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A. F. TEITSCHIED ET AL

2,670,682

POINT INITIATING FUSE FOR SHAPED CHARGE PROJECTILES

Filed Jan. 16, 1950

2 Sheets-Sheet 1

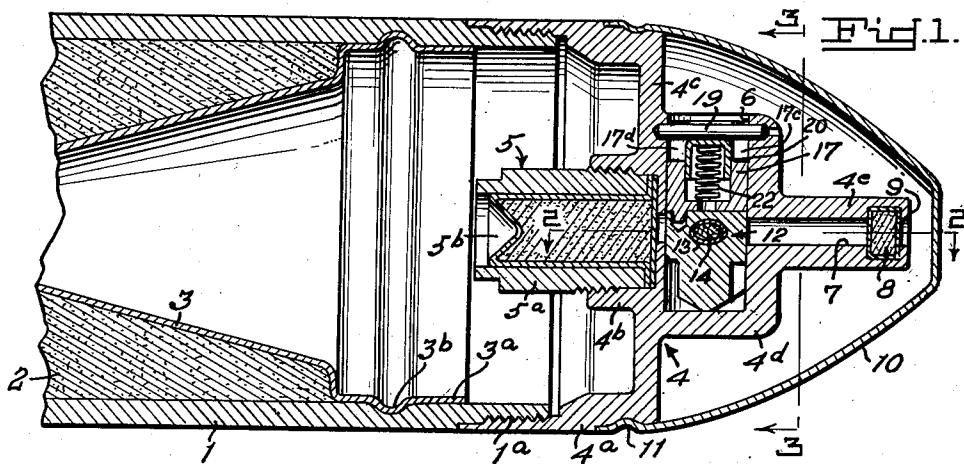


Fig. 2.

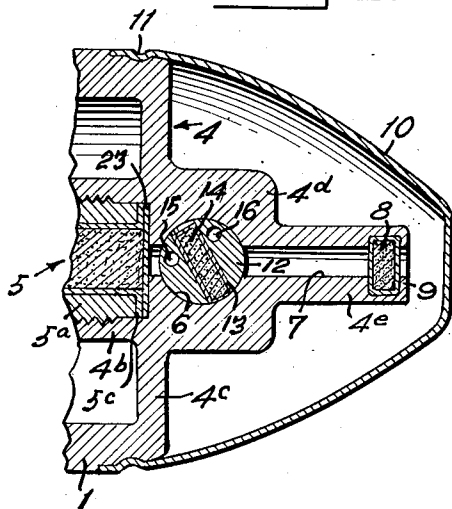
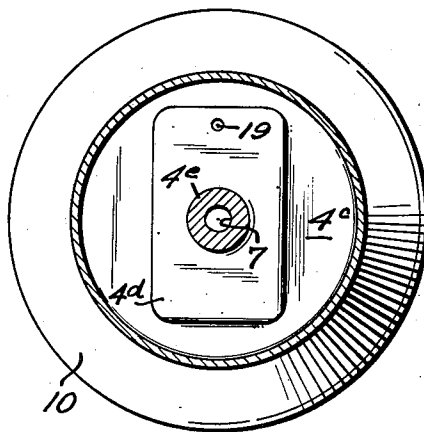


Fig. 3.



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Fig. 4.

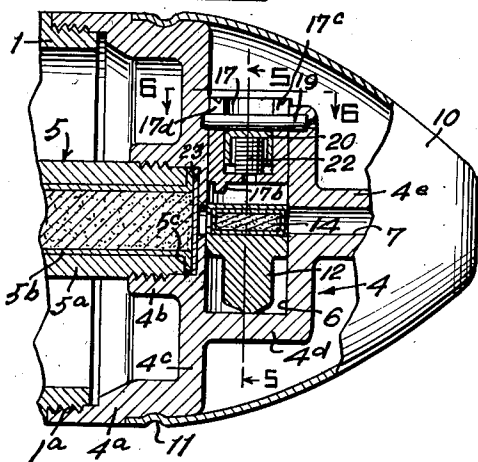


Fig. 5.

