Projectile with Shaped Charge and Point Initiating Fuze

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PROJECTILE WITH SHAPED CHARGE AND POINT INITIATING FUZE

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

The invention relates to fuses for projectiles, and has for an object to effect an improvement in the construction and arrangement of parts whereby the device will be simplified and its action made more simple and effective while at the same time retaining the advantages of safety.

It is an important object to reduce the number of parts required in the fuse, and to also avoid the use of extremely small centrifugal moved parts to the end that the possibility of relatively high variables of friction in proportions to mass of such elements, and the possibility that the friction factor may exceed the moment of inertia in such parts will be largely if not entirely obviated.

It is an aim to offer a point detonated base fuse construction of novel form, in which will be overcome objections to prior base fuses, such as irregularities or uncertainties due to varying sensitivity of the fuse as a whole, varying velocities, and varying retardation of the wind shield, and particularly variation of deceleration after impact, during collapse of the wind shield.

A further aim of the invention is to enable its use in conventional shell body construction, wind shield, hollow cone and main explosive charge.

A still further object is to provide a novel form of centrifugally operated arming device of novel construction including the usual safety from accidental operation by lateral shocks accidentally suffered by the projectiles, or accidental operation of the point detonator.

A further important aim is to present a novel construction for effecting the detonation of a base booster charge by a point-mounted primer fuse which includes a shaped charge detonable upon impact and upon collapse of the projectile wind shield to detonate the booster charge by means of a kinetically element of blast effect or pellet, released by the detonated primer and projected rearwardly in timed relation to the forward speed of the projectile to initiate action of a base booster detonator.

A further aim is to give a novel connection between base and point structure in such a fuse to the end that automatic compensation is effected for variation from standard dimensions of the various parts longitudinally of the shell and for variation in spacing of the base and point elements both as to assembly of the round in manufacture and in the operative and safety functioning of the parts.

Additional objects, advantages and features of the invention reside in the construction and arrangement and combination of parts involved in the embodiment of the invention as will appear and be understood from the following description and accompanying drawings, wherein:

Fig. 1 is a longitudinal section of an armor penetrating or demolition projectile, in which my invention is incorporated.

Fig. 2 is a transverse section taken on line 2—2 of Figure 4.

Fig. 3 is a fragmentary longitudinal section taken on line 3—3 of Figure 1.

Fig. 4 is a section on the line 4—4 of Fig. 1.

Fig. 5 is a section on the line 5—5 of Figure 4.

Figure 6 is a view corresponding to Figure 4 with slide moved to right and with booster detonator on longitudinal axis of projectile.

Figure 7 is a fragmentary longitudinal section taken on line 7—7 of Figure 4.

Fig. 8 is a fragmentary longitudinal section of a modification of the tube for detonating the kinetic element from the point located fuse to the base detonator.

Fig. 9 is a detail of a modified tube.

Fig. 10 is a detail of a further modification.

Fig. 11 is a sectional view of a modification of the base fuse.

Referring to the drawings, there is illustrated a projectile built to utilize the Munroe effect in penetrating armor or concrete structures, or for other purposes, and comprising a shell body 15 of conventional form, the ogival portion of which is a frusto conical wind shield 16 of conventional structure mounted on the end of the shell, conical elements of the shield being tangent to the short ogival curve 17. The shell has a bore or cavity 18 of cylindrical form throughout, the face of which is relieved at each end of the projectile, forming circumferential shoulders 19 and 20 at the front and rear respectively, the shoulder 20 being somewhat further from the rear of the body than the shoulder 19 is from the forward end. The relieved portions are interiorly threaded. A hollow cone 21 is provided, formed of thin material, with a base flange 22 set against the shoulder 19 and held thereto by an exteriorly threaded nipple 23 screwed into the interiorly threaded forward end of the shell body and extending forwardly therefrom a distance. An interior base ring 24 of the wind shield is screwed onto this forward part of the nipple so that the shield abuts snugly the forward end of the shell body.

A point detonator or fuse 25 is mounted at the apex of the wind shield, consisting of a heavy walled metal body 26 set and secured in a suitable concentric opening in the shield, with a broad point 26' and a reduced tubular stem 27 extending axially into the space within the windscreen.

