June 30, 1970 D. K. TOWER ET AL 3,517,618

ELECTRIC "POINT BLANK" BOMB FUZE

Filed April 19, 1960 3 Sheets-Sheet 1

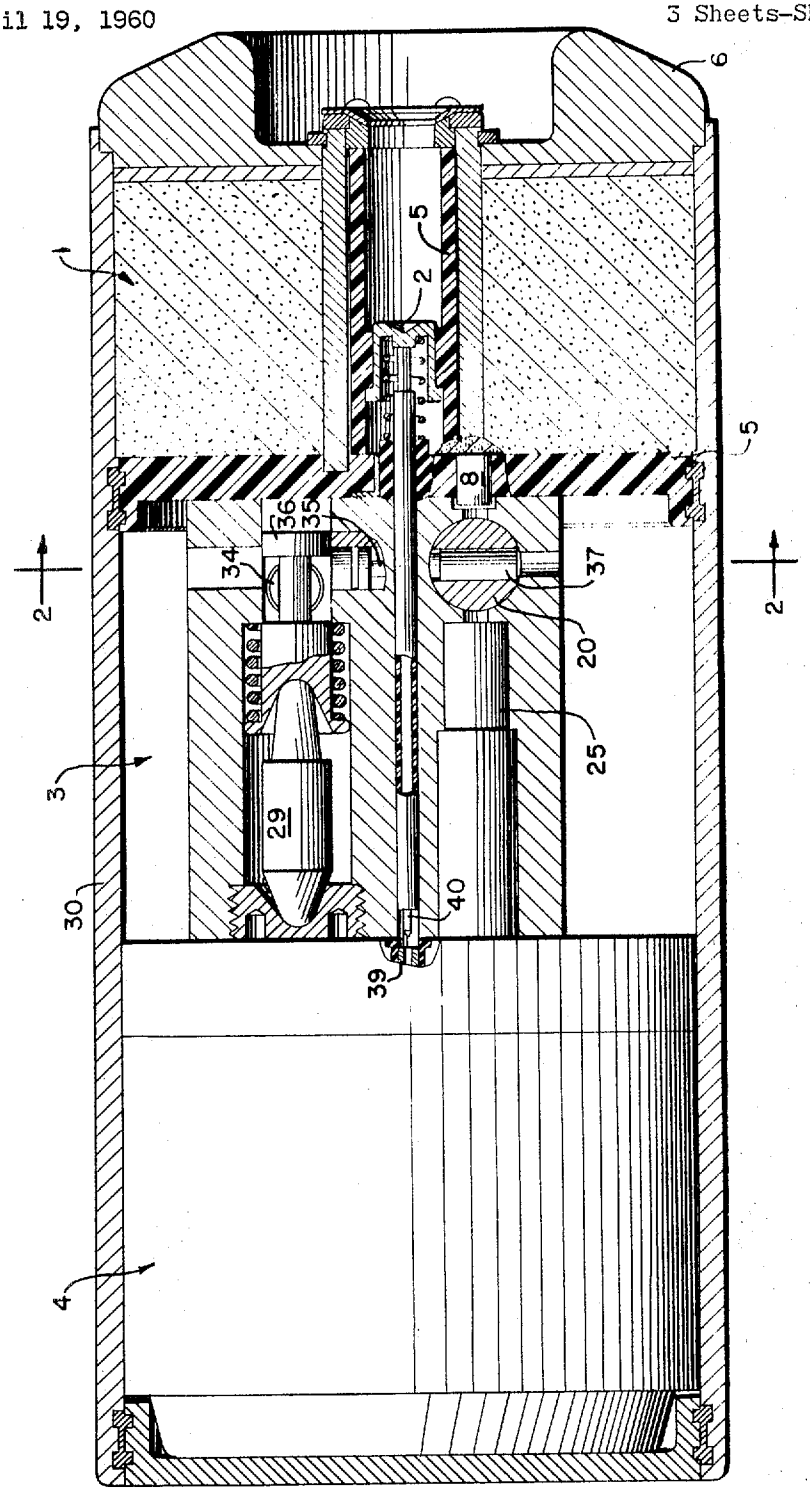

FIG. 1.

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Filed April 19, 1960 3 Sheets-Sheet 2

FIG.3.

