Aug. 27, 1968 R. C. KVAVLE 3,398,684

CASELESS CARTRIDGES

Filed June 28, 1966

Fig. 1

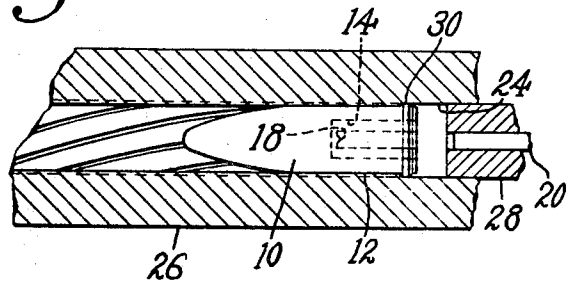


Fig. 2

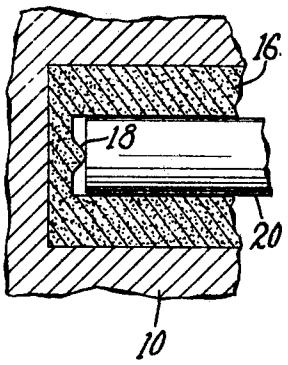


Fig. 3

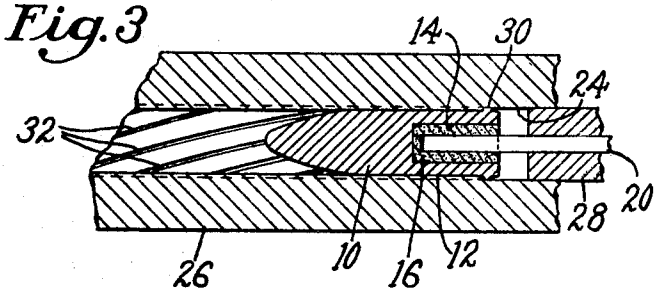


Fig. 4

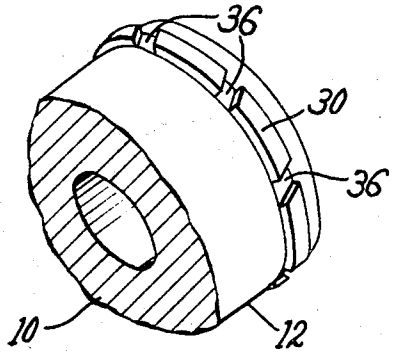


Fig. 5

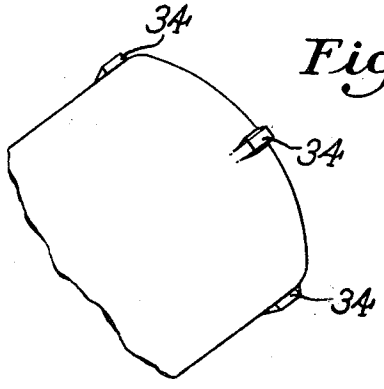
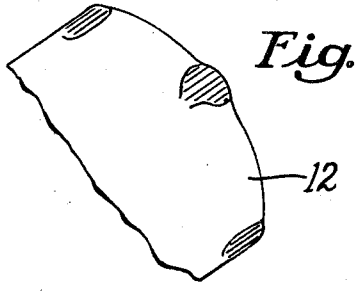


Fig. 6



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United States Patent Office

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CASELESS CARTRIDGES

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4 Claims. (Cl. 102—49.3)

ABSTRACT OF THE DISCLOSURE

A projectile houses in its rear end a propellant charge comprised primarily of solid low explosive preferably in the form of nitrocellulose fibres having air in their substantially interconnected interstitial spaces, the charge having a density less than that of nitrocellulose per se. While ignition may be effected electrically or otherwise, one mode of ignition contemplated for the cartridge is that effected by impact with the charge in a substantially closed chamber sealed by the projectile.