A circular coaxial recess 28 is formed in the point 26' and is open forwardly through the end of the point and of such size that a relatively thin wall 29 is left and the recess, collapsible by target impact. A small axial bore 30 is formed from the bottom of the recess inwardly, communicating with a larger primer bore 31 rearwardly thereof, in which a cased detonating primer 32 formed as a rearwardly opening shaped charge having a thin metal liner 32a is secured by means of a bushing 33 screwed into an enlargement of the bore behind the primer. A tube 35 is set in the apex of the cone, extending therefrom to a base fuse 40 to be described. In practice the tube 35 is formed with an external diameter of three eighths of an inch and an internal diameter of five sixteenths of an inch or more. The tube extends through the vertex of the cone 21, which is suitably necked theretoward, and forms communication axially between the interior of the cone and the base fuse as will appear.

The shaped charge primer 32 in one form is provided with, or produces from its cup material or liner 32a on detonation, a pellet or slug, which is propelled rearwardly through space to and through the tube to detonate the base fuse. It is contemplated that the detonator will produce a Munroe effect which will act through the tube 35 to detonate the base fuse. In the small bore 30 there is slidably a firing pin 36 having a mushroom head 37 in the recess 28 normally close to the extremity of the wall 29, and in the wall there is set a thin frangible or otherwise impact-yielding wind and dust guard plate 38, which may be of lead or gilding metal.

The pin 36 is of such length that its extremity is within the bore 30 initially and retained in this position by a tubular support 39 frangible or collapsible of a predetermined force acting on the head 37 of the pin. This support 39 is set loosely, or slightly frictionally engaged around the pin and resting on the bottom of the recess 28 and against the head 37 of the pin.

