

Feb. 4, 1947.

J. B. SEMPLE

2,415,262

FUSES FOR PROJECTILES

Filed Aug. 12, 1941

2 Sheets-Sheet 1

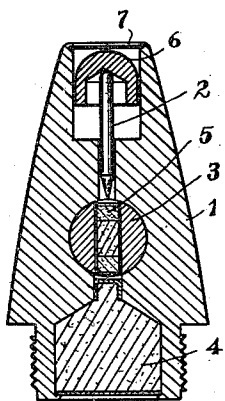


FIG. I.

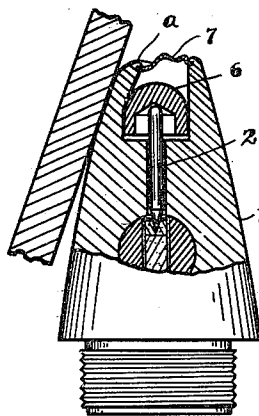


FIG. II.

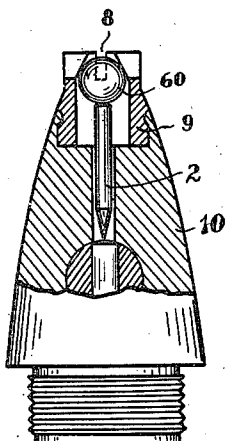


FIG. IV.

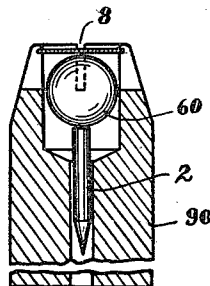


FIG. VI.

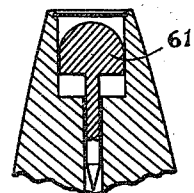


FIG. III.

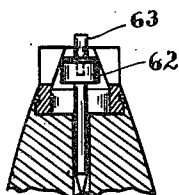


FIG. V.

INVENTOR

John B. Semple
by Christy, Remmel and Strickland
his attorneys

Feb. 4, 1947.

J. B. SEMPLE

2,415,262

FUSES FOR PROJECTILES

Filed Aug. 12, 1941

2 Sheets-Sheet 2

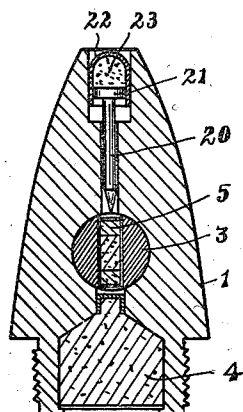


FIG. VII.

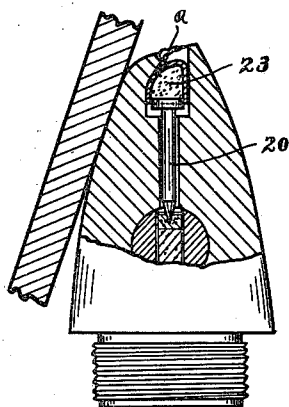


FIG. VIII.

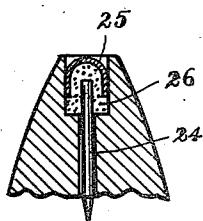


FIG. IX.

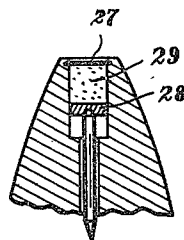


FIG. X.

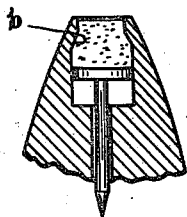


FIG. XI.

INVENTOR

John B. Semple
by Christy, Pannell and Strickland
his attorneys

UNITED STATES PATENT OFFICE

2,415,262

FUSE FOR PROJECTILES

John B. Semple, Sewickley, Pa.

Application August 12, 1941, Serial No. 406,495

8 Claims. (Cl. 102-73)

1

This invention relates to fuses for projectiles, and, more particularly, to point fuses that include in their structure a firing pin which, under the stress of impact, is driven rearwardly to penetrate and fire the primer or equivalent element. The invention consists in a refinement of structure that insures the successful rearward drive of the firing pin through a widened range in the angle of impact.