This invention relates to projectiles, and more particularly to self propelling missiles of a type adapted to be driven solely by the force generated from their deflagrating charges in consequence of ignition by impact in a substantially closed chamber. While the invention is herein shown in one illustrative embodiment, it will be appreciated that it may be employed for many purposes and utilize numerous variations in structure without departing from the scope of the invention.

A copending application, Ser. No. 371,242 filed May 29, 1964, in my name, now Patent 3,283,657 discloses a novel method and means for initiating deflagration in a solid low explosive, the required heat being frictionally generated solely by impacting the charge in a substantially closed chamber. This procedure does not rely upon raising temperature by precompression of air about the charge. In another copending application Ser. No. 524,168, filed Feb. 1, 1966, in my name, there is described a formed low explosive charge of fibrous nitrocellulose for use in impact ignition devices operable in the novel manner indicated.

A primary object of the present invention is to provide a caseless cartridge carrying within its breech end a solid, stable, impact ignitable charge of low explosive propellant.

A further object is to provide a relatively safe, low cost combination projectile and solid propellant adapted to be operated by impact ignition in a chamber sealed by the projectile itself and its own firing mechanism. Another object is to provide a light weight projectile having no cartridge case requiring extraction.

To these ends, and in accordance with a feature of the invention, there is contemplated a projectile having its breech end formed with a charge-containing cavity, the walls and bottom of the cavity being lined with solid low explosive, and a portion of the explosive lining, preferably the bottom wall, being adapted to be impact ignited to initiate deflagration and hence gas propulsion of the projectile. A further feature of the invention resides in the provision, in a caseless cartridge of the type indicated, of means such as an external sealing ring or other obturating means, for instance fins, for providing initial resistance to relative movement of the projectile with respect to the firing mechanism, the fins being radially deflectable or deformable in response to pressural build-up in the firing chamber to permit acceleration of the projectile. Since as heretofore noted, ignition of the projectile is to occur in a chamber sealed in part by itself, it is contemplated that a limited air volume surrounding the breech end of the projectile may be predeterminedly entrapped during ignition by a bolt in the firing chamber and a relatively movable firing pin adapted to enter the projectile cavity to impact its bottom or deflagratable lining. The air volume permitted by the projectile, bolt, and pin is predeterminedly small and hence there is practically no energy wasted in raising its temperature by compression, substantially all kinetic energy of the pin being used to compress and frictionally crush at least a portion of the propelling charge being ignited.

The foregoing and other features of the invention, together with novel details in construction, will now be more particularly described in connection with an illustrative embodiment and with reference to the accompanying drawings thereof, in which:

FIG. 1 is a view in side elevation of a caseless cartridge in accordance with this invention and including a projectile loaded into the firing position of a barrel bore having firing mechanism including a bolt and firing pin;

FIG. 2 is a detail showing the firing pin striking the projectile charge;

FIG. 3 is a view corresponding to FIG. 1, the projectile being shown in axial section at the instant of impact ignition;

FIG. 4 is an enlarged perspective view of the breech end of the projectile of FIGS. 1 and 3 after it has been fired and indicating its annular sealing ring as deformed by the barrel rifling;

FIG. 5 is a detail view in perspective similar to FIG. 4 but showing another projectile retaining means in the form of groove fitting ribs; and

FIG. 6 is a view corresponding to FIG. 5 and showing the retaining ribs as radially deformed in consequence of deflagration of charge.

Referring to FIGS. 1 and 2 a projectile having a cylindrical body **10** may be of any preferred external configuration, its muzzle end generally being pointed and its breech end **12** formed with a cavity **14**. This cavity is usually, though not necessarily, cylindrical and coaxial with the body **10**. No separate case is needed for the projectile since its cavity **14** is adapted to receive and internally store its charge **16** of solid, low explosive.