The base fuse 40 consists in this instance of a substanti-
ially cylindrical body 41 of steel, and for a six inch shell has been made approximately two inches in diameter, its length being somewhat greater. In addition it is formed with a threaded tenon 42 at the rear and an annularly cylindrical neck 43 forwardly. The tenon is screwed into a circular base plate 44, which is set against the shoulder 20 with an interposed gasket 44 and so held by the plug 45 screwed into the threaded enlargement of the rear end portion of the bore or cavity of the body 15. In this way the body 41 is supported concentrically in the projectile with the gland neck 43 receiving therein smoothly a small portion of the inner end of the tube 35. The rear extremity of the tube may be closed with a thin weak septum 47 in the form of lead foil across the opening through the side of the body 41. The rear end edge of the tube is rounded at the outer side, as at 48. A relatively large booster chamber 49 is formed at the rear part of the body 41. This consists of a simple cylindrical flange opposite sides of the body 41. Its rear side is spaced slightly from the base plate 44 and it has a diameter of somewhat more than one inch in the size of fuse passage 55. The bore 50 in the neck 43 extends into the body 41 a distance but stops short of the chamber 49. A cylindrical recess 51 is bored in the side of the body 41 thereby and stopping short of the bore 50 so that an intervening partial wall portion 52 is left at the bottom of the recess. A smaller bore 53 forms a transverse continuation of recess 51, to the inner end of the bore 50, and adjacent to the periphery of the body 41. The lower faces of the recess and bore 53 are aligned facing the chamber 49, and a flash port 54 is bored in the body 41 and bore 53, passing through the material intervening between the booster chamber and bore 53. Diagonal penetrations from the passage 55 are bored into the body 41 on an axis intersecting the axis of the passages 55 and intersecting each end of the recess 51. In the bore 50 there is engaged an arming slider 57, including a cylindrical bar or stem 58 fitted slidably in the bore 53 and having an eccentric circular weight head 59 fitting slidably in the recess 51 normally with one of its surfaces in the length of the lateral, and of sufficient thickness radially of the fuse body as to permit necessary sliding movement of the slider in the bore 53 and recess 51. In the forward side of the slider 57, there is formed a transverse cam recess 60 having flat sides sloping divergently in opposite directions longitudinally of the stem and at an acute angle to the axis of the stem, from a central line of the maximum depth of the recess to the periphery of the stem 58. The depth of this recess and the disposition of its sides is such that the recess will include a geometrical projection of the passages 55 across the bore 53 and recess 60 will be termed the cam face 61. Slidable in the passages 55 there are respective detent centrifugals 62 having at their inner ends reduced normally meeting flat end pins 63. Slidable in the inner or rearward part of the bore 50 there is a slider lock 64, consisting of a cylindrical block having opposite bevelled rear end faces conforming and normally fitting to the sides of the recess 60. The lock 64 has formed in opposite sides small apertures 65 in which the pins 63 engage initially. The pins initially close passage 66 through the lock 64. The centrifugals 62 are initially held in detent position as in Fig. 5 by means of a U-shaped spring 67 set in the groove 56, the ends of the spring bearing on the outer end of the centrifugal, which extend entirely into the groove 56 slightly and are movable outwardly to the periphery of the fuse body, clearing the lock 64. The spring has a restraint block 68 having inwardly a bottom of the groove 56, while its arms 69 lie in the groove and across the ends of the passages 55 and centrifugals 62. The shoulders 60 on the body 41 and retained there by a fuse case 70 to be subsequently described. In the extreme inner end portion of the slider 57 there is a detent receiving opening 69 extending from the forward side nearly through the stem 58 but having a reduced opening through the rear side of the stem. A shoulder 71 is thus provided at the rear end of the opening against which the base fuse 72 of conventional kind for the purposes intended. When the slider is at the outer limit of its movement the detonator 72 is in line with the flash port 54 at the rear and with the bore 50 at its forward side. The bore 50 is slightly relieved at its outer part near the end of the tube and a cup 73 of gilding metal is set against the shoulder spacing the end of the tube 35. The material of the cup is quite thin such as gilding metal having a thickness of .002-inch having been employed in one embodiment of the invention. The body of the fuse is snugly enclosed by a cylindrical case 70 of soft steel in the form of a cup having a flanged opening through its inner part to receive the neck 43 therewith, the flange 74 lying flat against the inner face of the body 41. The lip of the case is crimped into a base groove 71 of the body 41 immediately adjacent the base plate 44. In this way the fuse is securely enclosed and may be made watertight with application of shell or other suitable material under or at the edges of the casing. In the base fuse, for operation with the point detonator described, the detent 72 must have in the forward part a material 76 such as lead azide or fulminate of mercury suitable for detonation by blast propagation, penetration or concussion, as a lead shot, or other unit, and at the rear part may have an explosive 77 such as tetryl. Usual retaining and sealing discs may be used, one at each end of the detonator as customary. In the chamber 49 a booster 79 such as tetryl is packed, being retained by the case 70, and in the large case 70 the charge 80 of a suitable high explosive is provided. In the manufacture of my fuse, it is an advantage that the cavities in the body may be provided with cavities in the opposite sides of the cone 21 and with the charge 80 a suitable high explosive is provided. The bore 50 and flash port 54 may be produced in one operation. The slide and centrifugals are correspondingly simple and free from complications in securing good working fits and functioning. The various parts of the fuse may be moulded with protective and corrosive material, as desired, and in practice a cadmium coating has been employed, which has the further advantage of reducing friction. My invention also enables the centrifugals to be made of good bulk in order to attain adequate mass for good working qualities, and ready calculation of the necessary strength in the spring, as well as reducing the factor of friction in proportion to the spring and centrifugal force in the centrifugals 62 as well as in the slider 57, and lock 64. Assembly and loading of the projectile

My invention also simplifies and facilitates assembly of the parts of the projectile and loading thereof with its main charge. The shell, cone, windshield and point detonator may be assembled before loading, or, for safety, the point detonator omitted until after loading and then introduced. The base fuse may be assembled on its base plan and positioned after loading of the shell with its main or bursting charge. The latter has been produced in a plastic state and its lower part moulded to afford a recess conforming to the shape and location of the base fuse when finally positioned. In the placing of the charge with such form, the rear end of the tube 35 projects axially into the smaller inner part of the recess 43 of the fuse body engaging slidably around the tube end as the base fuse is inserted in the base of the shell and charge, and the base plate 44 brought to rest against the gasket 44 and shoulder 20. The shell is then closed with the base plug 45, which holds the parts rigidly secured in their proper positions. Fuse action

In the use of the projectile and operation of my fuse, it is not necessary to operate any safety devices to permit the fuse to function, as the fuse is self-actuated and automatically operative within the projectile. The projectile may be handled and loaded in the gun conventionally and usual propellants employed. When at rest and after loading in the gun, the fuse parts are in the positions shown in Figs. 3 and 7. On firing, during initial propulsion movement of the...
projectile in the gun, the parts remain in the same positions, and they remain so until axial acceleration of the projectile in engagement with the rifling of the gun reduces the rate of rotation of the projectile to such extent as it has been predetermined as desirable for the centrifugal 5 62 to overcome the force of the spring 67. This rate may be 200 revolutions per minute, and may be more or less depending upon the total twist of the rifling in the gun, and/or the maximum rate of projection of the projectile as the leaves of the muzzle of the gun. While the exit of the fuze is greater behind the action of the centrifugal, the purpose of this limitation of their action is not entirely to delay arming of the fuse, during, as will appear, but will be effective in preventing arming if a mistake in the selection 10 or amount of the propelling charge is made which results in too little speed in the projectile and so an explosion too near the gun will not occur. Also safety in case of accidental lateral shock is attained.