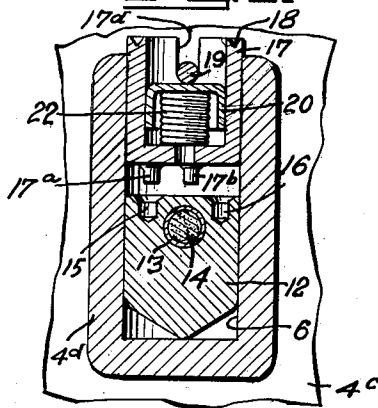


Fig. 7.

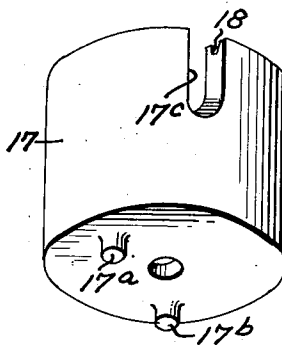


Fig. 6.

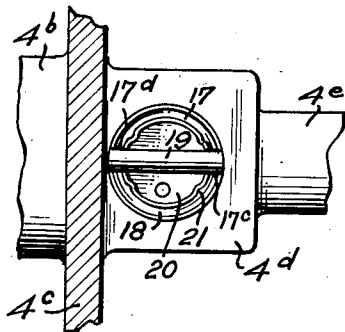


Fig. 8.

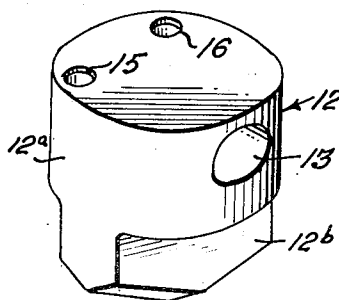
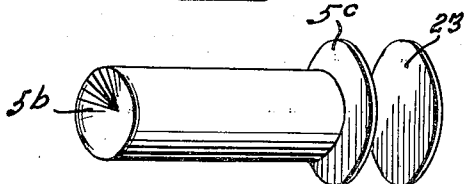


Fig. 9.



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UNITED STATES PATENT OFFICE

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POINT INITIATING FUSE FOR SHAPED
CHARGE PROJECTILES

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4 Claims. (Cl. 102—79)

(Granted under Title 35, U. S. Code (1952),
sec. 266)

1 The invention described herein may be manufactured and used by or for the Government for governmental purposes without the payment of any royalty thereon.

This invention relates to high explosive anti-tank projectiles based upon the shaped charge principle. The extremely effective armor-penetrating action of the jet formed by detonation, under proper conditions, of a shaped charge, is well known. Such conditions involve principally the detonation of the charge at the correct stand-off distance from the target, the shape of the cavity, and a path of minimum obstruction between the cavity and target at the time of detonation.

Prior to the present invention, it was customary to detonate shaped charge projectiles by means of fuzes located in the base of the projectiles since initiation of the detonation must be at the base of the charge. In an early type of fuze for this purpose, the base-detonating fuze employed an inertia plunger which moved in response to impact to fire the charge. However, such plungers have an inherent delay in operation and, since the timing of the detonation of the charge is critical, a heavy ogival windshield was provided over the nose of the projectile in order to effect sufficient retardation to assure functioning of the fuze at the desired stand-off distance. On the other hand, such a heavy windshield was undesirable in that it interfered with the penetrating action of the jet. It has been proposed to provide such a projectile with a shaped charge having a central lined axial passageway, together with a point-initiating fuze and an auxiliary detonator using a shaped charge to direct a flame or detonating flash rearwardly along the passageway to thereby effect the base detonation of the main charge. However, such fuzes employed a firing pin for detonation and were therefore subject to at least some of the drawbacks of the base-detonating type because of the inherent inertia of the firing pin and its obstruction and impairment of full jet action. Furthermore, with the type fuze just mentioned, the ogival windshield had to be heavier and more rugged than would otherwise be necessary, in order to provide adequate attaching threads for the primer and to rigidly support it in position during loading.

