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Ciccone et al.

[11] **3,734,020**

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[54] IGNITER FOR PROPELLING CHARGES

[75] Inventors: **Thomas Q. Ciccone,** Langhorne; **Martin Visnov,** Philadelphia, both of Pa.

[73] Assignee: **The United States of America as represented by the Secretary of the Army,** Washington, D.C.

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[52] **U.S. Cl.**.....**102/40,** 102/DIG. 7, 102/27, 149/19, 149/29

[51] **Int. Cl.**.....**F42b 5/02**

[58] **Field of Search**.....102/40, 39, 38, 44, 102/45, 87, 49.3, 49.7, 104, 32, DIG. 1, DIG. 7

[56] **References Cited**

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Primary Examiner—Robert F. Stahl

Attorney—Harry M. Saragovitz, Edward J. Kelly and Herbert Berl et al.

[57] **ABSTRACT**

A small caliber ammunition cartridge case containing a molded propellant charge having an axial igniter extending longitudinally through a central passage in the molded charge in which complete breakup and consumption of the molded propellant charge is achieved and increased projectile velocity is obtained.

This invention relates to improved small arms cartridges having an axial-type igniter. The advantages of an axial type igniter including the achievement of more uniform ballistics and particularly more uniform projectile velocity in small arms ammunition have been disclosed in U.S. Pat. No. 3,103,884 to Ciccone and Scanlon. In this previous work, the axial igniter was a detonating type material and consequently an explosive train was required to operate or cause the axial igniter to function. A booster of PETN (penta erythritol tetranitrate $C_5H_8(ONO_3)_4$) and lead azide was used between the primer and the igniter in order to assure combustion of the igniter.