After the centrifugals have moved out of engagement with the lock, the latter still remains firmly pressed against the cam face 61 by "set back" or inertia of the lock acting rearwardly under forward acceleration of the projectile still occurring in the gun. This acceleration continues the lock to the rear and the projectile continues to accelerate until the designated speed to attain the predetermined centrifugal force is achieved. While it cannot move outwardly displacing the lock 64 forwardly from the cam recess 60 by camming action of the face 61 against the rearwardly receding arm of the lock, it remains in the armed position, at the outermost limit of movement, with the detonator 72 in line with the passage through the lock 64 and with the flash port 54 behind which the booster charge 79 is exposed.

On impact of the projectile with the target, the head 37 of the firing pin of the point fuse is operated, driving the pin 36 into the primer and igniting its charge. The wall portion 29 may collapse at the same time, but detonation at 25 will occur before any material impedance or obstruction occurs in the path of the pin or in the passage to or through the tube. Explosion of the primer 32 results in projection of a pellet or blast, or both, from the point detonator rearwardly through the tube 35, through the foil 47 and cup 73 in the bore 50 and against the sensitive material 76, which immediately fires the high explosive primer powder 77. This produces a flash through the port 54, exploding the booster 79 and setting off the main charge 90 in the projectile.

During the described occurrences, incident to impact on the target, elements or factors of time and movement will have been manifest, including the time and movement occurring after impact of communication is collapsing, and the mouth of the shell and cone are moving into position for best utilization of the Munroe effect. The nature and amount of the bomb 32 and the weight of the pellet are selected relative to the force of impact of the projectile, its forward speed, and the rate of collapse of the wind shield, so that the main explosive charge is detonated at the proper stand-off distance of the shaped charge from the target, to give maximum penetration and optimum explosive effect.

These elements are so coordinated that the explosion of the main charge will occur as, or about when the mouth of the shell body reaches the material engaged by the detonation of the primer and the main charge is initiated. The time of movement of the pellet or blast to the detonator 72 will compensate for the time of movement of the shell body the length of the wind shield, including retarded by variations in the energy released in its application the Munroe effect method.

It would be appreciated that while there may be some variation in the time required for complete collapse of the wind shield due to various causes including longer or shorter deceleration incident to longer or shorter range, or variations in wind resistance, etc. the time will nevertheless be the same. Consequently selecting a primer for the point detonator which will project its detonating effect to the detonator 72 in a period of time which is a mean of those which experience may be required under extreme of variance in the tardance to be expected, there will be an automatic compensation in the practical fuse time, and by departures in either direction from such mean requirement. That is to say, where the communicated detonation is ideal for a given speed of the shell in collapse of the wind shield the transmission from the point of the base fuse will involve a time x. If the shell engages the target at a greater speed, the convergent motion of the base and the projected detonating point may correspondingly more rapidly, shortening the time of travel of the communicated effect, to accord with the earlier arrival of the shell cavity in good operative relation to the target body. Correspondingly, if the speed of the shell is slower than the chosen mean projectile speed, the convergence of the base fuse and the propagated element from the point fuse will be correspondingly slower and delayed.

In the form of the invention, shown in Fig. 8, the bore in the stem 27' of the point body is extended further and enlarged rearwardly of the primer retaining bushing of the point structure, as at 25 and a tube 35' engaged and secured therein which is extended rearwardly and into the tube 35. The neck 43 where it may be secured. The base and point structure may otherwise be the same as described. In this form, the forward part or the whole length of the tube between the cone and stem 27' of the point is of a lighter weight and less density material. One material suitable for the purpose is known as Pentalite. In another form the tube 84 may be metal-shausted tetral or as in Fig. 9. The sheet may be the same as at 45, as at 85, as well as the interior of the tube, as at 86. A lead sheath has been used. With the modification indicated, on detonation of the primer at the point, the blast with the Munroe effect, or a projecting portion of the primer, will travel through the tube with great certainty effecting the detonation of the detonator 72.

