

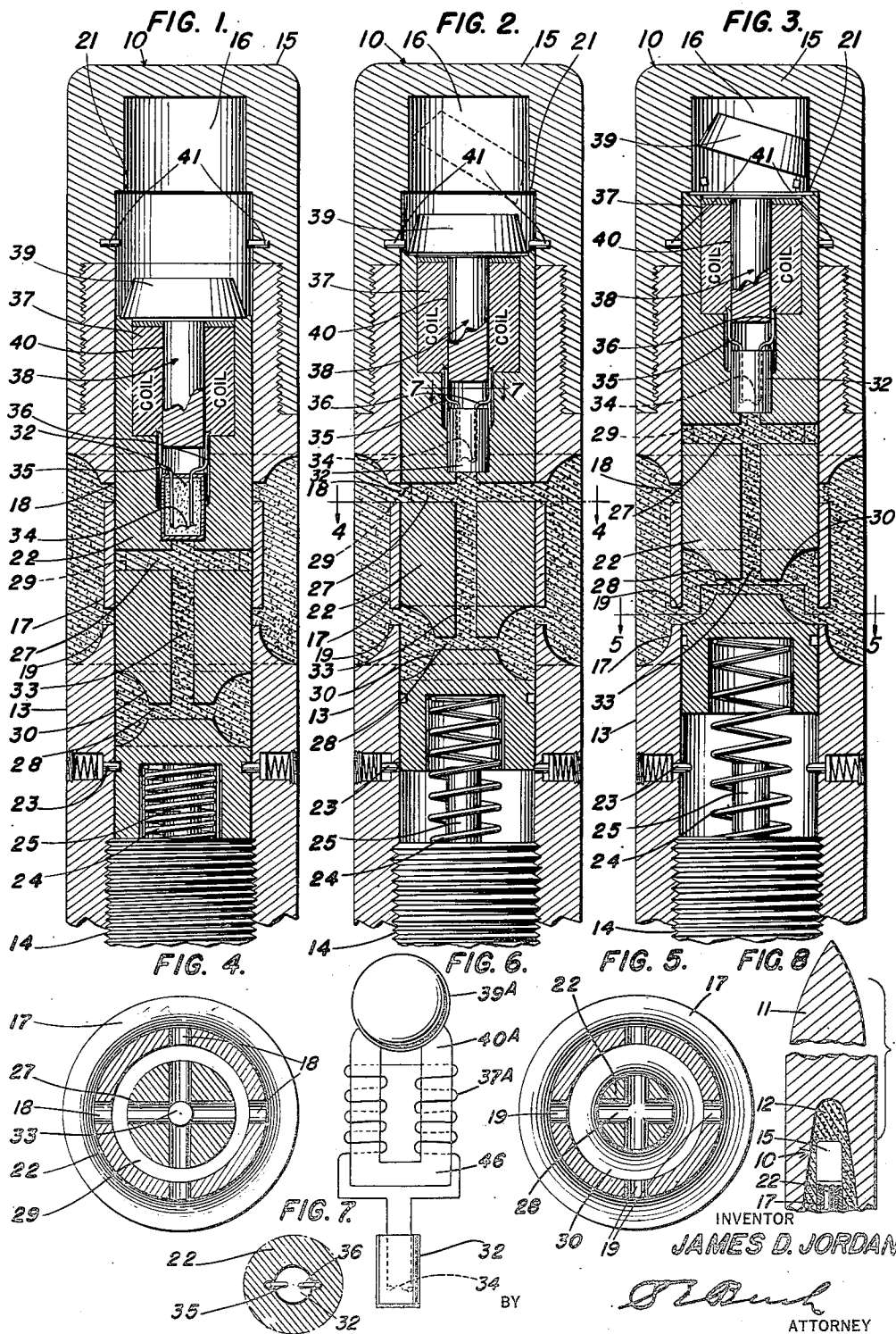
June 8, 1948.

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2,443,041

FUSE

Filed Nov. 29, 1944



UNITED STATES PATENT OFFICE

2,443,041

FUSE

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Application November 29, 1944, Serial No. 565,674

3 Claims. (Cl. 102—70.2)

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The present invention relates to fuzes and related mechanisms for releasing the energy stored in explosive missiles, and more particularly to selective fuze mechanisms incorporating variable time delay means whereby the detonation of the explosive charge may be initiated after delay periods that are made to vary in accordance with the nature of the target.