It is the principal object of our invention to provide a highly-efficient point-initiating fuze for high explosive shaped charge projectiles wherein the drawbacks of prior art fuzes, as just explained, are lessened or eliminated.

2 A further object is to provide a point-initiating fuze which is positive in action and which will detonate the associated shaped charge at an optimum substantially constant stand-off distance from the target.

Another object is to provide a fuze of the type described which is carried wholly by the casing or body of the projectile and which thus requires only a thin light protective nose cap or windshield so that the latter is easily crushed and offers minimum obstruction to the ensuing jet from the shaped charge.

A still further object is to provide a point-initiating fuze for use with a shaped charge, which has a safety device armed only in response to the centrifugal force engendered by the rotation of the projectile in firing.

Another object is to provide a fuze of the type mentioned whose metal frame can be made as a casting of light aluminum alloy, thus offering only slight obstruction to the jet.

Yet another object is to provide a fuze of the type described employing an auxiliary detonator operating upon the shaped charge principle wherein the detonator is capable of initiating a tetryl booster pellet in the base of the projectile, in contradistinction to the more sensitive explosives such as lead azide, formerly required in such pellets.

Another object is to provide a fuze of the type mentioned wherein detonation is initiated by a sensitive primer carried independently of, but located closely adjacent the front end of the thin-walled ogival nose cap or windshield, whereby a firing pin and its attendant drawbacks, are eliminated.

Still another object is the provision of a fuze threaded on the outside of the projectile whereby, on impact, maximum disintegration of the fuze body is assured with a concomitant lessening of obstruction to the ensuing jet and a maximum penetration of the target.

Other objects and advantages will become apparent after a study of the following specification in connection with the accompanying drawing wherein:

Figure 1 is a longitudinal axial section through the nose of a shaped charge projectile equipped with the improved point-initiating fuze in unarmed condition,

Figure 2 is a longitudinal axial section taken in a plane at right angles to the plane of Figure 1, as indicated by the line 2—2 of Figure 1.

Figure 3 is a longitudinal cross section in a plane identified by line 3—3, Figure 1.

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Figure 4 is a longitudinal axial section corresponding to Figure 1 but showing the fuze armed. Figure 5 is a cross section, taken in a plane identified by the line 5—5, Figure 4.

Figure 6 is a detail cross sectional view as indicated by the line 6—6 of Figure 4.

Figure 7 is a perspective view of the safety lock,

Figure 8 is a perspective view of the fuze rotor, and

Figure 9 is a perspective view of the auxiliary detonator cup.

Referring in detail to the drawing, the numeral 1 identifies the projectile casing of any desired caliber having a standard base construction, not shown, and its forward end shaped and externally threaded as at 1a, Figures 1 and 4.

A shaped charge 2 having its cavity in the form of a forwardly-directed cone, is secured within the casing 1 by a thin metal liner 3 which has a forward cylindrical extension 3a secured to the casing as by crimping at 3b into an internal circumferential channel in the casing. It will be understood that the cavity in charge 2 merges into a central axial passageway extending through the charge to the rear end or base thereof. A booster pellet, not shown, which may be of tetryl, is located at the rear end of the aforesaid passageway in position to be initiated by a flame jet passing rearwardly along the passageway and in turn, to detonate the charge 2 at the rear end thereof. It will be understood that the aforementioned axial passageway is lined the same as the conical cavity of the charge. Such lining may be an integral continuation of lining 3, or it may be initially formed separately from 3 and interfitted therewith at the meeting ends to form an imperforate continuous passageway or flash tube to the base of the charge.

A fuze body generally identified by the numeral 4, is shown as a one-piece item preferably formed as a die casting of thin-walled aluminum alloy. This body comprises a main cylindrical section 4a internally threaded for attachment with threads 1a of the projectile casing. A central coupling 4b extends rearwardly from the transverse wall 4c for engaging and supporting a first or auxiliary detonator 5, subsequently described.