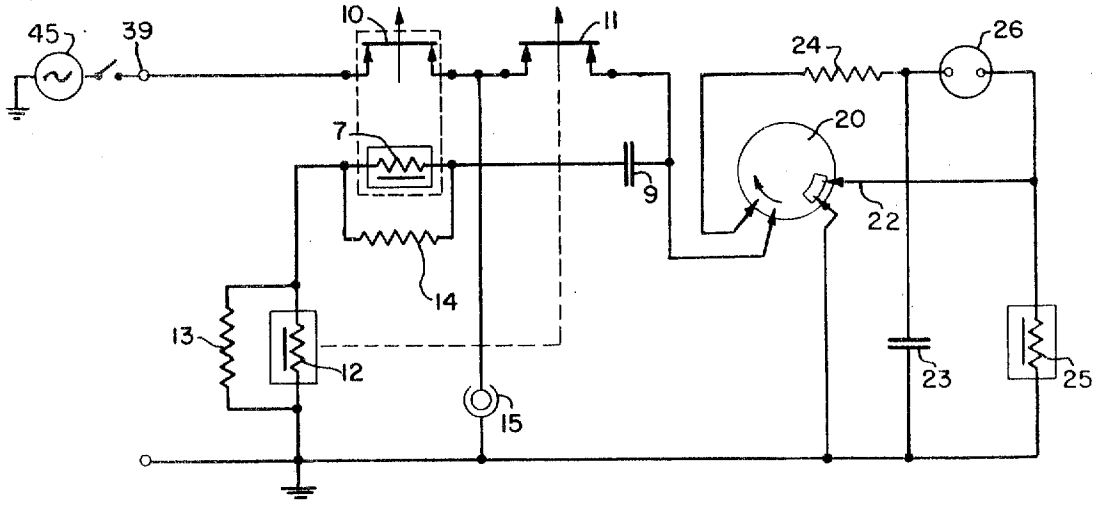
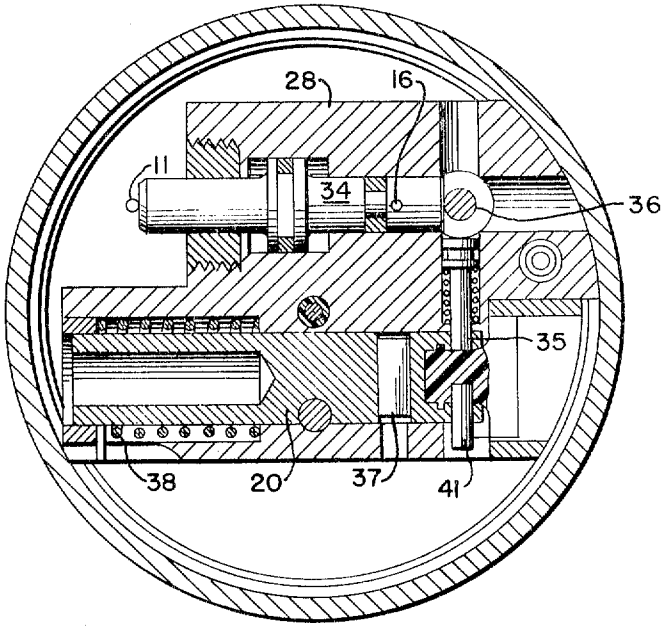


FIG.2.



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Filed April 19, 1960 3 Sheets-Sheet 3

FIG.4.