10 Claims, 2 Drawing Figures

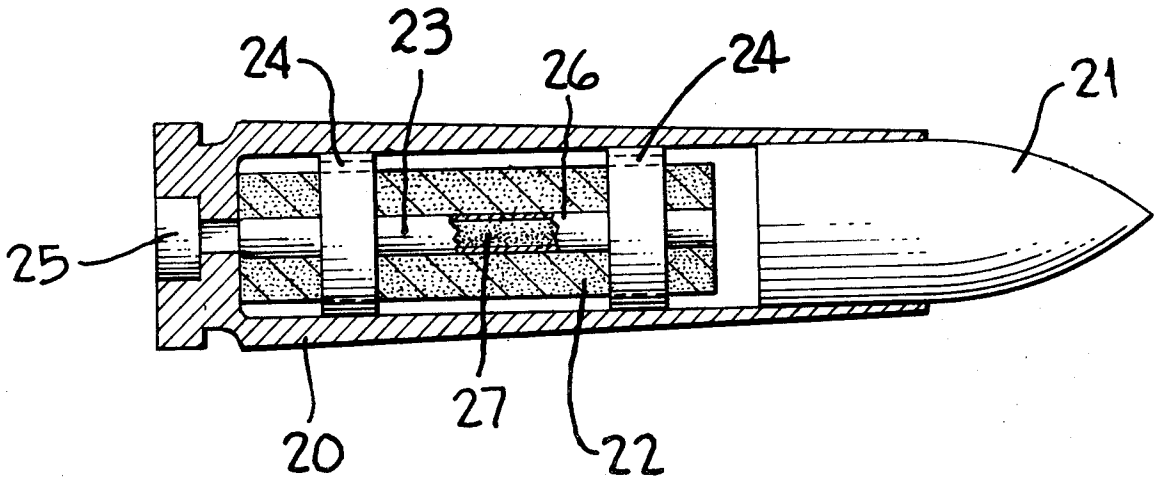


Fig. 1

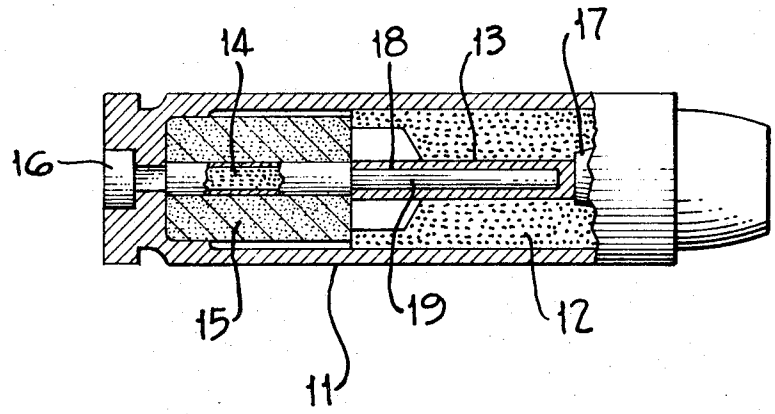
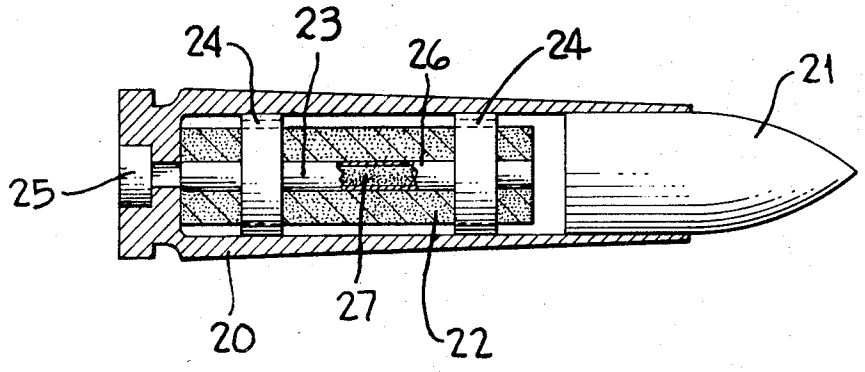


Fig. 2



INVENTORS
THOMAS Q. CICCONE
MARTIN VISNOV
BY
HARRY M. SARAGOVITZ
EDWARD J. KELLY
HERBERT BERL
W. SOMMER
ATTORNEYS

IGNITER FOR PROPELLING CHARGES

In the present invention the axial igniter has taken the form of a non-brisant priming composition which is responsive to the heat output of an ordinary primer. Furthermore, using this improved axial igniter molded charges can be effectively used in cased ammunition. Previously, it was difficult to employ the molded charge concept in small-caliber ammunition due to inability to break up the charge and achieve complete consumption of the propellant within the ballistic cycle. Using the axial igniter of the present invention, ignition, complete breakup and consumption of propellant is achieved, resulting in the desired superior performance. The main advantage of molded charge over loose granular propellant is that considerably more weight of molded charge can be loaded into a given cartridge case, thus causing greater energy to be imparted to the projectile and resulting in increased projectile velocity.

The axial igniter of the present invention consists of appropriate parts of stabilized red phosphorus, barium nitrate and a small percentage of calcium resinate. It is sheathed in aluminum or aluminum alloy. This igniter may be used in all sizes of small arms cartridges and in particularly useful when used with molded charge. This molded charge is supported within the cartridge case by sheet propellant strips circumferentially wound around the charge.

Accordingly it is an object of this invention to provide an improved axial igniter which is not dependent upon a booster charge for ignition.

It is a further object to provide an ignition system suitable to achieve total combustion of a molded charge.

It is another object to provide an igniter which is not only reliable to ignite the propellant charge but also to ignite a tracer round.

It is yet another object to provide an ignition system which may include an anti-coppering agent as a functional element which does not take up volume otherwise available for the propellant charge.

Other objects and attendant advantages of the present invention can be more fully appreciated when the specification is considered in connection with the attached drawings in which:

FIG. 1 shows a longitudinal section through a flechette-type tracer cartridge employing one embodiment of the present invention.

FIG. 2 is a longitudinal section through another cartridge employing a second embodiment of the present invention.

Cartridges of the very small caliber SPIW (special purpose infantry weapon) system are currently under development. These rounds contain a single flechette as a projectile. Due to the extremely small size of the flechette it has been difficult heretofore to design a tracer projectile which was consistently reliable. One of the problems was that the small cross-sectional area of the tracer cavity permits only a very small volume of the tracer composition. Consequently, this composition was rendered difficult to ignite. One of the advantages of the present axial igniter is the fact that a great amount of heat and energy is directed not only radially to the propellant charge, but also axially directly onto the tracer cavity. Thus, the tracer composition is assured of ignition. FIG. 1 shows such a cartridge.