It is considered desirable to delay detonation for a period of the order of 0.03 second after impact with a heavily protected object, in order to permit the missile to penetrate before exploding, while against lightly protected objects detonation should be substantially instantaneous or delayed for a period of the order of 0.01 second. The principal object of the present invention is to provide means of a simple, compact, efficient, and reliable character whereby the time delay period is automatically varied by the effect that the target itself has upon the missile. In accomplishing this result in accordance with my novel means, advantage is taken of the difference in the degree of deceleration of the projectile resulting from impact with materials having different retarding values. Another object is to provide an improved fuze of the indicated character that avoids the necessity of any manual or other pre-setting and advance knowledge of the nature of the target protection.

It is also an object of the invention to provide an improved fuze mechanism of the aforementioned character that may be relied upon to initiate detonation without regard to the angle of impact with the target and even at high obliquities.

In accordance with the invention, a fuze for causing detonation of a missile of the type including an explosive charge comprises a primer, a plurality of fuze train means for coupling the primer to the explosive charge, thereby to cause detonation of the charge, said fuze trains having different time delay characteristics, and means dependent upon a property of an object impacted by the missile for blocking at least one of the fuze trains, whereby detonation occurs at a time determined by the time delay characteristic of the remaining fuze train.

For a better understanding of the present invention, together with other and further objects thereof, reference is made to the following description taken in connection with the accompanying drawings, and its scope will be pointed out in the appended claims. Referring to the drawings, Figs. 1, 2, and 3 are elevational sectional views of a preferred embodiment of a selective fuze mechanism in accordance with the present invention, in

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the unarmed, short time delay and long time delay positions, respectively; Figs. 4 and 5 are sectional views taken on the planes indicated by the lines 4—4 and 5—5 of Figs. 2 and 3 respectively, looking in the direction of the arrows; Fig. 6 is a schematic diagram of a modified form of electromagnetic generator that may be employed in the Fig. 1 embodiment; Fig. 7 is a sectional view of the primer and associated electrical connections incorporated in the Fig. 1 embodiment, as taken on the plane indicated by line 7—7 of Fig. 2; and Fig. 8 is an elevational sectional view showing a fuze of the type illustrated in Fig. 1 installed in a missile of the projectile type.

With reference to Fig. 8 of the drawing there is disclosed a fuze 10 in accordance with the present invention installed in the base of a projectile 11 designed to be fired from a rifle. The projectile includes an energy-storage explosive charge indicated generally at 12. As used throughout this specification the words "explosive charge" may be construed to include booster charge and booster lead-ins of the fuze 10. The fuze constitutes means for releasing the energy stored in the explosive charge upon detonation.

With reference now to Fig. 1 the embodiment of the present invention there represented includes a cylindrical tubular casing 13 closed at its rear end by a screw plug 14 integral with an adjoining component part of the projectile 11. The forward open end of the casing is closed by a threaded cap 15 to form a chamber 16.

The casing has an exterior annular groove 17 containing a booster charge in contact with the main explosive charge 12 of the projectile. Groove 17 communicates with the interior of the casing through two sets of radial booster lead-in ports spaced longitudinally, numbered 18, 19 and also filled with a suitable explosive.

Within the interior cylindrical bore of the casing is slidably mounted a plunger 22, which responds to the force developed by impact of the missile on an external object to determine the operative setting of the fuze. The plunger is held in the unarmed position illustrated in Fig. 1 by a plurality of spring-pressed detents 23 retractable by centrifugal force resulting from rotation of the projectile and precluding operation of the fuze until the projectile is fired. Compressed against the face of a recess formed in the rear of the plunger is a spring 24 positioned by a boss 25 integral with the screw plug 14.

The plunger is provided with two longitudinally spaced interconnected fuze trains 27, 28 each comprising a radially arranged group of passages

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filled with explosive. As best seen in Fig. 4 an annular recess 29, also filled with explosive, provides potential communication between the ducts 27 and the groove 17, while another explosive-filled annular recess 30 in the plunger provides communication between the ducts 28 and the groove 17. The above-mentioned recesses 29 and 30, respectively, are so spaced as to register with the longitudinally spaced sets of ports 18 and 19 provided in the casing.

Axially positioned in a counterbored extension of a well formed in the front end of the plunger is an electrically operable primer 32. In communication with the primer and traversing the ducts 27 so as to terminate at the ducts 28 is a longitudinal passage 33, also filled with explosive. A firing filament 34 of the primer is connected to leads 35, 36 of a coil 37 included in an electromagnetic generator indicated generally at 38. The inducing member of this generator is a magnetic armature element 39 formed as a disc with a chamfered edge, constituting substantially a truncated cone and held in static position with respect to the coil by reason of its attraction with respect to a core 40 rigidly secured within the coil.