Ordinarily, in fuses of the type under consideration, the firing-pin extends within and normally protrudes forwardly from an axial bore that opens at the tip of the fuse body. This protruding firing pin makes immediate impact upon the surface of the target, and in consequence of such impact is driven rearward in its bore to perform its intended purpose. If, however, the impact be at a low angle to the surface upon which impact is made, so that the component of the force that tends to press the firing pin against the wall of the bore exceeds the component that tends to drive the pin rearward, the latter force is ineffective; the firing pin will bind in the bore, and will not function. The critical angle varies somewhat, depending upon proportions, materials, and condition of surfaces, but will ordinarily be approximately 25°. In particular cases—in anti-aircraft service, for example—it becomes a matter of great importance and value to accomplish what by this invention I have accomplished: the functioning of the shell, even though the angle of impact be substantially less than the critical angle just mentioned.

In the accompanying drawings Fig. I is a view in axial section of a particular fuse of the type indicated, in which the feature of this invention is incorporated. Fig. II is a similar view (though partly in elevation) that illustrates diagrammatically the mode of operation; Figs. III, IV, V, and VI are similar views, illustrating variations in details of structure; Figs. VII and VIII are views corresponding to Figs. I and II in which a firing pin of specifically different structure responds in different manner to the stress of impact; and Figs. IX, X, and XI are fragmentary views in axial section that illustrate variations in detail of the firing pin of the structure typically shown in Figs. VII and VIII.

Referring first to Fig. I, a fuse body 1 of conventional outline carries within itself a firing pin 2, an interrupter 3, and a booster charge 4. The interrupter is of cylindrical shape and is contained in a bore that is formed within and extends transversely of the fuse body. A diametrical perforation through the interrupter is

2

filled with a train of detonation initiating material that includes a primer 5. In the flight of the projectile the interrupter (released on firing) turns under centrifugal force from a remote position to the position shown, in which the train of detonation-initiating material is aligned between the firing pin 2 and the booster charge 4. It will be understood that, with respect to the interrupter, the showing is exemplary merely. It is essential to the invention only that there be within the fuse a primer (or its equivalent) which at the moment of impact is subject to the action of the firing pin.

The firing pin 2 is designed for facile traverse in the bore that carries it. It conveniently takes the form of a slender spindle of polished steel freely movable within the bore. The outer end of the firing pin is enlarged and may conveniently be formed as a separate block 6, arranged in an anterior enlargement of the bore. The block 6 may for the sake of lightness be formed of aluminum; it is of circular cross-section; its outer surface is of convex curvature, advantageously spherical; its inner face may be formed with a re-entrant conical recess, within which recess it makes abutment upon the outer end of spindle 2.

The firing pin, consisting of the spindle 2 and the block 6, is contained within the bore, so that at the tip the rim of the bore extends free of the forwardly convex face of the block 6. Preferably the firing pin is contained wholly within the bore, and suitable means are provided, such as a thin metal disk 7 secured at its rim for closing the mouth of the bore.

In course of flight of the projectile the interrupter block 3 within the body of the fuse comes to position; and at the instant of impact the parts are in the positions shown in Fig. I. If impact be on a line exactly perpendicular to the target surface the firing pin will sustain a rearward thrust such as to pierce the primer 5 and fire the shell. If the impact be on oblique line, operation in the manner illustrated in Fig. II is effected. The rim of the bore is crushed, as indicated at *a*; the collapsing inner wall presses powerfully upon the convex outer face of block 6 and by such pressure drives the firing pin rearward—after such manner as an orange seed may be projected by pressing it between the finger tips and then changing slightly the angle between the engaging finger surfaces. The effect is the firing of the shell.

The rearward drive of the firing pin will be accomplished in any case in which the impact deforms the rim of the bore; and this deformation

will occur even though the angle of impact be less than the minimum at which a projecting firing pin will be driven rearward in the fuse as heretofore known.

As indicated in Fig. III, the firing pin need not be formed in two parts, but may be an integral body 61 having the characteristics of shape and functioning in the manner already described.

Figs. IV and VI show firing pins formed in two parts, and they show that the block forming the outer portion of the firing pin may take the form of a sphere 60, abutting upon the outer end of the spindle 2. These figures also show that the rim of the bore at the tip of the fuse body may be weakened for more ready deformation by the cutting of kerfs or slots 8 in it.