Explosion of the main charge will destroy the tube 35' instantly. The blast from the point primer will tend to ignite the tube 35', but such ignition will not occur until after communication of the necessary concussion to the rear detonator or, at least upon aforesaid passage of the dense area of the Munroe wave or pellet or both, past the point of ignition and ahead of any propagation of ignition along or in the material of the tube. This applies particularly to the metal-shausted tetral metal serving to delay the ignition and combustion of the tube.

On account of the great stresses set up in the body of the tube 35, 35' and 84 when the point structure engages the target, due to inertia of momentum in the tube material, and to guard against possible breakage of the tube before the pressure wave reaches the sensitive material, I have shown in Fig. 8 an anchoring means on the base fuse by which the tube is automatically connected to the base fuse when the base fuse is put in place. In this instance the tube is thickened at the end portion and formed with a circumferential groove 87 near its rear extremity and its rear end is bevelled as at 88. The neck 43' and bore 50' are suitably enlarged to receive the enlarged end of the tube, and an interior groove 89 formed in the enlarged bore 50' arranged and proportioned to aline with the groove 87 when the tube end is inserted. A groove 90 of circular form, set initially in the groove 89, is of a radial cross sectional dimension sufficient to lie with portions in the grooves when the latter are aligned. The spring 90 has flat sides in parallel planes normal to the axis of the tube and neck, but is bevelled on its inner side so as to permit the end of the tube to be readily pushed through it when the base fuse is being put in place. After assembly the tube cannot be pulled from the neck 43', except by disassembling the fuze structurally, due to the engagement of the spring 90 therewith.

The construction of the safety and arming features in the base fuse of my invention are of such character as to be applicable to various forms of fuses, and in Fig. 11 I have shown an adaptation of that part of the invention in the base fuse 52 by a small deviation from the inertia base fuse of general application. Here, the booster chamber and charge, and the slider except centrifugals 62 as before described, are embodied in the identical form and relation as described, and the rear portion of the body 41' of the fuse may be of similar
form. The forward part, however, instead of having the reduced neck is extended the full size of the rear part and a large bore 100 formed concentrically, opening on the forward end, 103, which a smaller bore 53 opens on the bore 53. A lock and primer carrier 101 having an axial passage 102 therethrough is slidable in the large bore, having also a reduced hollow stem 103 (through the passage 102 continues) extending through the bore 55" into the recess 60 of the slider, this recess being of the same form as before, and having the inner end spaced against the end of the stem 103 in the same manner as it acts against the lock 64 in the first construction.

The forward end of the bore 100 is interiorly threaded and has screwed therein to a closing plug 104, on the inner side of which there is a firing pin 105 aligned with the passage 102 and adapted to enter the same on relative forward movement of the lock 101. The inner rear end of the passage 102, is formed with a stop shoulder or lip and against this is set a conventional primer 106 having a percussion material at its end toward the pin 105. In the initial or safety position of the parts as shown in Figure 11, the stem 103 being fully engaged in the recess 60, the primer is spaced from the pin 105 and the passage 102, so that the primer 106 is accessible and not engaged by the stem 103.

As a safety for the detonator 106 diametrically opposite centrifugals 107 may be mounted in suitable recesses in the body 101, held by a C-spring 108 in a groove 109 so as to operate in the same manner as the centrifugals 62 or 62 which may be omitted. The centrifugals 107, in proportion to the latter, may be reduced openings through the wall of the bore 100 and projecting only a short distance before the lock, so that the necessary radial movement for arming may be provided for in the material of the fuse body beside the bore. The action of this fuse in the gun on firing is similar to that first described. The centrifugals 107 are thrown out after the bullet reaches a rotation rate sufficient to overcome the force of the spring 108, but the stem 103 of the lock 101 remains in the recess 60, opposing arming movement of the slide 57 under set back effect.