A protuberance 4d extends from the forward face of wall 4c. This protuberance is generally rectangular in plan, as clearly shown upon Figure 3, and has a central bore 6 extending in the direction of the maximum dimension of the protuberance transverse to the longitudinal axis of the projectile. An axial tubular projection or neck portion 4e extends forwardly from protuberance 4d and has a central bore 7 opening into the bore 6 and through the forward end of the neck portion. The forward end of bore 7 is counterbored to form a shoulder or seat for a sensitive pinless or impact primer 8 secured in position on its seat by crimping as at 9, Figures 1 and 2. A hollow ogival nose or windshield 10 of thin metal is secured to main section 4a of the body, as by crimping into a circumferential groove in the body as indicated at 11, Figures 1, 2 and 4. From Figure 1 it will be noted that the primer 8 is positioned closely adjacent to nose of the windshield where it is detonated substantially instantaneously on impact. Because it is not required to support any of the fuze elements, and also because the extremely rapid action of the fuze does not require any retardation on impact, the nose cap or windshield 10 may be

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made of thin light metal. It therefore disintegrates rapidly and completely on impact and offers little or no obstruction to the penetrating action of the ensuing jet from charge 2.

Means are provided to render the fuze safe in handling and to arm the same only in response to centrifugal force engendered by rotation of the projectile effected by firing. These means comprise a rotor 12 having a cylindrical portion 12a (Figure 8) smoothly fitting bore 6, and an integral flattened end portion 12b symmetrical in an axial plane (the plane of the paper in Figure 5) through the rotor axis, which axis is coincident with that of bore 6. Rotor 12 has a diametrical bore 13 adjacent one end, in which a second detonator 14 is fixed as by staking or crimping. From Figures 5 and 8 it will be noted that the axis of bore 13 is normal to the aforesaid axial plane and to the flattened parallel faces of portion 12b. A pair of locking sockets 15 and 16 are formed in the flat end of the rotor. In its unarmed position, the rotor 12 has a rotational position within bore 6 in which the aforesaid axial plane is at 45° to the longitudinal axis of bore 7. In this position the ends of bore 13 are out of alignment with bore 7, and are, in fact, completely closed by the walls of bore 6, as clearly shown at Figure 2, so that communication between primer 8 and auxiliary detonator 5, is cut off and the second detonator 14 is itself then completely enclosed within bore 6 and out of detonating relation with primer 8.

The rotor 12 is locked in the aforementioned safe position by a lock element consisting of a cup or locking element 17 having a flat base. A pair of prongs or lugs 17a and 17b extend outwardly from the base and are spaced to enter sockets 15 and 16, respectively, when the elements 12 and 17 are in the safe position. Cup 17 has a pair of diametrically opposite slots 17c and 17d in its side walls. These slots, as clearly shown upon Figure 7 for slot 17c, extend in an axial direction from the rim, a distance somewhat less than half the axial dimension of the cup. As indicated in Figures 5 and 7, the rim of the cup may be channeled as at 18, for staking, as subsequently explained.

A pin 19 is mounted in holes in body 4, diametrically aligned across bore 6 at the outer end thereof. This pin is inserted through the forward hole and passes through slots 17c and 17d to limit the outward movement of cup 17 in bore 6. The pin may be locked in position by staking or peening.

A spring abutment cap 20 is axially slidable within cup 17 and, prior to assembly of the complete fuze, is held within the cup by staking the channeled rim thereof as indicated at 21, Figure 6. However, when assembly is completed, pin 19 acts as an abutment for cap 20. A spring 22 acts between cap 20 and the base of cup 17 to urge the latter into engagement with rotor 12 with lugs 17a and 17b engaging within sockets or holes 15 and 16. Since cup 17 is positively prevented from rotating by pin 19, and is urged toward the closed end of bore 6, that is, downwardly as the parts are shown upon Figure 1, the fuze is effectively maintained in unarmed condition. No shock or jar tending to move rotor 12 axially along bore 6 can arm the fuze since any resulting movement will move detonator 14 upwardly in Figure 1 out of the axial plane of bore 7 normal to the plane of the paper of this figure. Furthermore, since rotor 12 has a greater mass than cup 17, any such shock will