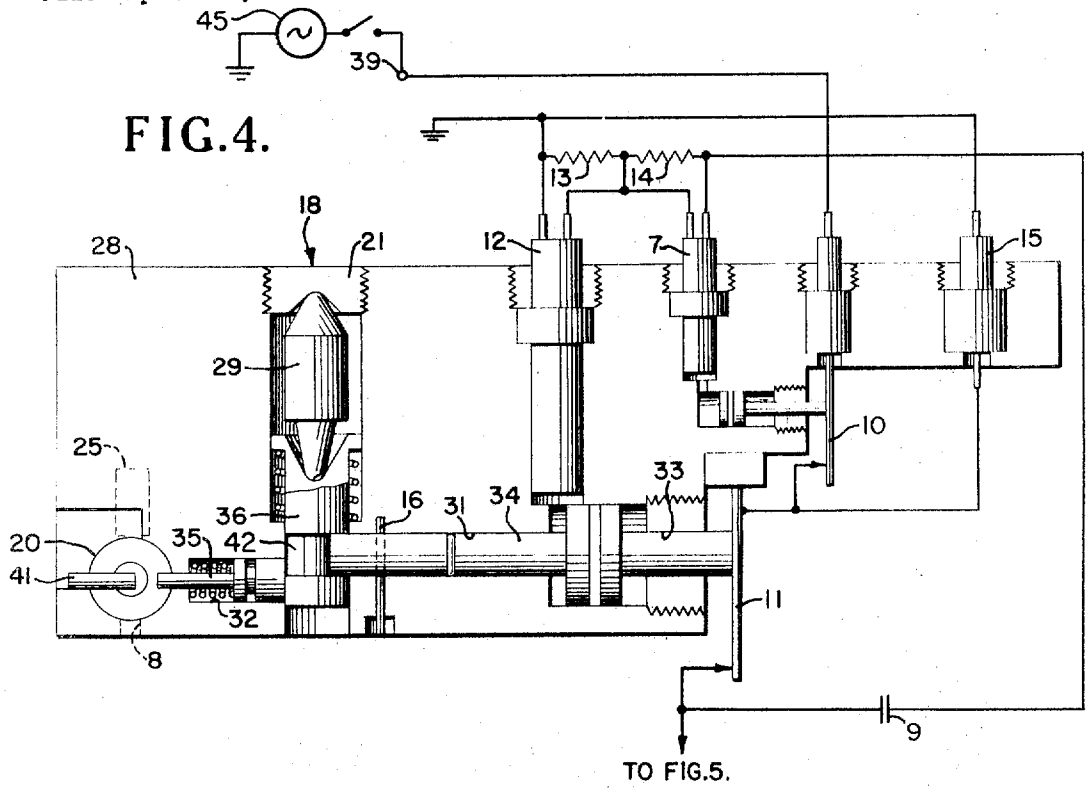
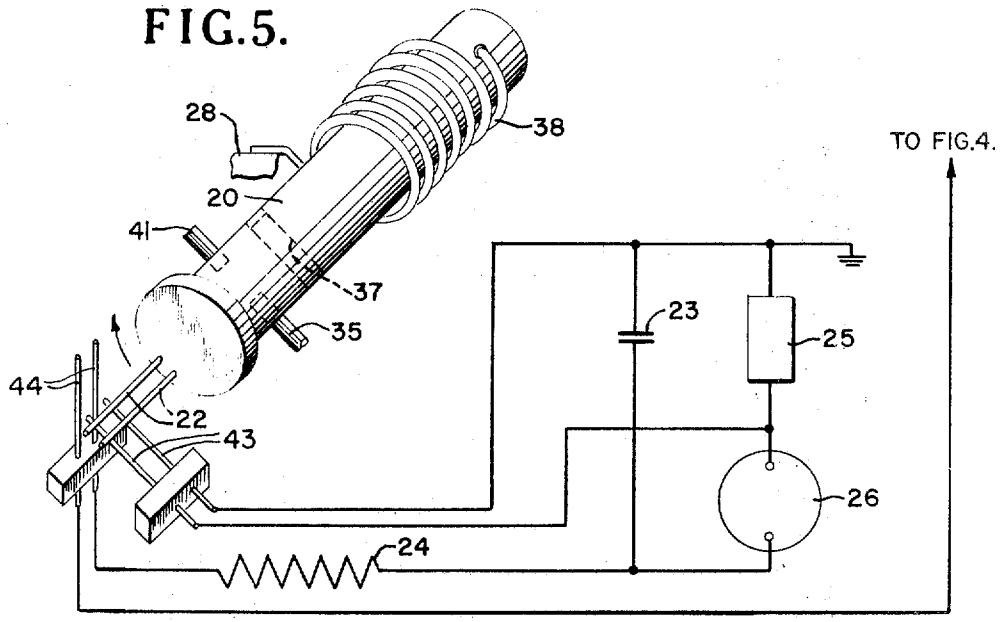


FIG.5.



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ELECTRIC "POINT BLANK" BOMB FUZE

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U.S. Cl. 102—70.2 4 Claims

ABSTRACT OF THE DISCLOSURE

An electromechanical fuze for a bomb intended to fire upon impact with a target. The fuze includes a first time delay which will disable the bomb if the bomb makes any impact within a predetermined time after launch. If no impact contact occurs within the predetermined period, a pyrotechnic actuator releases a restrained inertia mass, rotates an arming rotor from its safed to armed position, and activates a time delay circuit to delay detonation of the bomb for a predetermined period after impact with a target.

