United States Patent

[11] 3,611,939

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[23] **Division of Ser. No. 691,647, Dec. 18, 1967, Pat. No. 3,499,386 which is a continuation of Ser. No. 612,049, Jan. 26, 1967, abandoned, which is a continuation of Ser. No. 326,457, abandoned.**
[45] Patented **Oct. 12, 1971**
[32] Priority **Nov. 29, 1962**
[33] **Germany**
[31] **D 40 379**

[54] **PRIMER**
2 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **102/46,** 102/86.5
[51] **Int. Cl.** **F42b 9/08**
[50] **Field of Search** 102/46, 28, 70.2, 86.5

[56] **References Cited**
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ABSTRACT: A primer comprising a body of priming composition composed of a thermal mixture and an initial detonating agent, and a body of booster material composed of thermal mixture substantially free of initial detonating agent. The booster material and the priming composition are in direct contact.

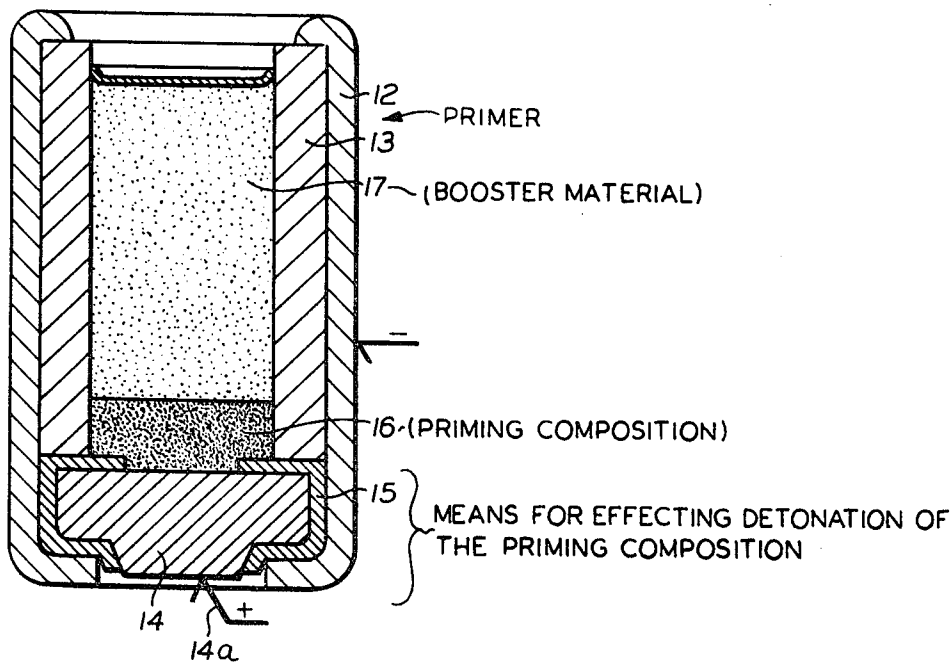


FIG. 1.

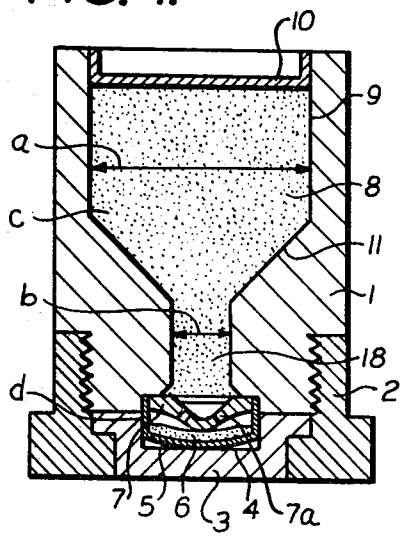


FIG. 3.