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merely tend to force these two elements into closer contact. Therefore, rotor 12 is continuously locked in the safe or unarmed rotational position of Figure 1, until the projectile is fired. Detonator 14 is secured in position within the bore 13 in any suitable manner, as by staking or crimping. Friction between rotor 12 and the closed end of bore 6 is reduced by the tapered end of portion 12b.

Auxiliary detonator 5 has been previously mentioned. Referring particularly to Figure 1, this item consists of a cylindrical holder 5a which may be of the same light alloy as is used in the construction of body 4. The body has a thin partition at the base of coupling 4b, centrally perforated to form a continuation of bore 7. The one-piece cup 5b of the detonator has a conical depression in its closed rearward end and a flanged forward end. When holder 5a is screwed into the coupling 4b, it acts through flange 5c to clamp the detonator cup in position against an interposed imperforate thin disc 23 which may be of onion skin paper and acts to seal off the explosive within the cup.

The operation will be clear from the foregoing description. Figures 1 and 2 show the fuze unarmed with rotor 12 in position such that bore 7 is closed to cut off all communication between primer 8 and auxiliary detonator 5 and with detonator 14 sealed within bore 6. As the projectile reaches a rotational speed of more than 1500 R. P. M. but less than 3000 R. P. M. as it traverses the rifled bore of the gun in firing, the centrifugal force first causes cup 17 to move outwardly along bore 6 to the position shown at Figures 4 and 5, thus freeing the rotor 12. The center of gravity of rotor 12 is located between the longitudinal axis of the projectile, that is, its axis of rotation, and the closed end of bore 6. Consequently, the resulting centrifugal force on the rotor acts to urge it toward this closed end. In the unarmed position the plane faces of portion 12b are at about 45° to the axis of rotation, as will be noted from comparison of Figures 2 and 8. Hence when the rotor is freed by lock element 17, it rotates about the axis of bore 6 so that these faces lie in planes normal to the axis of spin of the projectile. This is the position shown upon Figures 4 and 5, wherein the rotor is turned counterclockwise 45° from the position of Figure 2, and detonator 14 is aligned with bore 7. The fuze is then fully armed and, on impact, windshield 10 disintegrates, primer 8 is initiated and, in turn, initiates detonators 14 and 5. Due to the shaped charged effect produced by initiation of detonator 5, a rearwardly-directed flame jet is produced which extends down the central axial passageway and initiates the previously-mentioned booster pellet, not shown, at the base of the charge 2 to thereby detonate the latter. Because of the novel arrangement and disposition of parts as shown, together with the absence of an inertia-operated firing pin, firing is practically instantaneous on impact and the shaped charge is detonated at the optimum stand-off distance from the target where the ensuing jet has maximum penetration. Furthermore, the one-piece auxiliary detonator 5 with its one-piece cup, acts on the shaped charge principle to produce a jet which is sufficient to initiate a tetryl booster at the base of the charge, instead of the more sensitive lead azide, formerly required. The exceedingly rapid and reliable action of the fuze, together with the fact that primer 8 is carried by the fuze body, enable the use of a thin light

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nose cap 10 which disintegrates on impact and offers minimum obstruction to the jet. Likewise, the thin-walled and light weight fuze body 4 offers minimum obstruction to the jet. Complete disintegration of the body is enhanced by threading it externally upon casing 1.

We have thus produced a centrifugally-armed fuze which is reliable, safe to handle and extremely rapid in operation so that its use assures the maximum effectiveness of the shaped charge with which it is employed.

In the claims the term "longitudinal axis of the fuze" means the axis about which it spins with the projectile as the latter emerges from the gun barrel in firing. The term "normal position" in the claims means the position of the parts when the fuze is without motion of translation or rotation.