This disclosure relates generally to electric bomb fuzes and more particularly to an electric bomb fuse adapted for tail mounting in low drag bombs. It is an object of this invention to provide a low drag bomb with sufficient time delay so that it may be utilized by a low flying plane.

It is a further object of this invention to provide a bomb having an electrical circuit with mechanical actuated movements.

Another object of this invention is to provide a bomb fuze with an arming device which is responsive to the movement of a restrained inertia mass upon impact of the bomb with a target from almost any angle.

It is still another object of this invention to provide a low drag bomb with a safety circuit for deenergizing the detonator if the bomb receives an impact within 2 seconds after launching.

Further objects and the entire scope of the invention will become further apparent in the following detailed description and in the appended claims. The accompanying drawings display the general construction and operational principles of the invention. It is to be understood, however, that said drawings are furnished only by way of illustration and not in limitation thereof. Like reference numerals in the several drawings refer to like or similar parts.

In the drawings:

FIG. 1 discloses a preferred embodiment of the detonating fuze and the housing therefor;

FIG. 2 is a detailed section view taken along line 2—2 of FIG. 1;

FIG. 3 is a schematic view of the electrical wiring circuit of the invention;

FIG. 4 discloses the initiating circuit of the invention in the form of a block diagram with its several component parts; and

FIG. 5 discloses a schematic view of the firing circuit and its connecting means with the initiating circuit of FIG. 4.

Referring now to FIG. 1, the fuze herein described is comprised of three main sections and a container therefor. 1 on the drawing designates the explosive booster section of the complete fuze and includes a charging plug contact 2 located in and extended through a central cavity within the booster section. The second section indicated by numeral 3, contains the cooperating mechanical parts

of the fuze. The electrical circuitry for the fuze is arranged in the third section, as is indicated in the drawing by numeral 4. The three sections are so formed as to be readily received in a cylinder-like container 30 having a separator 5 for separating sections 1 and 3 and a cap for the end closure 6. The insulating separator 5, in addition to providing an insulated hermetic seal for charging plug contact 2 also contains an explosive lead 8 which transfers the explosive wave initiated by the primer and detonator contained in Section 3, when properly aligned, into the explosive booster section 1 which detonates the bomb.

The operation of the fuze is based on mechanical actuator movements as well as electrical circuitry as will be more fully described herein. Referring now to FIG. 3, the electrical circuitry of the fuze will be described. When the bomb is launched from the aircraft, a 300 volt charge is received by contact 39 from the electrical system 45 of the aircraft by means of an insertable contact, not shown. The electrical circuit is completed by pushing through insulated conducting rod 40 and plug contact 2 into electrical contact with contact 39 imparting a voltage charge on capacitor 9 through a series circuit containing switches 10, 11 and the bridges of pyrotechnic actuator 12 and actuator 7. The bridges of actuator 12 and the actuator 7 are shunted by resistors 13 and 14 respectively. The purpose of these resistors is to insure that the capacitor 9 will receive a full charge whether or not the initiating bridges 12 and 7 have burned open. The actuator 12 has an explosive delay of two seconds, while the switch 10 has an explosive delay in the order of 50 milliseconds. Thus switch 10 is open in 50 milliseconds after launching and isolates the circuitry of the fuze per se from the charging cable and prevents any leakage through the cable and its connections from reducing the charge on capacitor 9. However, switch 11 is not opened until 2 seconds have expired after launching and, should the bomb receive any impact during this 2 second delay period of actuator 12, the fuze will be sterilized through the closure of the impact actuated switch 15 which, in turn, will drain the charge from capacitor 9. If no impact is received by the bomb within 2 second after launching, switch 11 is opened by the operation of actuator 12 and the impact switch 15 thus is isolated from the circuitry of the fuze.

At the time actuator 12 is operated the hot gas pressure operating on member 34 opens switch 11. This mechanical movement shears the wire 16, FIG. 4, and removes a physical block 34 from the path of movement of an inertia mass arming device 18 which consists of elements 21, 29 and 36 to be described in more complete detail hereinafter. Any subsequent impact experienced by the bomb causes deceleration forces to act on the inertia mass arming device 18 and sufficient movement thereof releases a detent 35 allowing a spring driven out-of-line arming rotor 20 to rotate into an armed position and restrained there by blocking element 41 resting against body 28. The supporting or restraining means 21 and 36 of the inertia mass 29 are each provided with a tapered recess which coacts with tapered portions of mass 29 and any movement of mass 29 from the position as shown in the drawing causes a movement of element 36 in one direction only. This design provides essentially equal arming action for impacts at all angles within an arc of 180°. The arming sensitivity of the design for angles greater than this, while theoretically possible, is somewhat reduced.