The cartridge case **11** contains the flechette tracer projectile **13** surrounded by loose propellant charge **12.** To the rear of the flechette is the axial igniter **14.** The axial igniter **14** is physically held in alignment with the primer **16** and the tracer cavity **18** by the molded propellant charge **15.** The tracer cavity **18** is filled with an appropriate tracer composition **19.** A fiberglass sabot **17** surrounds the tip of the flechette **13** as is well known in the art.

The axial igniter **14** consists of a thin sheath of aluminum or aluminum alloy surrounding a core of the igniter composition which is fully described hereinbelow.

FIG. **2** shows a conventional cartridge propelled by a molded charge and an axial igniter. The cartridge case **20** contains a projectile **21** and a primer **25.** Aligned with the primer **25** in the center of the cartridge case **20** is axial igniter **23.** Surrounding the igniter **23** is a molded propellant charge **22** which is supported within the cartridge case **20** by sheet propellant strips **24** circumferentially wound around the charge **22.** The strips **22** have a dual advantage in that they align the axial igniter **23** with the primer **25** regardless of cartridge position and they allow a small annular space between the cartridge case wall **20** and the molded charge **22** for peripheral breakup of the charge **22** upon functioning of the igniter **23.** The igniter itself is composed of a core of igniter composition **27** surrounded by a thin metal sheath **26.**

The improved ballistic characteristics of the present system are specified in Table I in which cartridges using molded charge with and without an axial igniter are compared.

TABLE I

Propellant Charge Weight	Igniter	Peak Pressure psi	Velocity at 12½ ft	Remarks
34 gr, molded* 8 gr, loose, gran.	none	28,200	3,296	Unburned propellant
34 gr, molded * 8gr, loose, gran.	none	26,900	3,311	Unburned propellant
34 gr, molded* b 2 gr, spacer **	axial igniter	36,800	4,000	Propellant consumed
34 gr, molded * 2 gr, spacer **	axial igniter	40,100	4,029	Propellant consumed

Note:
* Molded charges prepared from same granular propellant, under identical molding conditions.
** Circumferential propellant sheet strip to align axial igniter in molded charge with cartridge case primer.

The specific composition now used for the axial igniter is 5–90 percent by weight of stabilized red phosphorus, 5–90 percent by weight of barium nitrate and 0–10 percent by weight of calcium resinate. A preferred composition is 24 percent stabilized red phosphorus, 75 percent barium nitrate and 1 percent calcium resinate. An advantageous loading for a typical axial igniter would include approximately 3.0 grains per foot of composition contained in an aluminum sheath with an outside diameter of 0.050 inch and an inside diameter of 0.020 inch. This axial igniter is responsive to the heat output of an ordinary primer, thus, causing functioning and, with the wall thickness of the aluminum held to an upper limit of approximately 0.015 inch, the entire piece becomes combustible and

disappears. The core loading can and will vary depending on the quantity and type of propellant to be ignited.

Although a simple three component composition is described above, the mixture can be varied to suit performance. For example, in place of calcium resinate other materials may be used. These include carbon black, graphite, metallic stearate, and other metallic soaps, polyvinyl alcohol, polyvinyl chloride, etc. If additional kinetic or thermal output is required in the axial igniter, a suitable primary or secondary high explosive can be added in quantities up to 40 percent, or fuels. The high explosives which may be used include these known in the art as PETN, HMX and RDX. The fuels which may be used include aluminum, magnesium, zirconium, titanium, antimony trisulfide, or calcium silicide.

Aluminum or aluminum alloys are the preferred material for the axial igniter sheath because of their contribution of hot particles to improve ignition, but other metallic, polymeric or fabric materials can be employed when these add a particular desired advantage to the system such as thinness and total combustability. Tin or tin alloy as an axial igniter sheath material is attractive as an anti-coppering agent for gun barrels when used with gilding metal or copper-clad projectiles. Tin as an axial igniter sheath is a novel means of employing this material in small arms rounds, where previously it was either a non-gaseous part of the propellant composition or was loaded into the cartridge case where it took up part of the volume otherwise available for propellant charge.