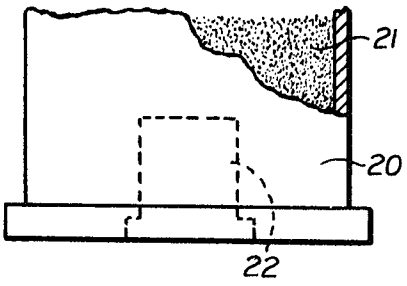
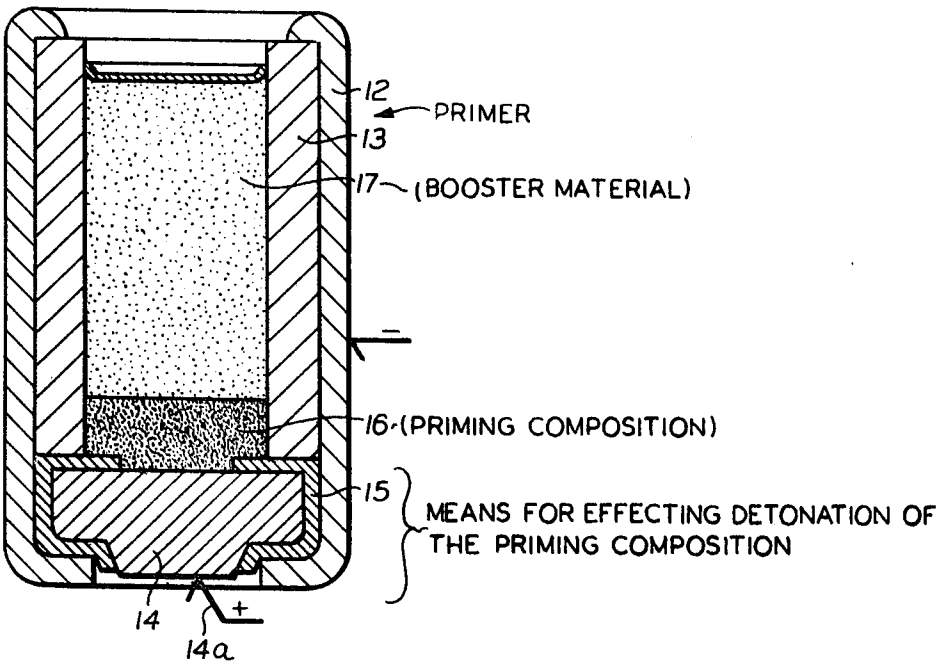


FIG. 2.



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PRIMER

This application is a division of application Ser. No. 691,647, filed Dec. 18, 1967, now U.S. Pat. No. 3,499,386, which is a continuation of Ser. No. 612,049, filed Jan. 26, 1967, now abandoned, which in turn is a continuation of Ser. No. 326,457, filed Nov. 27, 1963 abandoned.

For the ignition of powder in gun cartridges, shotgun shells, etc. etc., are used which contain a limited amount of primer composition which suffices to ignite the relatively small amount of powder in these cartridges. The powder is usually smokeless powder, in a charge amounting to between 1 and 8 grams, in which case quantities of 20 to 40 mg. of priming composition suffice.

Larger cartridges with a caliber of 15 or 20 mm., in which the amount of powder runs as high as about 50 grams, require correspondingly larger amounts of priming composition to ignite the powder. Percussion and electrical primers are made for this purpose which contain a charge of up to 200 mg. of priming composition. The handling of these heavily charged primers is not always without danger, and special precautions must be taken in the shipment and in the installation of these primers to prevent unintentional explosions. An amount of 200 mg. of primer composition is, in general, not exceeded for reasons of safety because otherwise it would act as an explosive detonator.

Consequently, in the case of still larger charges, i.e. larger than 50 grams, threaded percussion primers have long been used. These threaded primers have only small percussion caps containing approximately the same amount of priming composition as a gun cartridge primer and in addition contain a charge of black powder. The priming composition serves to ignite the black powder. This black powder, the charge and arrangement of which may vary considerably according to requirements, serves in turn to ignite the smokeless powder.

Herein the term "primer" is used to designate the thing inserted in a shell or the like, and which receives an initial impulse to effect firing of the shell. The term "primer composition" is a composition within the shell responsive to the initial impulse. In addition to the primer composition, the primer may contain a "booster charge." In the case of shells containing a charge in excess of 50 grams, described above, the primer contains a primer composition and in addition a booster charge (which can be black powder), and the primer composition initiates the booster charge and the booster charge in turn initiates the shell charge.

The use of a black powder booster charge is accompanied by the disadvantage of requiring much space, this being due to the relatively small caloric yield developed by black powder. Due to black powder's high sensitivity to moisture, special measures must be taken to seal it. It is furthermore necessary to pack the black powder loosely, so that it will burn fairly rapidly to achieve the short ignition time required for the shot. It is not possible to concentrate the black powder into a small space by great compression, because this causes it to burn slowly and with a great delay.

Attempts have been made to replace black powder with a brisant smokeless powder. The igniting capacity of this powder, however, is lower than that of black powder, and hence the brisant smokeless powder is not a satisfactory replacement.

All these primers develop relatively a relatively amount of gas, which results in a high pressure in the primer body and also in the cartridge, and hence the bottom of the cartridge is placed under a severe stress, necessitating a special design that provides a very strong wall between the charge and the firing pin or electrode. This is especially disadvantageous in the case of percussion-type threaded primers since it greatly reduces their percussion sensitivity.