Having now fully disclosed our invention, what we claim and desire to secure by Letters Patent is:

1. In a point-initiating fuze for a projectile having a casing and a shaped charge therein provided with a lined axial passageway to the base of the charge, a one-piece fuze body of brittle, disintegrative metal comprising a centrally-apertured transverse wall and means for attaching said wall to and across the forward end of the casing, a first detonator secured to the rear face of said wall in alignment with the aperture therein and adapted when initiated, to direct a jet rearwardly through the passageway in said charge, means rigidly carried by the forward face of said wall to form a forwardly-extending axial passage in alignment with said aperture, said body having a transverse bore interposed between and opening into said aperture and passage, a rotor fitting said bore and rotatable about the axis thereof from a first position in which said rotor cuts off said passage from said aperture, to a second position in which a transverse opening therein connects said passage and aperture, a lock element in said bore and movable outwardly away from engagement with said rotor in response to spin of said fuze about its longitudinal axis, means preventing rotation of said element in said bore, yielding means urging said element into contact with said rotor, interengaging means carried by said rotor and element and operable to lock said rotor in first position only when said element is in engagement with said rotor, and a pinless primer carried by said body at the forward end of said passage, said rotor rotating to second position in response to centrifugal force, when unlocked.

2. In a fuze for projectiles, a fuze body having a central axial flame passage therethrough and a transverse bore intersecting said passage, said bore being open at one end and closed at the other end, a rotor in the closed end of said bore and turnable therein from a first position cutting off said passage, to a second position in which a hole through said rotor is aligned with said passage, a locking cup fitting said bore at the open end thereof, said cup having diametrically opposite slots in its wall, a pin fixed in said body and extending through said slots to prevent rotation of said cup and to limit movement thereof along said bore from a first position engaging said rotor to a second radially outward position out of contact with said rotor, interengaging means between said rotor and cup holding said rotor in its said first position when said cup is in its said first position, and spring means yieldingly urging said cup into contact with said rotor.

3. In a fuze for a projectile which rotates about a longitudinal axis in flight, a fuze body having a central passageway coincident with said axis and a transverse diametral bore intersecting said passageway between the ends thereof, said bore having one end closed, a rotor rotatably and slidably fitting said bore said rotor having its center of gravity radially offset from said longitudinal axis when in contact with the closed end of said bore, said rotor being constructed and arranged to rotate about the axis of said bore under centrifugal force due to rotation of the fuze about said longitudinal axis, from a safe position wherein a transverse hole therein is out of alignment with said passageway, to an armed position wherein said hole is aligned with said passageway, a pin secured in said body and extending across said bore at the end remote from said closed end, a locking element slidable in said bore between said pin and rotor and having slots embracing said pin whereby said element is restrained against rotation in said bore, a spring interposed between said pin and said element whereby the latter is urged into contact with said rotor, said rotor and element having means interengaging only when said rotor and element are in contact, and said rotor is in safe position of rotation, the centers of gravity of said element and rotor being on opposite sides of said longitudinal axis when said parts are in normal position.

4. In a fuze for a rotating projectile, a fuze body having a central longitudinal axis of rotation and a central flash passageway coincident with said axis, there being a transverse diametral bore in said body intersecting said passageway between the ends thereof and having one end

closed, a rotor fitting said bore for axial movement and for rotation therein about the axis of said bore from a safe position closing said passageway, to an armed position wherein a diametral hole in said rotor is aligned with said passageway, said rotor being so proportioned as to rotate from safe to armed position in response to rotation of said body about said longitudinal axis and having its center of gravity radially offset from said longitudinal axis in the direction of the closed end of said bore, a locking member slidably fitting said bore and having its center of gravity upon the other side of said longitudinal axis of the projectile from said rotor, means limiting said member to axial translation only in and along said bore, means yieldingly urging said member along said bore into contact with said rotor, and detent means between said rotor and member and interengaging only when said rotor and member are in contact and said rotor is in safe position.

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