Another particularly advantageous utility for the present axial igniter is forseen in the field of caseless ammunition. One of the greatest problems presently in the development of caseless ammunition is its vulnerability to accidental ignition. Propellants for caseless ammunition are now being developed which are much less vulnerable, event at high temperatures. These new propellants, however, are also less reliable in ignition in use. The use of an axial igniter as an auxiliary igniter for less vulnerable propellants for caseless ammunition will therefore take in great value.

It is now apparent that a desired ballistic performance can be achieved by varying the axial igniter core composition, amount of core load, and length of igniter, the composition of the igniter sheath, the composition and geometry of the individual propellant granules which are molded into the one-piece, high density charge, the size of the molded charge, and the amount of annular space allowed for charge breakup.

We wish it to be understood that we do not desire to be limited to the exact details of construction shown and described, for obvious modifications will occur to a person skilled in the art.

We claim:

1. In a small caliber cartridge case having a base portion containing a primer and a mouth portion containing a projectile,

a substantially cylindrical molded charge of granular propellant within said case and seated against said base portion, said molded charge having a central longitudinal passage therethrough,

an axial igniter filling said molded charge central passage,

said base portion having a central passage in axial alignment with both said primer and axial igniter, and

means laterally spacing a substantial portion of the outer surface of said molded charge from corresponding adjacent internal sidewall surface portions of said case,

said spacing means including a plurality of longitudinally spaced sheet propellant strips circumferentially wound around said molded charge outer surface.

2. The structure as set forth in claim **1** wherein said igniter comprises:

a metal sheath filled with igniter composition,

said composition comprising 5–90 percent by weight barium nitrate, 5–90 percent by weight stabilized red phosphorus, and 0.1–10 percent by weight of a member of the group consisting of calcium resinate, carbon black, graphite, metallic sterate, polyvinyl alcohol and polyvinyl chloride.

3. The structure as set forth in claim **2** wherein said igniter composition comprises 24 percent by weight stabilized red phosphorus, 75 percent by weight barium nitrate and 1 percent by weight calcium resinate.

4. The structure as set forth in claim **2** wherein the composition of said metal sheath comprises a member of the group consisting of aluminum, aluminum alloys, tin and tin alloys.

5. The structure as set forth in claim **2** wherein said metal sheath has a wall thickness of not greater than approximately 0.015 inch.

6. In a small caliber cartridge case having a base portion containing a primer and a mouth portion containing a projectile,

a substantially cylindrical molded charge of granular propellant within said case and seated against said base portion, said molded charge having a central longitudinal passage therethrough,

an axial igniter filling said molded charge central passage,

said base portion having a central passage in axial alignment with both said primer and axial igniter, and

means laterally spacing a substantial portion of the outer surface of said molded charge from corresponding adjacent internal sidewall surface portions of said case,

said spacing means including means extending inwardly from the sidewall of said case adjacent said base portion and engaging rearward portions of said molded charge outer surface,

said axial igniter comprising:

a metal sheath filled with igniter composition,

said composition comprising 5–90 percent by weight barium nitrate, 5–90 percent by weight stabilized red phosphorus, and 0.1–10 percent by weight of a member of the group consisting of calcium resinate, carbon black, graphite, metallic sterate, polyvinyl alcohol and polyvinyl chloride.

7. The structure as set forth in claim **6** wherein said igniter composition comprises 24 percent by weight stabilized red phosphorus, 75 percent by weight barium nitrate and 1 percent by weight calcium resinate.

8. The structure as set forth in claim **6** wherein the composition of said metal sheath comprises a member of the group consisting of aluminum, aluminum alloys, tin and tin alloys.

9. The structure as set forth in claim **8** wherein said metal sheath has a wall thickness of not greater than approximately 0.015 inch.

10. The structure in accordance with claim 6 wherein said projectile is a flechette tracer projectile having rearwardly opening tracer cavity filled with tracer composition, said tracer composition being in axial alignment with said axial igniter, and said flechette tracer projectile having a rearward portion in abutment with a forward surface of said molded charge.

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