In all cartridges in which the expansion of the area of combustion is very rapid, a gas-rich booster charge will drive the smokeless powder propellant out of the cartridge before it can be ignited. This is particularly true of cartridges having naught but light wadding (instead of a projectile), as for example in

the case of blank cartridges or cartridges used to propel mortar shells, and cartridges in which the sidewall of the casing is perforated.

The problem thus develops of creating a primer with a booster charge which will work with a relatively small amount of primer composition, ignites very easily, requires little space, and is better as regards gas development than the previously known primers which contain a booster charge.

A common primer composition is made up of an admixture of a thermal material or mixture, and an initial detonating agent. The thermal mixture can be composed of oxygen carrier, oxidizer and reducer; the initial detonating agent can be such as tricinate, tetracene, lead azide or mercury fulminate. Without the initial detonating agent, the thermal mixture reacts but poorly. Consequently (as is known), the content of initial detonating agent cannot be reduced below a certain percentage without risking the loss of the igniting power of the priming composition. Now the surprising discovery has been made that the reactivity of the thermal mixture containing no initial detonating agent is excellent if the reaction is initiated by igniting it with a thermal mixture that does contain an initial detonating agent. This characteristic of the reaction of the explosive-free thermal mixture is utilized according to the invention by providing a booster charge composed of a thermal mixture of oxidizer and reducer, but containing no initial detonating agent. In this manner a rapidly acting primer is obtained which, with a very small amount of initial detonating agent, is capable of igniting even relatively large amounts of smokeless powder.

The invention, however, is especially valuable because the booster charge, on account of its high calorie content, requires substantially less space than
prior art charges, and also especially because of the fact that it can be very highly compressed, e.g. up to 1,000 kg. per sq. cm., desirably 500–1,000 kg. per sq. cm. A booster charge 2.5 cm. along according to the invention is equivalent to a prior art booster charge approximately 10 cm. long.

The following are particularly good examples of thermal mixtures suitable as the booster charge:

1. 75% barium nitrate
   9% lead dioxide
   18% calcium silicide
2. 62% barium nitrate
   8% lead dioxide
   30% aluminum silicide
3. 65% barium nitrate
   7% copper oxide
   28% silicon

Generally speaking the nitrates of the groups Ia and IIa of the Periodical System of the Elements may be used oxygen carriers. Other nitrates can also be used as oxygen carriers, such as basic lead nitrates. The oxides and dioxides, respectively, as cited above are also oxygen carriers, but their main purpose is to accelerate the reaction of the nitrates. They are oxidizers. Also, instead of lead or copper oxides, manganese and iron oxides; and, as reducer components, instead of aluminum calcium or silicon, zirconium, boron magnesium etc. and their alloys. However, chlorates and perchlorates are to be avoided, since they give the thermal mixture an excessively high reactivity and would thus bring it dangerously close to constituting a detonating composition. Accordingly, the thermal mixture, i.e. the booster, should be free of or the tantially free of chlorates and perchlorates.

A mixture of thermal components and initial detonating agents which would be suitable as the primer composition, is, for example:

3% tetracene [1 - (5' tetrazolyl)-4-guanyl-tetrazene-hydrate]
42% tricinate [leadstythnate]
40% barium nitrate
5% lead dioxide
10% calcium silicide

The thermal mixture component in the priming composition does not have to be identical to the booster composition, but preferably has the same character.

How effective the new primer is can be seen from the fact that it has been possible to bring 4 grams of booster charge to reaction with a priming composition charge of only 30 mg. within 1 to 3 milliseconds, i.e., in a ratio of 200:1. The upper limit of the ratio of priming composition charge to booster charge can be set at about 1 to 500.

This wide range of sensitivity of the combination of a booster charge containing no detonating agent with a priming composition charge that does, is of especial importance in production for it is no longer necessary to match the two charges to one another in each case; instead, the same priming composition charge (which contains initial detonating agent) can always be used over a range of weight ratios of primer composition charge to booster charge of about 1:1 to about 1:500 (parts of booster).

Mention has already been made of the possibility of highly compressing the booster charge. This is also very favorable from the mechanical viewpoint, since such compression gives the primer considerable strength in itself, and thus it becomes very insensitive to mechanical stresses, e.g. shock.