After the projectile leaves the gun, the slider operates centrifugally, as before, moving the cup 69 into line with the port 54. The element 72 in this particular cup may be omitted if desired for certain uses, or may be so composed as to constitute a delay button of relatively slow burning powder, or may be a second percussion detonator. This cup 69 is at the same time aligned with the passage 102 and 106. The movement of the slider moves the lock forwardly until the primer 106 is near the pin 105, and on impact of the projectile with the target, the stem 103 of the lock 101 carries it forward carrying the primer against the pin. The resulting flash through the rear end of the stem 55" will pass through the cup 69, if empty, and also the flash port 54, exploding the booster charge 79.

If a delay button is incorporated in the cup 69 there will be a corresponding delay of ignition of the booster charge and if a second detonator is set in the cup there will be a consequent quicker detonation of the booster. As shown in Figure 10 I have embodied the Munro effect more definitively to act by propulsion of a detonating wave or blast, by forming the base of the cup 110 for the point detonator or primer with an extended and deepened reentrant cone 111, and in such case the wall material of the cone 111 may be much thinner than the usual cup base. It may also be made of zinc, aluminum, or magnesium, or alloys, or a combustible plastic, so as to be consumed on detonation of the primer.

It is a further advantage of my invention that the arrangement of the centrifugals 62, enables them to be located a greater distance from the axis of the projectile for use. This has important advantages from several aspects. Thus, it obviates liability of failure to operate due to variations from manufacturing specifications as to mass and proportions. And, perhaps more important, reduces or eliminates liability of failure of the centrifugals to clear the detonating train by reason of yaw or rotation of the centrifugals eccentrically for any other reason. Often the axis of rotation is not in the axis of the projectile and if the center of gravity of the centrifugal is close to the projectile axis, the moments of the centrifugals may have either reduced values or even negative effects.

While I have disclosed my invention with particularity in the best embodiment developed at this time, it will be understood that this is not limiting and that modifications of construction, arrangement and combination, substitution of materials and equivalents, mechanical or otherwise may be made without departing from the spirit of the invention.

I claim:

1. In a projectile, an impact responsive primer located in the point thereof for initiating action of said projectile upon impact with a target, said primer including a first rearwardly directed shaped charge, a second forwardly opening shaped charge in said body portion and said first shaped charge, said first and second shaped charges defining a space which is free of intervening structure, detonating means at the base of said projectile for initiating action of said second shaped charge, there being an axial passage formed in said second shaped charge and communicating with said detonating means, and a kinetic element responsive to the detonation of said first shaped charge rearwardly projectible through said space and to and through said axial passage to initiate action of said detonating means.

2. In a projectile, an impact responsive primer located in the point thereof for initiating action of said projectile upon impact with a target, said primer including a first rearwardly directed shaped charge, a second forwardly opening shaped charge in said body portion and said first shaped charge, said first and second shaped charges defining a space which is free of intervening structure, detonating means at the base of said projectile for initiating action of said second shaped charge, and means, including an axial elongated passage in said second shaped charge and intersecting said elongated passage, a primer and detonator therein, responsive to detonation of said first shaped charge for initiating action of said detonating means.

3. In a projectile, an impact responsive primer located in the point thereof for initiating action of said projectile upon impact with a target, said primer including a rearwardly directed shaped charge and a liner for said first charge forming a kind of case for a projectile rearwardly by the blast propagated by said first shaped charge, a second forwardly opening shaped explosive charge in said projectile axially separated from said primer, said primer and said second shaped charge defining a space free of interfering structure, detonating means at the base of said projectile responsive to impact of said kinetic element for setting off said second shaped charge, said second shaped charge having an axial passage formed therein providing an open path for said kinetic element between said first shaped charge and said detonating means.

4. In a projectile having a cylindrical body portion with a frusto-conical forward portion, a collapsible windshield secured to said body portion, an impact detonable primer in the nose of said windshield, said primer comprising an explosive having a small forwardly opening conical cavity forming a second shaped charge, an explosive charge in said body portion, explosive charge having a forwardly opening large conical cavity forming a second shaped charge, said windshield, said primer and said second shaped charge defining a space free of interfering structure, a detonator in said body portion adjacent the base thereof for setting off said explosive charge, said explosive charge in said body portion having an elongated axial passage intermediate said base detonator and said primer, whereby said detonator is responsive to the blast produced by said impact detonable primer traversing through said space and to and through said axial passage to set off said explosive charge.