As shown in FIG. 5 the spring driven arming rotor 20 is turned by spring 38 to the armed position as a result of an impact experienced more than 2 seconds after the bomb has been launched. As the rotor 20 is rotated electrical

contact member 22 carried by the rotor 20 will connect capacitor 9 to capacitor 23 through resistor 24 by shorting contacts 44 and will interrupt a short circuit across the primer 25 by removing the short across contacts 43. The capacitor, resistor, capacitor network, 9, 24, 23, respectively preferably is arranged to give approximately a 5 minute delay before the voltage will rise high enough on capacitor 23 to break down voltage-sensitive diode 26 and fire the primer 25. The object of this delay is to allow aircraft to plant bombs in several waves from a low altitude and escape before fragments are thrown into the air.

The electrical circuitry in section 4 of the fuze as shown in FIGS. 3, 4 and 5 preferably utilizes a printed circuit as part of its assembly, and contains all the circuit components including switch contacts for 10 and 11. Also, contact receptacles are provided for actuator 12, primer 25 and the charging contacts 22. This section, when the wiring has been completed, is potted in an epoxy compound (not shown).

The mechanical section 3 of the fuze as shown in FIG. 4 includes the body of actuator 12 and its interconnecting means with switch 11 and the arming rotor 20, the latter including the detontator 37 and operating contacts for switch 22; the inertia mass arming device 18; and primer 25.

Referring now to FIG. 4, a detailed explanation of the operation of the mechanical section of the fuze will be set forth. The body 28 of the section 3 of the block is bored as shown to accept the arming rotor 20, the inertia mass arming means 18, the arming means release detent 35 and switch actuator 12. Bores 31 and 33 interconnect the mass arming means release 34 and switch 11 contact operator. The bore 32 houses the arming rotor release detent 35.

As clearly shown on the drawing, the impact responsive inertia mass 29 of the mass arming means 18 is supported or restrained between smooth tapered surfaces of members 21 and 36. The top support 21 is fixed with regard to body 28 of section 3, and the lower support 36 which is spring loaded with regard to body 28 of section 3. The spring loaded support member 36, at the end remote from the inertia mass is provided with a circumferential recess 42, and this recess, in turn, accepts the mass arming means release 34 or the arming rotor release detent 35 depending upon the physical position of the movable member 36 with respect to the body 28.

During the foregoing description of the electrical circuit of FIG. 3, it was stated that at the time the actuator 12 was fired, a mechanical movement was set up in addition to the opening of switch 11. Referring again to FIG. 4, the firing of explosive actuator 12 produces a gas pressure operable against the piston of arming means release 34. This pressure results in the severing of the shear wire 16 and removes the blocking element 34 from the circumferential recess of member 36. It is at this point that the fuze according to this disclosure may be said to be armed since an impact within the aforesaid 180° arc which the bomb may hereafter receive will bring about an ultimate detonation. With the block imposed by release mechanism 34 removed from the circumferential recess 42 of element 36, the inertia mass 29 is unlocked, an impact will bring about a downward movement of the movable lower inertia mass support 36 which, in due course, will bring the circumferential recess 42 in line with the arming rotor release detent 35. When the release detent 35 is accepted into the recess of members 36, a lock is removed from the arming rotor 20 and this rotor will be rotated 90° by its driving spring 38 from the out-of-line position of the detonator 37 carried thereby to an in-line or armed position. At this point in the sequence of operations, the mechanical movements have been completed and the electrical circuitry once more takes over since the rotation of the arming rotor also has changed the contacts and circuitry through switch 22

in the manner heretofore described to cause condenser 23 to be charged sufficiently to fire the primer 25.