Shear pins 41, rigidly secured to the inner wall of the casing, project inwardly in the path of travel of the plunger 22 and limit the extent of its normal forward movement under the influence of the spring 24. The inner ends of the pins are spaced sufficiently to permit free passage of the armature element 39 therebetween. The mass of the plunger and the shear resistance of the pins are so proportioned that the pins cannot be sheared except as a result of impact with a relatively heavy or resistant target, and consequent sharp deceleration of the projectile and the can body 13, although the armature can be dislodged while the pins continue to restrain the plunger by impact with a lighter target, the action then being as indicated in Fig. 2.

It is believed that the operation of the device will be evident from the foregoing, but it may briefly be summarized as follows: The fuze is installed in the base of the projectile 11 (Fig. 8) in the unarmed condition shown in Fig. 1. Upon firing and the attainment of predetermined spin, centrifugal force frees the detents 23 from the plunger 22, permitting the spring 24 and the effect of creep to push the plunger forwardly until it is arrested by the shear pins 41. This establishes the armed condition. If the projectile then strikes a lightly protected target so that the missile undergoes a relatively small deceleration, the forward progress of the casing 13 is retarded but the momentum of magnetic armature member 39 carries it forward, as indicated in dotted lines in Fig. 2, so that it moves relative to the coil and induces an electromotive force therein. The resultant current fires the primer. Since the powder train comprising the ducts 27 and the recess 29 is in communication with the ports 18 and therefore with the booster, a short path is provided to the explosive charge, and detonation occurs at a time following impact that is appropriate to a lightly protected object such as would cause a relatively minor deceleration of the projectile. If the deceleration of the casing attains a predetermined greater value such as might result from impact with heavy armor, the momentum of the plunger is sufficient to shear the pins and impel the plunger to a further forward position shown in Fig. 3 in which it is arrested by the shoulder 21 while

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the armature is thrown forwardly and so produces the firing current by induction. In such case the shorter powder train is effectively blocked, since the recess 29 is no longer in direct communication with the ports 18, and the effective powder train then includes the time delay element 33, the ducts 28 and the recess 30, which at such time registers with the ports 19. Detonation then occurs at a time determined by the time delay characteristic of the last-mentioned fuze train and later than that first considered.

With reference to Fig. 6 of the drawing there is illustrated a modified form of electromagnetic signal generator suitable for installation in the above-described fuze. A spherical magnetic element 39A is used with a double-legged or U-shaped core 40A whose ends are conformably shaped to receive the ball. The ball armature is similarly maintained in static position with respect to a coil 37A by magnetic attraction until the time of firing. It will be seen that the arms 40A position the sphere in such a manner that lateral forces resulting from an oblique line of impact of projectile and target are effective to dislodge the sphere and fire the fuze. A similar effect is achieved, in the embodiment first described, by reason of the frusto-conic shape of the armature 39, which under the influence of a glancing impact is free to rock on its base and has a forward component assisting its movement away from the coil.

While there have been described what are at present considered to be the preferred embodiments of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention and it is, therefore, intended in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

I claim:

1. A fuze for causing detonation of a missile of the type including an explosive charge, comprising a casing adapted to be at least partially embedded in the said charge and formed with two longitudinally spaced apertures there-through, a plunger slidably mounted in the said casing and formed with passages of unequal length terminating in longitudinally spaced openings therein, priming means, powder trains in communication with said priming means, and individually disposed in the said passages, and means for restraining longitudinal movement of the said plunger to each of the said openings with a corresponding one of the said apertures, thereby placing all the said powder trains in communication with the said charge, said restraining means being frangible on critical deceleration of the said missile whereby the inertially-produced forces will cause said plunger to fracture the restraining means and will move the said plunger to destroy the alignment of certain of the said openings with their corresponding apertures, thereby positioning only the remaining of the said powder trains in communication with the said charge.

2. A fuze for causing detonation of a missile of the type that includes an explosive charge, the said fuze comprising a casing designed to be at least partially embedded in the charge and having a plurality of axially spaced apertures through its wall and thus affording communication with the said charge, a member slidably fitting within the said casing, the said member having openings therein that may be caused to reg-

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ister with the said apertures to establish communication therethrough when the said member has certain positions axially of the said casing, a primer carried by the said member, the said member also having a passage in communication with all the said openings, the said passage containing fuze train material and affording paths of various lengths between the said primer and the respective said openings, means offering stepped resistances to the sliding motion of the said member whereby the deceleration provided by impact of the missile on targets of varying difficulty of penetration determines which of the said stepped resistances is overcome and thus which of the said openings will register with any of the said apertures, and means controlled by impact of the missile for firing the said primer.

3. The fuze set forth in claim 2, including locking means releasable by centrifugal force for hold-

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ing the said member so that all its openings remain out of register with any of the apertures in the said casing until after the missile is fired.

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