Figs. IV and V show that the block (or ball) 60 (62) may be restrained within the bore (and the rearward thrust upon the block or ball intensified) by a forward tapering and diminution in the diameter of the bore, so that the forward face of the ball is engaged by a normally oblique and tapering conical surface. Such refinement is rendered practicable by providing a separate body 9 secured in a recess in the tip of the fuse body, which body 9 may readily be shaped as described before being assembled with the body 10.

Fig. VI indicates that the bore that carries the entire firing pin may be formed in a body 90 cut from rolled stock. Such an article, manifestly, may be set in the body of any fuse prepared to receive it.

Fig. V further shows that the block 62 that forms the anterior portion of the firing pin, engaged as it is by the forwardly converging walls of the bore, need not be of appreciably convex shape forwardly.

When the fuse of Fig. I makes impact obliquely upon the surface of the target, the stress-transmitting line of contact of the laterally crushed tip of the fuse body with the surface of the head of the firing pin shifts in a direction extending from the base of the spherical head of the pin toward the apex, with the effect that the stress which drives the pin rearward is increasingly effective upon the firing pin. In the structure of Fig. V, when the tip of the fuse is crushed under impact, the stress-transmitting line of contact of the conical bore portion of the fuse with the head of the firing pin shifts downward or rearward upon such conical surface. Here too the increasing effect is to drive the firing pin rearward.

Fig. V serves additionally to indicate that the firing pin, having the characteristics and assembled in the manner described, need not be contained wholly within the bore of the fuse body. It may be provided with an extension 63 that protrudes from the mouth of the bore. On perpendicular impact manifestly the firing pin will be driven rearwardly in response to immediate impact upon the surface of the target.

The firing pin shown in Figs. I-VI is formed of rigid material throughout, and is effective by virtue of rigidity and shape. Alternately, the firing pin may be formed with a plastic anterior end, and the plastic portion, properly confined and made subject to compression on the crushing of the rim of the confining bore, may impart to the posterior rigid spindle portion of the firing pin its primer-firing traverse. The operation in this case is comparable to the squeezing of toothpaste from a collapsible tube.

In Fig. VII the rigid spindle-shaped posterior

portion 20 of the firing pin is provided with a head 21. An otherwise open ended capsule 22 of thin and flexible material, snugly fitting within the bore, is applied to and snugly encircles the head 21. The enclosed space within the capsule is filled with a suitable fluid material 23, such, for example, as finely divided graphite, preferably worked to a paste with vaseline. On the impact of the shell and the crushing of the rim of the bore in the fuse body, the fluid-filled capsule is compressed from the forward end rearwardly, as indicated at *a*, Fig. VIII, and the stress of impact transmitted through the fluid material 23 drives the spindle 20 rearward to perform its primer-firing function.

In Fig. IX the spindle is not headed; the enlarged anterior portion of the bore, beneath the snug-fitting capsule, is entirely filled with the fluid material; and the forward end of the spindle, extending into the enlarged portion of the bore, is snugly embedded in the fluid material. In this case the capsule may take the form of a brass cap 25 with convex anterior face, the fluid material 26 may be graphite worked to a paste with castor oil, and the spindle 24 may be of aluminum. The functioning is as before, after the manner indicated in Fig. VIII.

In Fig. X the spindle of the firing pin is provided with a head that fits snugly within the enlarged anterior portion of the bore; the capsule is modified and becomes a disk 27 that closes the bore forwardly, and all the space between the head of the spindle and the closing disk is filled with fluid material. In this case the spindle may be of steel and its head 28 of aluminum. The fluid filling 29 may be of hydraulic soap or graphite.

In Fig. XI a structure otherwise resembling that of Fig. X is distinguished, in that the enlarged portion of the bore is tapered at *b* and reduced in diameter toward the rim (cf. the structure of Fig. IV). This feature manifestly intensifies the stress that upon impact is exerted upon the spindle. The fluid material may be soap or talc—for talc (and, for that matter, graphite too) in finely divided form possesses for the purposes in contemplation the qualities of a fluid, and is for my purposes a fluid.

I have specified a variety of preparations to constitute the fluid material through which the stress of impact is imparted to the spindle of the firing pin. Neither of these particular preparations is specific to the form in connection with which I have described it, but all may be used interchangeably. It is characteristic of the materials specified, and is essential to the operation described, that they be incompressible, and so capable of transmitting stress instantly and without appreciable diminution.