With the detonator 37 within the arming rotor 20 in its in-line position, the primer 25 will fire into the detonator carried within the rotor 20, and that in turn, will fire through the explosive lead 8 mounted within the separator between the mechanical section 3, and into the booster section 1, and set off a charge in that latter section to fire the bomb.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within a scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A fuze of a bomb comprising a first electrical circuit means for receiving a high voltage charge, electrical means for providing said high voltage charge, a mass arming means, a second electrical circuit means and an explosive element means; said first electrical circuit means including a first and second switch in series with an energy storage means for storing said charge; said mass arming means including an inertia mass held in place by a spring biased support having a circumferential recess on the one end thereof, a spring biased rotor, a normally open switch, a spring biased detent means normally holding said spring biased rotor in an initial unarmed position until said detent means moves a predetermined distance, a detonator normally held in an out-of-line position in said spring biased rotor, said inertia mass in response to an impact depressing said spring biased support thereby aligning the circumferential recess sufficiently with said detent means so that the detent means enters the said recess said predetermined distance to release the spring biased rotor means from its normal position, said rotor means being rotated ninety degrees by its biasing spring thereby to close said normally open switch and rotate said detonator to an armed position, means on said rotor for closing said normally open switch, said normally open switch electrically connecting said first circuit means with said second circuit means, said second electrical circuit means including a second energy storage means, a series connected electroresponsive primer and a voltage sensitive element connected in parallel with said second energy storage means, said first energy storing means supplying energy to said second energy storing means until said voltage responsive element begins to conduct and thereby energizes said electroresponsive element; booster means including an explosive element and an explosive lead; said explosive lead connecting the said detonator to said explosive element whereby the explosive element will be detonated when the electroresponsive primer actives the detonator.

2. A fuze as recited in claim 1 wherein said first electrical circuit means comprises a series circuit including a first switch actuator for said first switch, a second switch actuator for said second switch, each of said switch actuators having a resistor in parallel therewith; an impact switch connected between said first and second switches in a manner to shunt the voltage stored by said energy storing means, a charging voltage fed into said electrical circuit means thereby charging said energy storing means, said first switch actuator being actuated a first predetermined period of time after application of said charging voltage thereby opening said first switch and interrupting the circuitry of the fuze, said second switch actuator being actuated a second predetermined time that is longer than said first predetermined time after receiving said charging voltage thereby opening said second switch, said impact switch substantially shorting said electrical circuit means only if the fuze receives an impact of large magnitude prior to the opening of said second switch.

3. A fuze for a bomb comprising a high voltage source,

a first electrical circuit means for receiving a high voltage charge from said source, a mass arming means for allowing the fuze to arm upon impact, a detonator, a second electrical circuit means for actuating said detonator when energized; said first electrical circuit means including a first and second switch in series with an energy storage means for storing said charge; said mass arming means includes an inertia mass held in place by a spring biased support means, a circumferential recess located near one end of said support means, rod means normally located in said circumferential recess for keeping the mass arming means unarmed, a spring biased rotor means normally kept from turning by a spring biased detent means; the spring biased detent means located adjacent the circumferential recess and being of such size as to enter said circumferential recess when aligned therewith, said rotor means including said detonator normally held ninety degrees out of line; contact means mounted on said rotor means in a normally open position for making contact between said first and second circuit means; said rod means normally located in said circumferential recess of the support means being removed when said second switch is actuated by said charge to thereby arm said inertia mass means; upon impact the inertia mass depressing the spring biased support thereby aligning said circumferential recess with said detent means; said spring biased detent being forced into said recess a sufficient distance to thereby release said spring biased rotor means from its normal position, said rotor means being rotated ninety degrees by said spring biasing means thereby placing said detonator in an armed position and closing said normally open contacts electrically connecting said first circuit means and said second circuit means; said second circuit means being energized by the high voltage charge of said first circuit to thereby energize said detonator.

4. A fuze as recited in claim 1 wherein the said second electrical circuit means comprises a voltage storage means in parallel with a serially connected electroresponsive element and a voltage sensitive element, first contact means serially connected to said electroresponsive element and making contact with said rotor mounted contact means for normally maintaining the electroresponsive element in a shorted condition, second contact means connected in a manner such that when the rotor has been rotated ninety degrees said rotor mounted contact means is connected to said second contact means thereby connecting said second electrical circuit means to said first circuit means, said first energy storage means in said first circuit means energizing said second energy storage means upon closure of said second contact means until the voltage on the voltage sensitive element causes the said voltage sensitive element to conduct thereby energizing the electroresponsive element and activating the detonator whereby the explosive element is detonated by means of said explosive lead.

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102—76, 82