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Apstein

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[54] **FUZE**

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[52] **U.S. Cl.** ..... **102/70.2 P;** 102/70.2 R

[51] **Int. Cl.** **F42c 13/00**

[58] **Field of Search** ..... 102/70.2, 70.2 P

[56] **References Cited**

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Attorney, Agent, or Firm—Nathan Edelberg; Robert P. Gibson; Saul Elbaum

EXEMPLARY CLAIM

1. In an explosive missle having an electrostatically charged nose and body members insulated from each other, an electrostatic fuze comprising a thyratron relaxation oscillator, the thyratron switch of said oscillator having grid, anode and cold-cathode members, said grid member connected to said nose, a detonator having a time delay switch normally closed on it in the cathode circuit of said oscillator, a capacitor in the anode circuit of the oscillator, a resistor and a second capacitor in series and shunted across the anode circuit, means for charging the said second capacitor upon firing the missile, said second capacitor discharging to cause the oscillator to initially function for a predetermined period of time, said switch opening at the termination of the initial period of time, said missle upon close proximity to the target causing a positive charge to be impressed upon the grid whereupon said oscillator again oscillates and cathode current passes through the detonator to detonate said missile.

3 Claims, 3 Drawing Figures

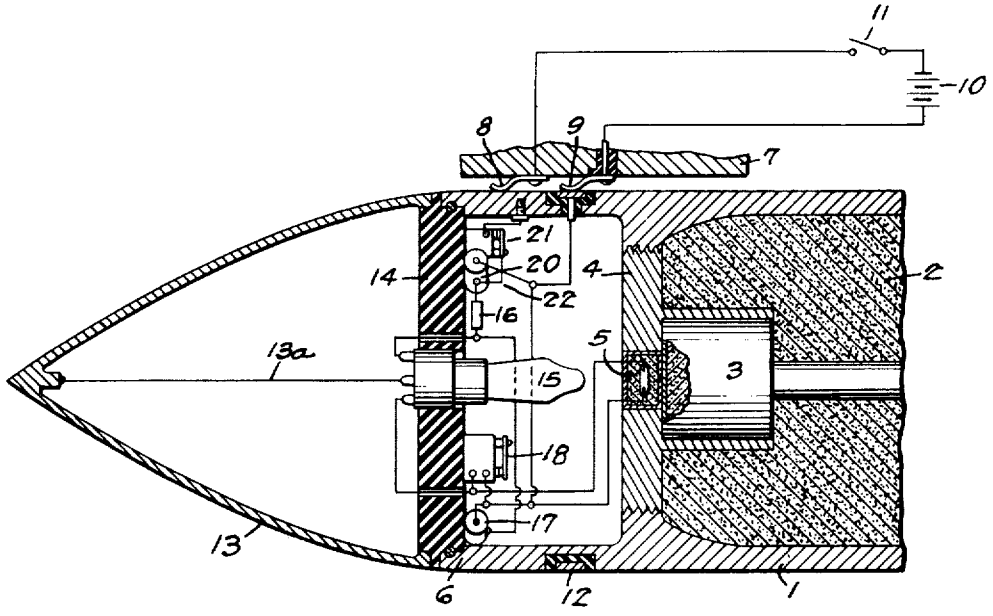


Fig. 1.