I claim as my invention:

1. A point fuse for an artillery shell including a fuse body formed with an axial bore and a firing pin arranged within and movable in said bore and adapted in its rearward travel to fire the fuse, the firing pin including a posterior spindle and an interior deformable capsule, incompressible fluid material confined in the said capsule, the deformable capsule being subject to the stress of deformation of the rim of the bore on impact, and adapted to transmit the stress through the said incompressible material rearwardly to the spindle.

2. A point fuse for an artillery shell including a fuse body formed with a forwardly opening axial bore and a firing pin arranged within and

5

movable in said bore and adapted in its rearward travel to fire the fuse, said firing pin including a posterior spindle portion and an anterior portion in the form of a collapsible capsule filled with stress transmitting incompressible fluid material engaging the forward end of the spindle portion, the said capsule so filled being subject to deformation in response to the crushing of the rim of the bore on impact and adapted in such deformation to impart the stress of the crushing of the rim of the bore to the posterior spindle portion of the firing pin.

3. A fuse comprising a body having a tapering nose, an axial bore and an enlarged axial counterbore opening through said tapering nose to form a deformable rim section, a firing pin slidably fitting said bore, and having a plunger portion within said counterbore, a body of fluent material within said counterbore, and means confining said material within said counterbore in contact with said plunger means, whereby said material is compressed on deformation of said rim to rearwardly translate said pin.

4. In a fuse for an artillery shell, a fuse body having a reduced nose, there being a chamber in said body opening through said nose to form a weakened rim section, a body of fluent material in said chamber, means confining said material in said chamber so that the same is compressed on deformation of said rim section on impact, and firing pin means having a portion within said chamber to be operated by compression of said material as aforesaid.

5. In a point fuse, the combination of a fuse body having a tapered nose and provided with an axial bore having an enlarged counterbore opening forwardly through said tapered nose to provide a weakened deformable rim at the fuse nose, a firing pin slidably fitting said axial bore, a primer in said body in alignment with said bore and axially spaced from and mounted independently of said pin, and means independent of said firing pin and slidably fitting said counterbore and operative to move said firing pin rearwardly into detonating engagement with said primer by and in response to deformation of said rim on impact.

6. In an impact fuse, a body having a tapered nose and a bore extending axially of said body and having an enlarged concentric counterbore opening through said nose to form a weakened deformable rim in said nose, a firing pin slidably fitting said bore and having one end normally projecting into said counterbore, a primer in said

6

body in alignment with said bore, and mounted independently of said pin, and actuating means unconnected with said firing pin and slidably fitting said counterbore and engaging said pin to slide the same into detonating engagement with said primer by and upon deformation of said rim upon impact.

7. An impact fuse including a body having a frusto-conical nose of low apex angle, there being a bore extending axially of said body and having an enlarged concentric counterbore opening through the end of said nose to form in said nose, a weakened deformable rim section, a pin slidably fitting said bore, a primer in said body in alignment with said bore and mounted independently of and spaced from said pin, and operating means fitting in and independently slidably in said counterbore to engage said pin to axially slide the same into detonating engagement with said primer upon movement in response to impact deformation of said rim section.

8. In a fuse of the type described, a fuse body having a tapered nose, and an axial bore, an enlarged axial counterbore opening through said nose to form a weakened rim section deformable on impact, a firing pin slidably fitting said bore and extending forwardly into said counterbore, a primer in said body in alignment with said bore and mounted independently of said pin, and a ball fitting said counterbore and positioned to be positively forced rearwardly by deformation of said rim section on impact, to thereby axially translate said pin into detonating engagement with said primer.

JOHN B. SEMPLE.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,356,633	Kirchloff -----	Oct. 26, 1920
340,935	Butler -----	Apr. 27, 1886
1,321,455	Kennedy -----	Nov. 11, 1919
1,462,173	Haas -----	July 17, 1923
399,879	Graydon -----	Mar. 19, 1889
1,316,607	Watson -----	Sep. 23, 1919
1,666,792	Remondy -----	Apr. 17, 1928
444,537	Merriam -----	Jan. 13, 1891
1,313,651	Sutton -----	Aug. 19, 1919
1,318,098	Midgley -----	Oct. 7, 1919
1,758,635	Weiser -----	May 13, 1930