The charge **16** may itself be of different low explosive materials and shapes but it preferably lines the bottom and walls of the cavity **14**, a portion at the cavity bottom having a raised, reduced area **18** (FIG. 2) to be initially impacted to effect ignition, for instance by a firing pin **20** moving axially to crush at least a part of the charge and thus frictionally generate the heat for ignition which thereafter causes the entire charge progressively to deflagrate.

As disclosed in the application Serial No. 524,168, cited above, one charge which may be formed within the body **10** or separately formed as a pellet and then inserted at the time of imminent use, comprises compacted fibrous nitrocellulose powder. It may include a stabilizer and/or coloring agent, and desirably has a density of less than 1.6 gms. per cc. While the range of propellant density may vary, a density of about 1 gram per cc. is usually preferred for uniform, reliable performance. The porosity of such a charge when molded into self-sustaining shape and having entrapped air is believed to facilitate initial ignition by reason of the heat from friction generated during crushing action. Ignition is facilitated by reason of the ribbon-like fibres defining substantially continuous interstitial burning surfaces.

As disclosed in the above-mentioned applications, no detonation is initially produced, but deflagration is achieved in the solid, low explosive with the expenditure of a relatively small amount of energy by spot heating it electrically or by impacting consequent build-up in pressure leading to detonation. This manner of safely and effectively generating propellant gases from the charge is practiced in a closed or substantially closed chamber

24 one end of which is sealed in a barrel 26 by the breech end of the projectile, and the other end of the chamber may be sealed by firing mechanism, for example a bolt 28 and the pin 20 reciprocable therein. For the purpose of holding the projectile against axial displacement in the barrel at the instant of firing pin impact on the charge 16, the breech end 12 preferably is provided with restraining means such as an external sealing ring 30 (FIGS. 1, 3, and 4) adapted to engage the wall of the chamber 24 at the end of bore rifling 32. As indicated in FIGS. 5 and 6, another form of restraining means may be circumferentially spaced lugs 34 adapted initially to prevent displacement of the projectile as by interference initially with the barrel bore, but upon build-up of pressural gases in the chamber 24, be radially deformed or sheared off to permit projectile flight. FIG. 4 indicates how the ring 30 may be slotted as at 36 by the rifling 32 following ignition and completed combustion of the charge 16. Numerous other sealing fins and shrouds are known or may be devised for use with the projectile, or as an integral part thereof, to restrain it during impact ignition and insure that it will receive the benefit of effective obturation.

It is unnecessary that the pin 20 closely fit the hollow within the charge 16. The volume of the latter is selected to provide the degree of projectile velocity required. Only a short firing stroke of the pin 20 is needed. The volume of the firing chamber 24 is mainly determined for a charge size by fixedly positioning the adjacent end of the sealing bolt. Upon impact of the pin 20 with the igniter portion 18, the initial restraining means 30 or 34, for instance, insure that the projectile will have its charge 16 deflagrated. The gases of combustion increase their pressure in the chamber 24 as deflagration accelerates in the cavity 14. Accordingly, in a very short time the sealing ring 30 or other equivalent can no longer restrain the projectile which then is rapidly propelled from the barrel. Means (not shown) is of course provided for preventing blow-back of the pin 20 and the bolt 28.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. A caseless cartridge comprising a projectile body having a breech end formed with a cavity, and a solid, low explosive propellant lining at least a portion of the cavity, said explosive being mainly of nitrocellulose fibres having a density less than that of nitrocellulose per se, the fibres defining substantially continuous interstitial burning surfaces.

2. A primerless cartridge as set forth in claim 1 wherein the low explosive propellant is fibrous nitrocellulose powder compacted to a density of about one gram per cc.

3. A cartridge as set forth in claim 2 wherein the lining of low explosive is cylindrical, tubular, and has a diameter less than its axial length.

4. A primerless cartridge as set forth in claim 1 wherein said cavity is coaxial with the projectile body, and the propellant at the bottom of the cavity has a centrally raised, reduced area adapted to facilitate ignition.

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ROBERT F. STAHL, *Primary Examiner.*