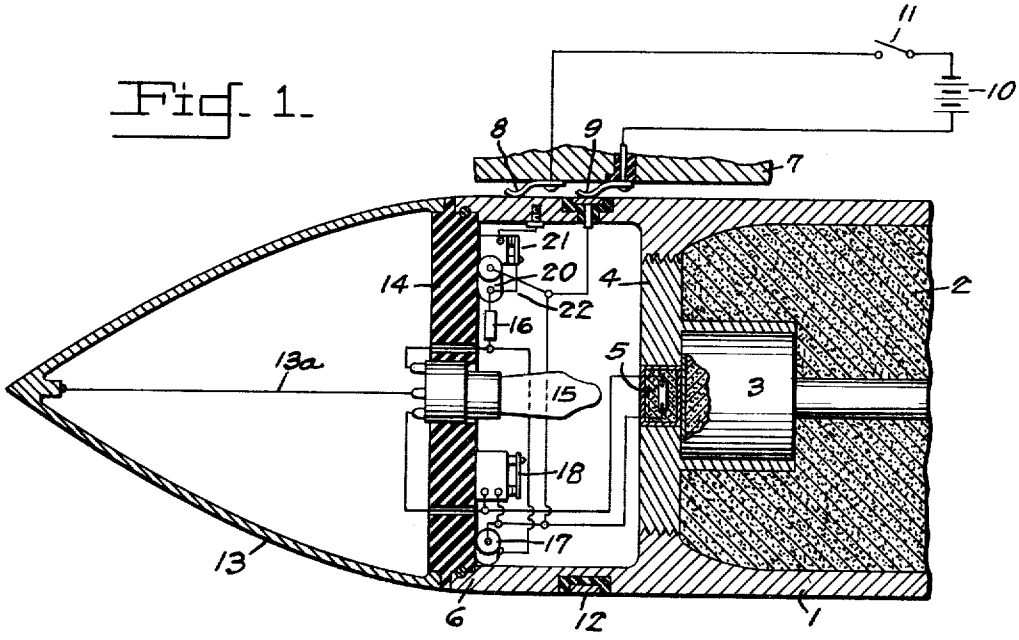


Fig. 2.

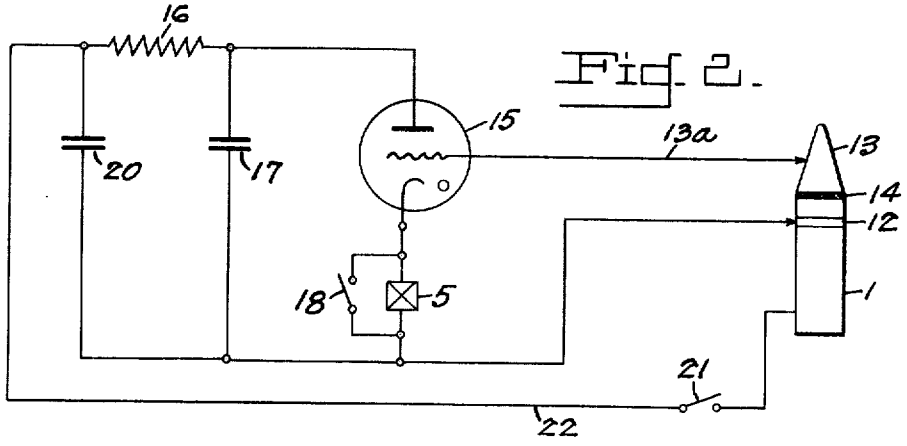
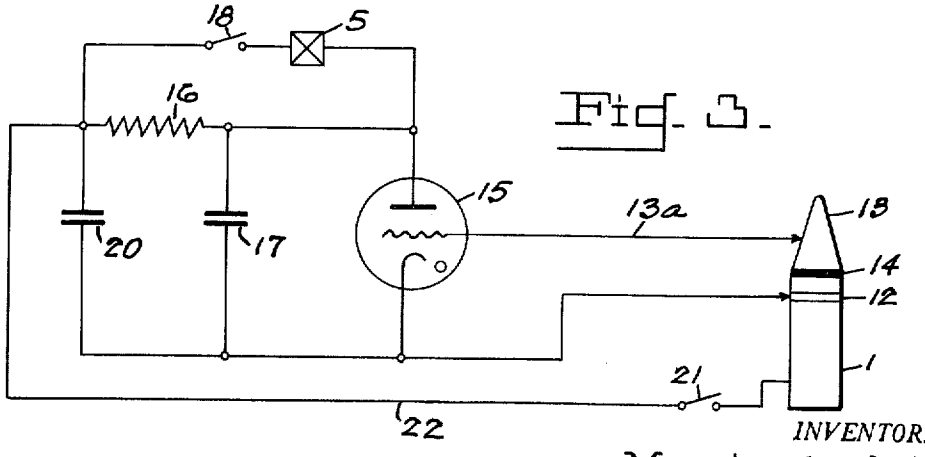


Fig. 3.



