end of a size adapted to enter a blasting cap shell, entering said tubular container into said shell a sufficient distance to permit the moist charge to be ejected at a low point in the shell without smearing the sides of said shell with said moist charge.

9. The herein described method of manufacturing blasting caps, which consists of loading a base charge into an elongated me-

tallic shell, forming a cavity in said base charge, loading into said cavity a moist charge of a material of a nature likely to exert a corrosive action upon the metal of the shell and then loading a dry charge upon said moist charge, and thereafter pressing the whole, the moist charge being in such amount as to be contained wholly within the cavity of the base charge and out of contact with the shell, the moisture from the base charge penetrating the dry charge and desensitizing the same during the pressing operation.

In testimony whereof he affixes his signature.

SYLVESTER B. LARGE.