5. In a projectile having a cylindrical body portion, and a forwardly extending frusto-conical impact collapsible windshield secured to said body portion, an impact detonable primer in the nose of said windshield comprising an explosive forming a first shaped charge, a liner for said first shaped charge forming a pellet when said primer is exploded, an explosive charge in said body portion, explosive charge having a small forwardly opening conical cavity forming a second shaped charge, said windshield, said primer and said second shaped charge defining a space free of interfering structure, a detonator in said body portion adjacent the base thereof for setting off of said explosive charge, said
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explosive charge having an elongated axial passage intermediate said base detonator and said first shaped charge, whereby the blast from said first shaped charge on impact drives said pellet rearward through said space and to and through said axial passage to set-off said detonator.

6. A projectile comprising in combination a shell having a hollow front end, a load of explosive located in said shell with its front face rearward of said hollow front end, said load of explosive being formed with a cavity extending rearwardly from its front face, said cavity increasing in diameter from rear to front, a sheet metal hood applied against the wall of said cavity, said hood having an aperture at the rearward end thereof, a main detonator located in the explosive load rearward of the sheet metal hood, a tubular member located in said load of explosive and extending through the aperture and having its front end centered in the hood with a front orifice opening into the space in said hood, said tubular member cooperating with the hood for preventing gasses of the exploded charge from penetrating inside the hood, a sensitive head fuse located at the front end of the projectile and including a priming detonator having a part extending into the hollow frontal end positioned for delivering the flame of detonation into said hollow frontal end of said hood, said detonators being held spaced one from the other, said part, front end, hood and tubular member providing means for fire transmission in a direct path from the priming detonator to the main detonator whereby the space within said hollow frontal end and said hood is free of any intervening structure between said part and said tubular member.

7. In a fused projectile, a casing, a main explosive charge within said casing and having a forwardly-facing shaped cavity, a detonator in detonating relation with said charge at the rearward end thereof, there being an axial passage in said charge extending only from the apex of said cavity to said detonator, an impact fuse, means mounting said fuse in fixed relation with said casing and on the forwardly-extended axial passage to said detonator out of contact with said main explosive charge.

8. The projectile in claim 7 wherein said impact fuse includes a rearwardly directed shaped cavity.

9. The projectile in claim 7 including a liner for said shaped cavity.

10. The projectile in claim 8 and including a first liner for the shaped cavity of said main charge and a second liner for the shaped cavity of said impact fuse.

11. In a spin stabilized projectile having a cylindrical body and an impact collapsible frusto-conical windshield secured to said body, an impact responsive primer located in the point of said windshield for initiating action of said projectile upon impact with a target, said primer including a first rearwardly directed shaped charge, a second forwardly opening shaped charge within and co-extensive with said body, said body an axial separation between the apices of said shaped charges, said windshield, said first and said second shaped charges defining a space free of intervening structure, detonating means at the base of said projectiles for detonating said second charge, there being an elongated axial passage in said second charge and communicating with said detonating means, and a kinetic element responsive to the detonation of said first charge rearwardly projectible through said space and to and through said axial passage to initiate action of said detonating means.

12. The projectile of claim 11 and including a centrifugally responsive slide member transversely slideable in a bore formed in said detonating means, a detonator in said slide member integrally movable therewith from first safe position to second armed position in axial alignment with said flash passage, and centrifugally responsive detent means in said detonating means releasably engaging said slide member, said detent means releasable at a predetermined forward speed of said projectile to permit said slide and detonator to move to arming position.

13. The projectile of claim 11 and including a liner for said first shaped charge, said liner forming said kinetic element when said first shaped charge is detonated.

14. The projectile of claim 13 and including a centrifugally responsive slide member transversely slideable in a bore formed in said detonating means, a detonator in said slide member integrally movable therewith from first safe position to second armed position in axial alignment with said flash passage, and centrifugally responsive detent means in said detonating means releasably engaging said slide member, said detent means releasable at a predetermined forward speed of said projectile to permit said slide and detonator to move to arming position.

15. The projectile of claim 11 wherein said kinetic element is the blast propagated by detonation of said first shaped charge.

16. The projectile of claim 15 and including a centrifugally responsive slide member transversely slideable in a bore formed in said detonating means, a detonator in said slide member integrally movable therewith from first safe position to second armed position in axial alignment with said flash passage, and centrifugally responsive detent means in said detonating means releasably engaging said slide member, said detent means releasable at a predetermined forward speed of said projectile to permit said slide and detonator to move to arming position.

**References Cited in the file of this patent**

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