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FUZE

The invention relates to electrostatic fuzes for explosive missiles and more particularly to a capacitor powered electrostatic fuze having means incorporated therein whereby the fuze is self-setting to a point of maximum sensitivity.

One object of the invention is an electrostatic fuze employing a cold-cathode thyratron as a sawtooth generator having means arranged to charge the tank capacitor to the firing potential of the thyratron during a predetermined period after the missile or projectile to which the fuze is fixed is under way.

Another object of the invention is a novel means whereby the electrostatic fuze of the invention is charged at the moment the missile is released or the projectile fired.

Another object of the invention is an electrostatic fuze having controlled arming and controlled sensitivity.

Another object of the invention is an electrostatic fuze requiring but relatively low value of charge and simple circuitry.

Another object of the invention is an electrostatic fuze that is readily adopted to mass production methods.

The specific nature of the invention as well as other objects and advantages thereof will clearly appear from the following description and accompanying drawings in which:

FIG. **1** is a longitudinal sectional view of one embodiment of the electrostatic fuze of the invention.

FIG. **2** is a schematic diagram of the fuze illustrated in FIG. **1.**

FIG. **3** is a schematic diagram of the fuze showing an alternative arrangement for firing the detonator.

Referring to the drawings the numeral **1** designates the body of a projectile containing an explosive charge **2** and a booster unit **3** set in the charge. A closure member **4** spaced from the open end **6** of the projectile, and fixed therein, carries a detonator **5** which is in intimate contact with the booster. The projector tube or gun barrel indicated by reference numeral **7,** has fixed in its interior wall two contacts **8** and **9** connected in series with a battery **10** and switch **11.** The contact **9** is insulated from the wall of tube **7** and positioned to register with the conducting ring **12** fixed in the peripheral surface of the projectile and insulated therefrom. Contact **8** makes direct contact with the projectile. The nose **13,** comprising the antenna of the fuze, is fixed in the open end of the body **1** and is insulated therefrom by means of a disk **14** which forms in conjunction with disk **4** a sealed compartment housing the electronic components of the fuze. These components may be mounted on disk **14** or held in position in the compartment by means of a potting compound.

In the schematic diagram shown in FIG. **2,** a thyratron relaxation oscillator comprises a cold-cathode, three element thyration **15** and an r-c network as indicated by reference numerals **16** and **17.** The antenna **13** is connected to the grid of the thyration by means of a lead **13a.** A detonator **5** is connected in series with the cathode and has a setback operated arming delay switch **18** normally closed on it. The charge capacitor **20,** forming the power supply of the fuze, is shunted across the r-c network. A setback operated switch **21** is connected in series with the lead **22** which connects

one side of the capacitor **20** to the projectile **1** and is normally held in closed position. The purpose of switch **21** is to open on setback to to prevent charging of capacitor **20** by the electrostatic charge placed on the projectile during the firing period.

When the missile or projectile is readied for firing, the switch **11** is closed and a d-c voltage is applied to the contacts **8** and **9** to charge capacitor **20** which in turn charges the capacitor **17** through the resistor **16.** The voltage on capacitor **17** builds up slowly following an r-c charge curve to the striking voltage of the thyratron **15.** Also during the firing period an electrostatic charge is placed on the projectile by the ionized gases of the propelling charge or by some other convenient means. It will be understood that the charge placed on the projectile may be chosen to have a polarity such that when the projectile comes within close proximity of a target, a positive voltage is applied to the grid of the thyratron. It has been found that placing a positive charge on the projectile produces the desired positive voltage on the grid at close target proximity. Upon setback, switch **21** opens to prevent charging of the capacitor **20** by the electrostatic charge on the projectile. The arming switch **18** which is normally closed across the detonator **5,** is opened by means of a conventional timer, not shown, after the voltage of capacitor **17** has been reduced to below the firing value of the thyratron **15** which causes the relaxation oscillator to cease oscillating. At this point in time the fuze is fully armed and is at its maximum sensitivity since any positive bias applied to the grid of the thyratron will cause the thyratron to become conductive. When the missile is within a predetermined proximity of the target, the electrostatic charge on the missile is disturbed causing a positive charge to be placed on the grid of the thyratron, which lowers the firing potential value of the thyratron. The relaxation oscillator then goes into oscillation again, and again the capacitor **17** discharges through the anode and cathode circuits of the oscillator, causing a current to flow through the cathode circuit and function the detonator **5** in the cathode circuit.

In the fuze circuit shown in FIG. **2,** the value of capacitor **17** may be chosen as a result of a compromise. That is, it may be a value which will give the desired time delay, but not necessarily the optimum value to operate the detonator **5,** for which a capacitor of greater capacity might be more desirable in connection with certain detonators. Therefore, the circuit of FIG. **2** has been modified as shown in FIG. **3.** The various components are distinguished as shown in the preceding figure, but their arrangement has been altered to permit capacitor **17** to serve merely to render the thyratron **15** conductive, while the firing current for the detonator **5** is drawn from the charge capacitor **20.** The arming switch **18** has been placed in series with the detonator **5.** The operation of the circuit is identical with that of the preceding circuit except that when approach to a target has caused a decrease in the firing voltage characteristic of the thyratron **15,** the energy stored in capacitor **17** passes only through the anode-cathode circuit of the thyratron causing the thyratron to fire. When the thyratron fires the capacitor **20** discharges through the detonator and thyratron causing the fuze to function. Switch **18** is closed by a timer, not shown, after the oscillator has ceased its initial oscillating state.

I claim:

1. In an explosive missile having an electrostatically charged nose and body members insulated from each other, an electrostatic fuze comprising a thyratron relaxation oscillator, the thyratron switch of said oscillator having grid, anode and cold-cathode members, said grid member connected to said nose, a detonator having a time delay switch normally closed on it in the cathode circuit of said oscillator, a capacitor in the anode circuit of the oscillator, a resistor and a second capacitor in series and shunted across the anode circuit, means for charging the said second capacitor upon firing the missile, said second capacitor discharging to cause the oscillator to initially function for a predetermined period of time, said switch opening at the termination of the initial period of time, said missile upon close proximity to the target causing a positive charge to be impressed upon the grid whereupon said oscillator again oscillates and cathode current passes through the detonator to detonate said missile.

2. In an explosive missile having an electrostatically charged nose and body members insulated from each other, an electrostatic fuze comprising a thyratron relaxation oscillator, the thyratron switch of said oscillator having grid, anode and cold-cathode members, said grid member connected to said nose, a capacitor in the anode circuit of the oscillator, a resistor and a second capacitor in series and shunted across the anode circuit, means for charging the said second capacitor upon firing of the missile, said second capacitor discharging to cause the oscillator to initially function for a predetermined period of time, a time delay switch and detonator series connected between the second capacitor and anode, the time delay switch closing after said predetermined period of time has elapsed, said oscillator again functioning due to target influence upon said missile whereupon anode current passes through the detonator to detonate said missile.

3. In combination with an explosive missile, an electrostatic fuze comprising a thyratron having anode, cathode and grid elements, a nose insulated from the body of said missile and serving as the antenna of said electrostatic fuze, said nose being electrically connected to said grid, said nose having an electrostatic charge placed thereon during the firing period of said missile, means for maintaining a potential between said anode and cathode of said thyratron nearly equal to the firing potential of said thyratron, said potential being sufficiently below said firing potential to prevent firing of said thyratron, and means responsive to the firing of said thyratron for detonating said missile, said thyratron being adapted to fire in response to the positive charge that is impressed on said grid when said nose comes within close proximity of a target.

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