Thus, the invention provides a primer comprising a container, a body of priming composition within the container, and a body of booster material within the container. These bodies are in communication with each other for igniting of the booster material in response to detonation of the priming composition. The primer further includes means for effecting the detonation, such as a plate for transmitting impact to the priming composition or for transmitting an electrical igniting impulse thereto. The booster material comprises a thermal mixture which is substantially free of initial detonation agent, and the priming composition consists essentially of a thermal mixture and initial detonation agent. Desirably the thermal mixture of the booster and the thermal mixture of the priming composition consist essentially of the same components.

The invention is further described in reference to the accompanying drawing, wherein:

FIG. **1** and FIG. **2** are of primers according to the invention; and

FIG. **3** shows a portion of a shell outfitted with a primer according to the invention.

The primer body consists of the shell **1**, the threaded collar **2** and the bottom plate **3**, which is held tightly against shell **1** by the threaded collar **2**. The compressed priming charge **6** is inserted into a recess **4** in the bottom plate **3** in a cup **5**, the said priming charge consisting of a thermal mixture and an initial detonating agent. Above the priming charge **6** is the anvil **7** with holes **7***a*. The booster charge **8**, which contains no initial detonating agent, is pressed into the funnel-shaped hole **9** in shell **1**, and is covered by a thin lid **10**. Between the recess **4** containing the priming charge **6** **2–6** the booster charge there is a relatively narrow passage **18** whose diameter is to be expediently between one-half to **4–36** the booster charge chamber **9**. The transition from passage **18** to chamber **9** is not abrupt, but passes through a conically flared portion **11** with walls at an angle of about 30° to 60°. The ratio of booster charge to priming composition is 500.

In the embodiment shown in FIG. **1** the booster material is contained within a chamber provided in the container, and this chamber has an axially extending portion of relatively large cross-sectional area and an axially extending portion of relatively small cross-sectional area. The axially extending portion of small cross section is disposed to transmit initiation of the booster material from the primer composition to the portion of relatively large cross-sectional area. The diameter of the large portion can be 2–6 times the diameter of the small portion (or the area of the large portion can be about 4–36 times the area of the small portion). The booster material and priming composition can be in direct contact, and, desirably, the diameter of the body of booster material is about 3 times the diameter of the body of priming composition at the locus of direct contact (the cross-sectional area of the booster material about 9 times that of the priming composition).

In the embodiment in FIG. **2**, an electrically operated primer is shown. **12** represents the outer shell, **13** a supporting shell, **14** a plug for the one pole of the electrical igniting system including contact **14***a*, and **15** is an insulator. The priming charge is designated as **16**, and the booster charge containing no initial detonating agent is designated as **17**. This embodiment differs from the one in FIG. **1**, in that the booster charge **17** is pressed directly upon the priming charge **16**. However, it is not necessary that both charges have the same diameter when pressed together. The diameter of the booster charge can also be greater than that of the priming charge by as much as a factor of three. The design of FIG. **2** is desirable when it is desired to have the priming flash cover the entire charge chamber.

The arrangement shown in FIG. **2** can furthermore also be used for percussion fuses.

In FIG. **3**, a shell **20** containing a charge of smokeless powder **21** is outfitted with a primer **22**.

The primer of the invention is well suited for shells having a projectile piece as well as blanks, cartridges for use to propel mortar shells, cartridges with wadding, etc.

While the invention has been described with reference to particular embodiments thereof, these are merely representative and do not serve to set forth the limits of the invention.

What is claimed is:

1. A primer comprising a container, a body of priming composition within the container, a body of booster material within the container, said bodies being in communication with each other for igniting of the booster material in response to detonation of the priming composition, and means for effecting detonation of the priming composition, the booster material comprising a thermal mixture substantially free of initial detonation agent, the priming composition consisting essentially of a thermal mixture and initial detonation agent, the thermal mixtures comprising an oxidizer selected from the group consisting of the oxides of lead, copper, manganese, iron, and a reducer selected from the group consisting of aluminum, calcium, silicon, boron, zirconium, magnesium, the proportion of primer composition to booster material being in the range of about 1:1 to 1:500, the booster material and the priming composition being in direct contact.

2. Primer according to claim **1**, the cross-sectional area of the booster material being about 9 times that of the priming composition where the booster material and the priming composition are in direct contact.

PO-1050
(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,611,939 Dated Oct. 12, 1971

Inventor(s) Hans Stadler et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 1, line 63, cancel "relatively" (first occurrence);

line 63, before "amount" insert --large--.

Col. 2, line 45, change "75%" to --73%--.

Col. 3, line 53, change "2-6" to --and chamber 9 of --;

line 55, change "4-36" to --one sixth of the diameter of--.

Signed and sealed this 18th day of April 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents