United States Statutory Invention Registration [19]

Field [11] **Reg. Number: H136**

[43] **Published: Oct. 7, 1986**

[54] **ELECTRICALLY DETONATED GRENADE**

[75] Inventor: **Werner Field**, Rockaway, N.J.

[73] Assignee: **The United States of America as represented by the Secretary of the Army**, Washington, D.C.

[21] Appl. No.: **790,579**

[22] Filed: **Oct. 23, 1985**

[51] **Int. Cl.**[4] **F42B 27/00**

[52] **U.S. Cl.** **102/487**; 102/209

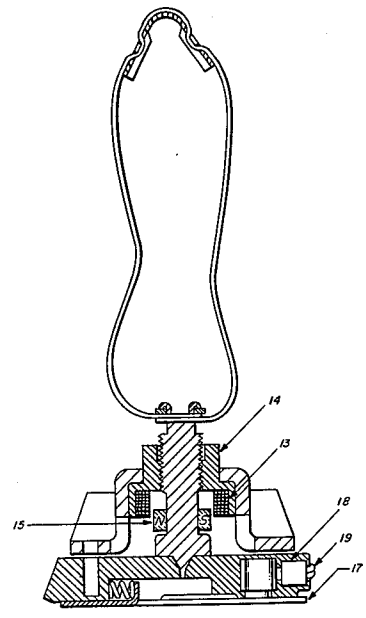
Primary Examiner—Harold J. Tudor

Attorney, Agent, or Firm—Anthony T. Lane; Harold H. Card, Jr.; Michael C. Sachs

[57] **ABSTRACT**

An electrically detonated fuse for a grenade is shown, used either as a back up system for the usual mechanical detonator, or independently as the sole arming and detonating means. The invention is considered more accurate and dependable than a mechanical system, which is aimed at the objective of reducing the amount of grenade duds, the dangerous phenomenon of still live grenades unexploded upon impact creating a hazardous situation for military and other personnel. The invention uses the ordinary twisting action of the currently used inflated ribbon which is extended from the grenade while it is in flight, to generate an electromotive force signal. An electrically activated detonator is installed next to the grenade's main charge, for blowing the device when the electrical detonator is switched on. A large surge of power is fed to the electrical detonator by the closing of an electrical impact fuse, when the grenade physically impacts a target. To store the necessary voltage for detonation a capacitor bank is employed, which store is charged by the said generated e.m.f. signal, after passage through a diode for half-wave rectification. The e.m.f. signal is generated through opposite polarity magnets attached to a rotor, which the ribbon is attached to for turning. Around the rotor and magnets is a wound wire coil, at which the said signal is generated.

6 Claims, 5 Drawing Figures



MODIFIED FUZE

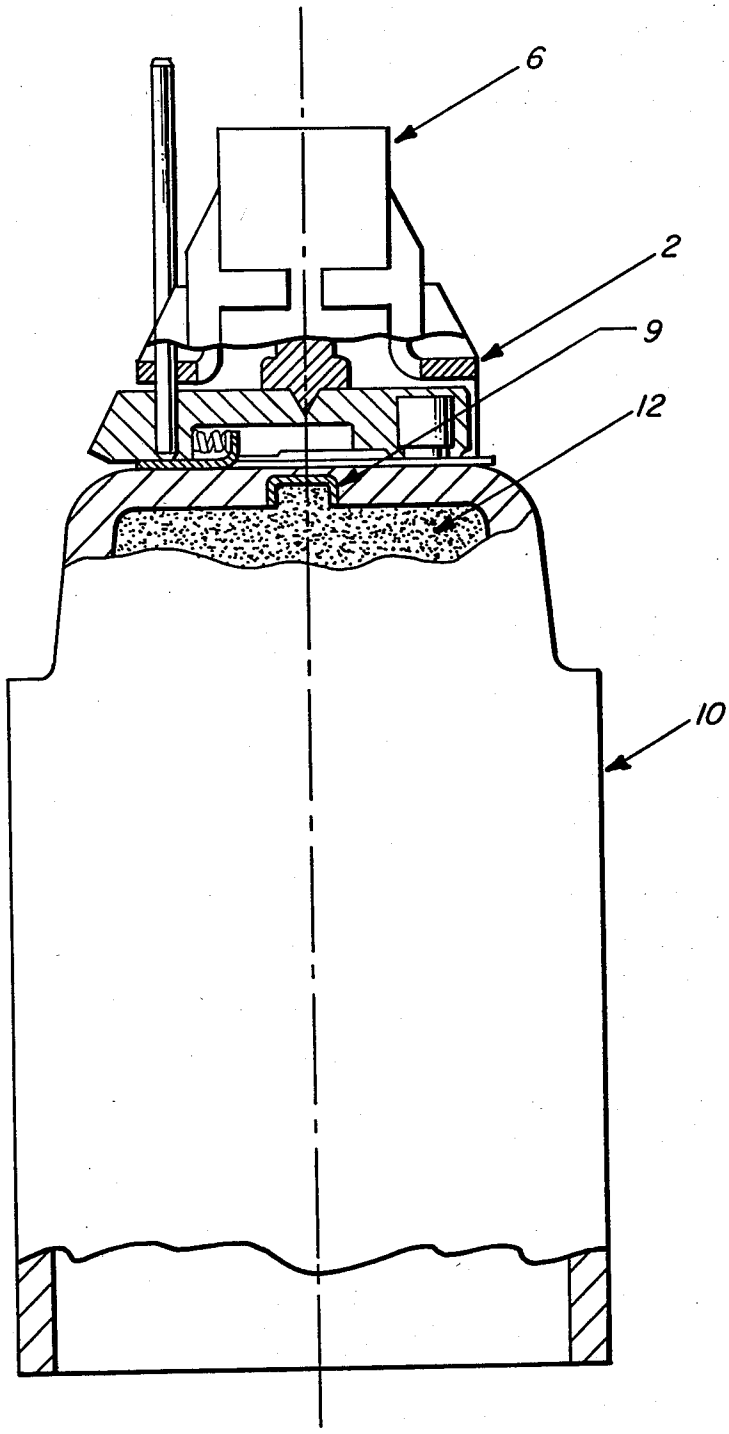


FIG. 1
GRENADE

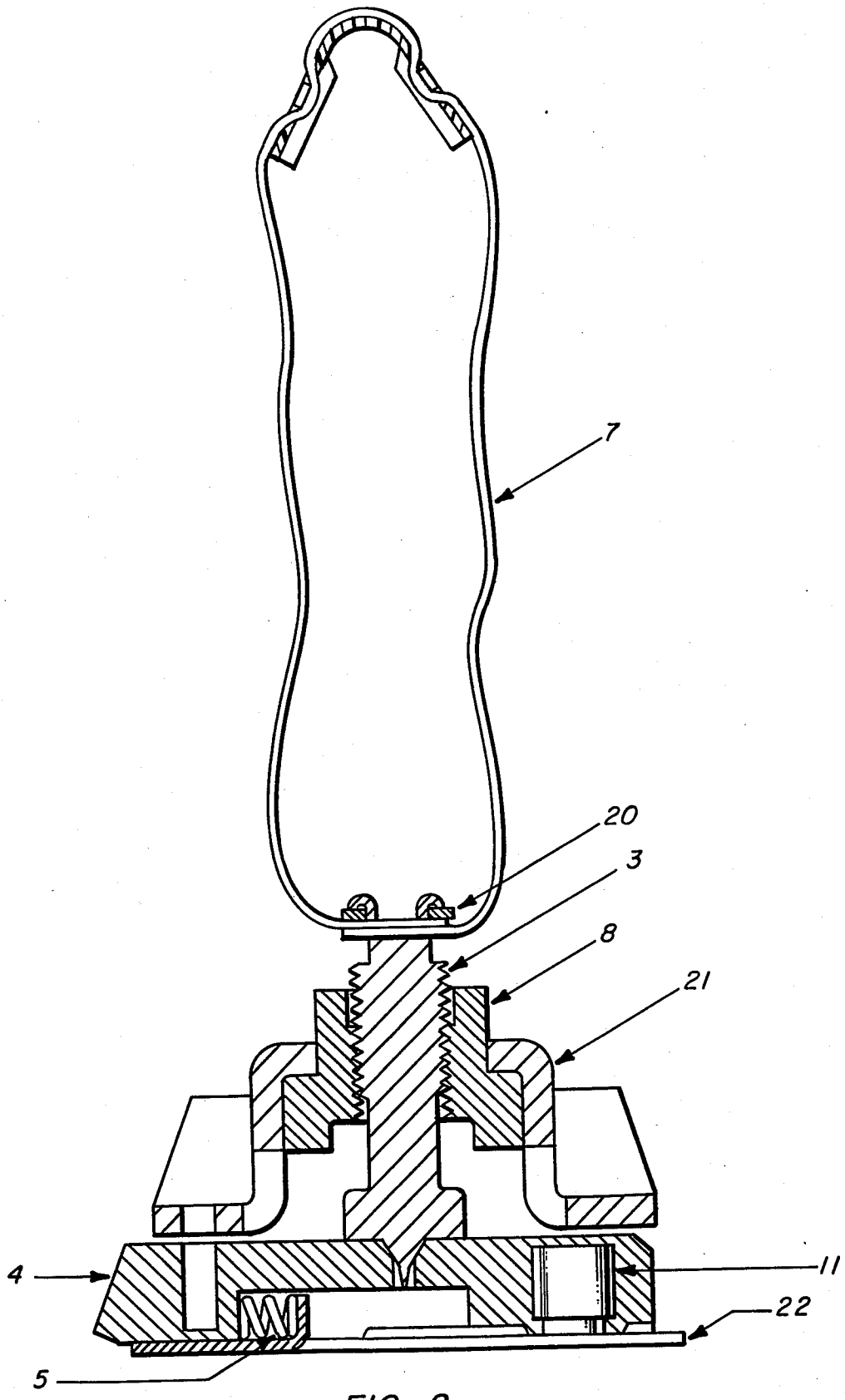


FIG. 2
FUZE

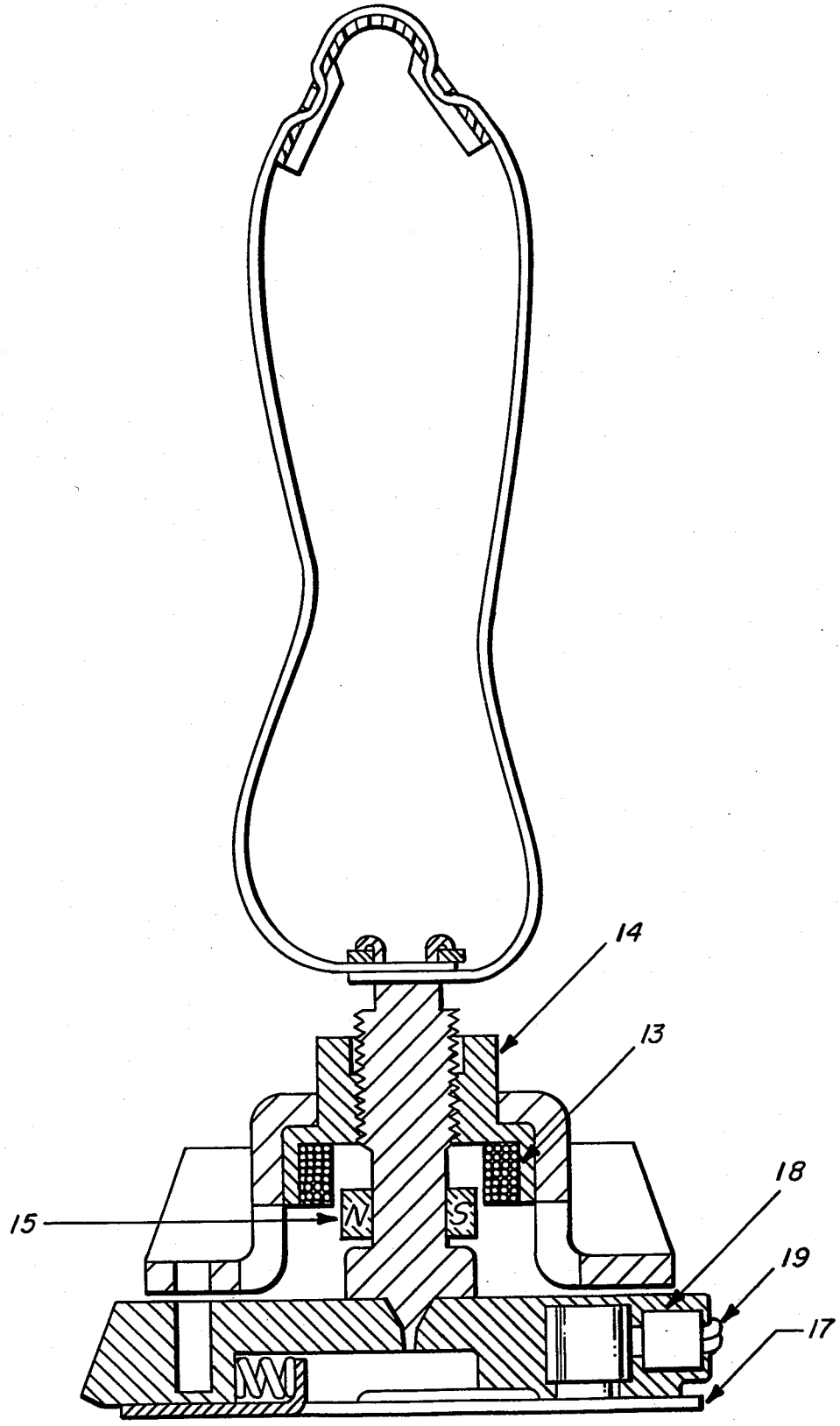


FIG. 3
MODIFIED FUZE

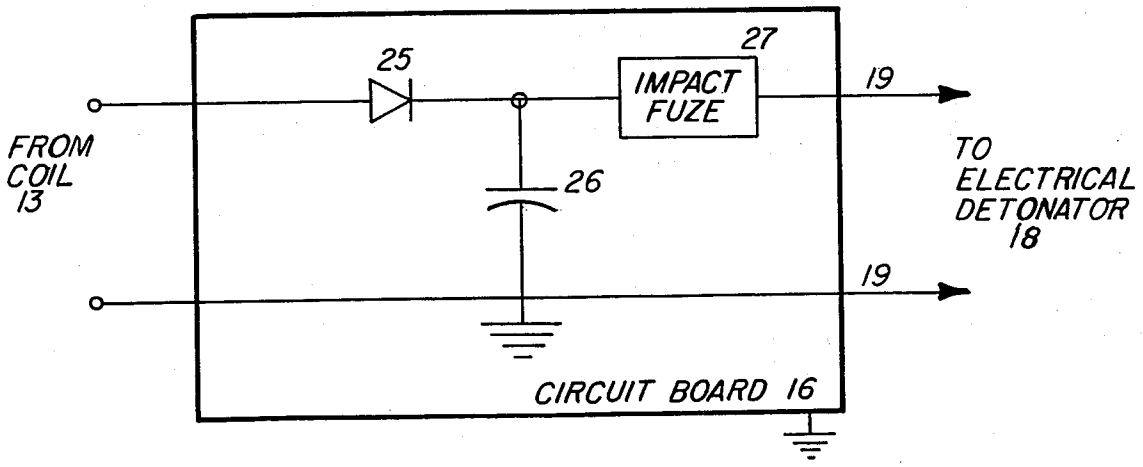


FIG. 5
ELECTRICAL DETONATION CIRCUIT BOARD 16

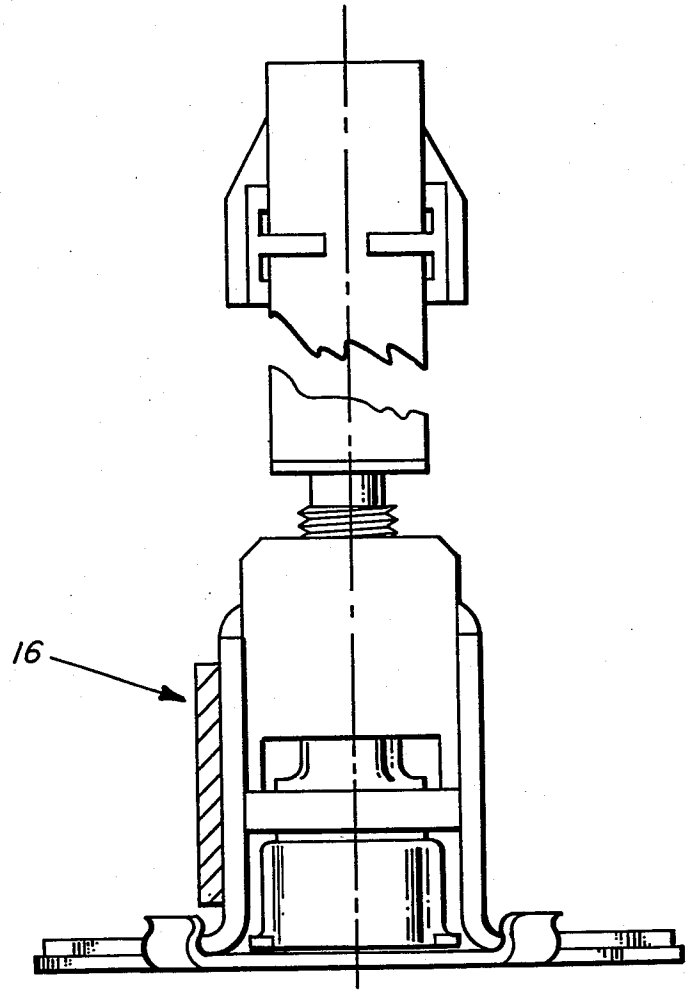


FIG. 4
MODIFIED FUZE ASSEMBLY

ELECTRICALLY DETONATED GRENADE

BACKGROUND AND FIELD OF THE INVENTION

This invention relates to the field of submunitions generally, and particularly to the field of grenade fuzes.

Grenades used by the various military services are basic items such as the U.S. Army's M42, M46, or XM77, and are generally armed with a standard fuze such as the M-223. The grenades may be carried in various quantities as submunitions in a variety of items of ammunition on a carrier which delivers them to a point above a target where they are ejected at various altitudes from the carrier by preset fuzing. The items, upon entering the airstream are still in a safe condition since the point of the arming screw is held fixed, preventing arming until the rotor of a trailing ribbon, which extends in flight, rotates enough to release it. In practice, a small percentage of the large number of grenades normally launched at a target area will fail to function as intended and will remain as duds dispersed in the field. The causes of such failures can range from complete failure to deploy the tape stiffener assembly to items which landed at such a flat angle that the component of the inertial force in the direction of the arming stem was insufficient to fire the item. Such items, when disturbed or handled, can function and represent a threat to friendly personnel. Entry into the infested zone is therefore hazardous and must await the time consuming clearing operations. In addition, trained enemy personnel may reclaim some portion of the duds and use them against friendly targets. Any improvement therefore in the elimination of grenade fuze duds, is an object of great usefulness to this field.

BRIEF SUMMARY OF THE INVENTION

These, and other difficulties are overcome by the provision of an electrical backup system which will function to detonate the said grenade, when the ordinary mechanical system which usually arms and also operates the detonator on impact with the target, fails to do so. An electrically operated detonator, placed near the main charge, blows the grenade when a large voltage is applied to it. The voltage is only fed to the said detonator upon the closing of an impact switch, which is activated upon a physical impact upon it at reaching the target. While the voltage might be stored in a battery, or loaded in a capacitor bank in advance, for dependability and economy, it is instead generated "on-board" by utilizing the twisting action of the generator to turn a generating device, here a wound coil within a magnetic field. The generated e.m.f., which is a.c., is half-wave rectified in a diode, then stored in a capacitor means for later discharge through the impact switch, to the mentioned detonator. The invention is envisioned for use as a self-destruct in artillery submissiles and multiple launch rocket warhead submissiles as well as for grenades as mentioned.

OBJECTS OF THE INVENTION

Accordingly, it is one object of this invention to provide a means of lessening or eliminating the amount of

dud grenades dropped over a target area, for safety sake.

Another object of this invention is to provide a more efficient detonating system for a grenade, to replace, or back up the mechanical safety-arming system.

A still further objective of this invention is to advance the art of electrical, versus mechanical detonation of submunition devices, particularly for miniaturizing such systems for inclusion in grenade devices.

Other objects and advantages of this invention will become apparent from a reading of the attached specification and drawings, in which:

LIST OF FIGURES

FIG. **1** shows a grenade device which includes a mechanically activated fuze device;

FIG. **2** shows a more detailed view of a safety and arming, fuze device;

FIG. **3** shows an improved fuze device including electrical generation and detonation means according to this invention;

FIG. **4** shows an assembly of the electrically improved fuze in position on the grenade; and

FIG. **5** shows an electrical detonation circuit for the improved fuze, according to this invention.

DETAILED DESCRIPTION OF THE FIGURES

In FIG. **1**, there is shown a grenade, which is armed by a fuze (**2**), which is shown in greater detail in FIG. **2**. Such grenades as mentioned earlier may be carried airborne in various quantities as submunitions in a variety of items of ammunition. The carrier delivers them to a point above the target where they are ejected at various altitudes from the carriers by preset fuzing. The items, upon entering the airstream are still in a safe condition since, as shown by FIG. **2**, the point of the arming screw (**3**) interferes with movement of the slider assembly (**4**) to the armed position under the action of centrifugal force and the arming spring (**5**). This keeps the detonator (**11**) out of line with the arming screw and the lead assembly (**9**) (shown in FIG. **1**). In normal action, the air stream at this point deploys the folded tape stiffener assembly (**6**) as shown in FIG. **1**, which is securely attached to the arming stem. On being fully extended, the tape stiffener assembly, deploys loosely as a loop (**7**), shown in FIG. **2**, and acts to stabilize the grenade during its descent; it also is retarded with regard to rotation, establishing a relative rotation between tape and grenade. This causes the arming screw (**3**) to unscrew from the weight (**8**). When the threads have become thus disengaged, the arming screw releases the slider assembly (**4**) to move to the armed position with the detonator in line under the firing point of the arming screw and in position above the lead charge (**12**) in the grenade body loading assembly (**10**). The arming screw continues free-wheeling rotation under the action of the tape stiffener assembly. On impact, inertia drives the arming screw-weight combination forward; this occurs with sufficient energy to initiate the detonator (**11**). This, in turn, fires the lead charge and the main explosive charge (**12**) in the grenade body loading assembly which completes the mission of the grenade as munition.

In FIG. **3**, an improved fuze is shown, which is based on the principle of using the relative spinning motion between arming screw and weight described above to generate an electromotive force when the grenade descends after expulsion from the carrier. This is achieved

by installing a coil (13) in a modified version of the weight (14) and a magnet (15) which rotates with the arming screw. The combination of rotating coil in a magnetic field generates the required e.m.f. In a small circuit board (16) attached to the fuze housing (21 in FIG. 2), illustrated in the FIG. 4 assembly, is found a basic circuit (FIG. 5) for conditioning the generated e.m.f. signal for later use in detonating the grenade, to be explained below. The slide assembly (17) shown in FIG. 3 is modified by extending its length sufficiently so that a low energy electric detonator (18) may be inserted and secured. Its output charge is in proximity of, and aimed at, the detonator (11) shown in FIG. 2. The leads of the detonator (19) are connected to the output terminals of the circuit board. To incorporate the new miniature alternator, modifications are needed to the weight, the arming screw and the housing, as illustrated in the sketch. Also, it is contemplated to incorporate a rotor into the ribbon of the submunition to assure proper rotation even when the submunition is fired as the cargo of an non-rotating projectile.

In FIG. 5, a basic circuit for conditioning the said generated e.m.f. signal of coil (13) is shown. A diode 25 function to half-rectify the incoming signal, whilst a capacitor bank 26 functions to store up to an ever increasing charge, the signal that passes out of the rectifier, such charge released by impact fuze 27, out through lines 19 to electrical detonator 18 which is illustrated in relation to FIG. 3. The impact fuze is explained as a physical device which closes a circuit upon physical impact of the grenade with the target; it might be a device which closes the circuit when it is physically crushed, bringing certain elements into electical contact; though other types of such switches might be used. As presently envisioned the electronic printed circuit board would contain in addition to the diode (to rectify the ac output of the alternator), and the firing capacitor (to store the electrical energy necessary to function an electric detonator), also a resistor (to bleed charge off the capacitor should the alternator cease operating) and a trembler switch of some type (to discharge the first capacitor into the electric detonator) and a switching transistor to assure full delivery of capacitor energy to the detonator 18. If the fuze functions as intended via its kinetic energy system, i.e., mechanically as in the operation of FIG. 2 for example, even though the capacitor 26 will charge up and on impact, the impact switch 27 will fuction the electric detonator, yet this detonation action would become superfluous. However, if the fuze arms, then arming spring 5 slides 4 against 11, but the kinetic energy system (weight 21 striking detonator 11) fails to function, then electric detonator 18 will at least ignite detonator 11 (as in FIG. 2) thus either propagating to the lead and main charge, or removing all primary explosive from the "duds" by destroying detonator 11, hence the concept of an electrical system as a backup. If the tape stiffener assembly (6) functions as intended, but the slide assembly (4) fails to aove to the armed position, the electric detonator will function to blow the detonator (11) and thus rid this otherwise resulting dud of all primary explosives, making it safe to handle. However, if the ribbon (7) never deploys, the slide assembly (4) will keep detonator (11) out of line and there will be no rotation to charge the condenser; both detonators will fail to function. However, duds will still be safe to handle since they are not even armed. armed. Another possibility for the grenade is to simply replace detonator (11) with an electric detonator entirely and use the system described above alone to generate electrical energy to fire detonator (11) by way of (18). The electrical system herein is believed far more sensitive in fact than the current kinetic system, and will thus reduce the number of duds resulting from grenades impacting at too shallow an angle.

While the invention may have been described with respect to a particular embodiment or embodiments, other modifications and substitutions possible within the scope of the invention, as will occur to those skilled in the art, are also included herein in this invention.

What is claimed is:

1. An electrical fuze for use in detonating a grenade which includes a main charge and a rotating ribbon for arming the grenade, said fuze comprising:
   - means for generating an electromotive force signal by the turning action of said rotating ribbon;
   - means for electrically rectifying said electromotive force signal into a rectified signal;
   - means for electrically storing said rectified signal to form a direct-current voltage source;
   - electrical means for setting off said main charge in response to a detonation voltage;
   - means for conveying voltage from said direct-current voltage source to said electrical means to initiate detonating, said means for conveying comprising a circuit closing means in series therewith which closing means only permits conveyance of said voltage when in its closed position, said closing means operative to enter its closed position upon an impact of said grenade with a ground area.

2. A fuze as in claim 1 wherein said means for generating a signal includes a spinning, wound coil placed within a magnetic field.

3. A fuze as in claim 2 wherein said elecrical circuit means comprises a half-wave rectifying diode in series with a capacitance bank.

4. A fuze as in claim 3 wherein said switch means comprises an impact fuze.

5. A fuze as in claim 4 wherein said magnetic field is produced by symmetrically placing opposite polarity magnets on a rotor attached to said rotating ribbon and rotating same within the hollow of said wound coil, coaxial to the longitudinal axis thereof.

6. A fuze as in claim 5 wherein said wound coil is a spool of wire whose longitudinal axis is coaxial to that of said rotating ribbon rotor.

* * * * *