Sept. 5, 1961 H. E. RIJEHLEMANN 2,998,773

SELECTIVELY VARIABLE TIMING FUZE

Filed Oct. 15, 1954

FIG.1.

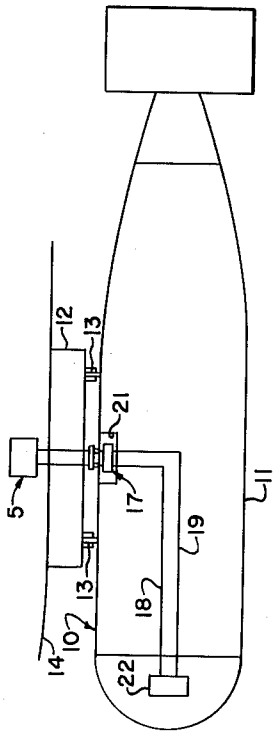
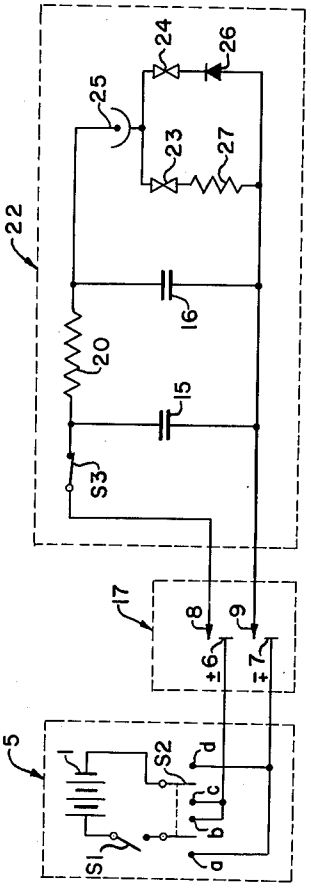


FIG.2.



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United States Patent Office 2,998,773
Patented Sept. 5, 1961

2,998,773

SELECTIVELY VARIABLE TIMING FUZE

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Filed Oct. 15, 1954, Ser. No. 463,078
9 Claims. (Cl. 102—70.2)
(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

The present invention relates to a bomb fuze and more particularly to a new and improved variable time detonating circuit arrangement wherein the instant of ignition is determined by the polarity of the charge applied to the detonating circuit.

Heretofore, in order to vary the time of detonation of fuzes, it has been customary to employ switches, or condensers charged from varying potential sources or an arrangement of cold cathode diodes having different breakdown voltages.

The present invention contemplates the provision of a new and improved electric fuze arrangement for a bomb in which are provided polarity selective charging means for selectively charging a storage device with an initial potential polarity condition as the bomb is released from the aircraft and a pair of polarity discriminating discharge circuits connected in parallel to the storage device through an impact switch whereupon the energy may be discharged through one of the discharge circuits on impact of the bomb with the target. One of the discharge circuits consists of a fast acting detonator connected in series with a rectifier which is poled to permit current flow through the detonator only for a current of a predetermined polarity. The other discriminating circuit contains a slow acting detonator through which current of either polarity may flow. Therefore, if the charging current applied to the storage device is of the same polarity as the polarity of the current passed by the rectifier, then the fast acting detonator is immediately electroresponsive to the discharge of the storage device upon closure of the impact switch and the fuze is instantaneously ignited. On the other hand, if the charging current is of opposite polarity, the rectifier presents a high impedance thereto and the current flows through the slow acting detonator which is in electroresponsive time delayed relation with closure of the impact switch thereby resulting in ignition of the fuze at a predetermined time after closure of the impact switch. In this manner, a bomb may be dropped which will detonate upon impact or at a predetermined time after impact, as determined by the selected polarity of the charge applied to the fuze circuit at the instant of release of the bomb.

An object of the present invention is to provide a new and improved electric fuze arrangement for use in a bomb.

Another object of the invention is to provide a bomb fuze selectively adaptable to be detonated instantaneously upon impact of the bomb with a target or detonated in time delayed relation with respect to the instant of impact of the bomb with the target.

A further object of the invention is the provision of an electric fuze wherein means are provided for selectively enabling the instantaneous detonation of the fuze upon impact or for a time delayed detonation after the instant of impact in accordance with the selected polarity of the energizing potential applied to the fuze.

Another further object is to provide in a fuze circuit a potential polarity discriminating detonating arrangement.

A still further object of the invention is the provision

in a fuze circuit of a polarity discriminating detonating circuit arrangement wherein the time of detonation is determined by the polarity of the current applied to the polarity discriminating circuit.

Still another object is to provide a polarity selective charging means for charging a storage device with a potential of pre-selected polarity and a discharge detonator circuit connected across the storage device through an impact switch whereby the detonator circuit operates, upon closure of the impact switch, selectively in accordance with the polarity of the charge on the capacitor.

A still further object of the present invention is the provision of an electric fuze which is energizable from a source of selective polarity potential and wherein a first detonator is responsive only to the voltage of one polarity to instantaneously ignite the fuze at the instant of impact and a second detonator, responsive to a potential of either polarity, ignites the fuze in time delayed relation with the instant of impact.

An additional object resides in the provision of an electric fuze for an ordnance missile wherein a pair of detonator discharge circuits are connected in parallel across the ignition condenser of the fuze, one of the detonator discharge circuits including a rectifier therein to permit current flow therethrough only for currents having the polarity to which the rectifier presents a low impedance path.

Another additional object is the provision of an electric fuze having an ignition capacitor adaptable to be energized from a source of selectively reversible polarity and a pair of discharge circuits connected across the capacitor, one of the discharge circuits presenting a conductive path to currents of either polarity and including a slow acting detonator, the other of the discharge circuits including a fast acting detonator and a rectifier connected in series and permitting current flow therethrough only for currents having the polarity to that of the unidirectional current design of the rectifier connection.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIG. 1 is a diagrammatic representation of the electric fuze arranged in a bomb and a portion of an aircraft to which the bomb is releasably connected; and

FIG. 2 is a schematic diagram of the fuze circuit arrangement of the present invention.

Referring now to the accompanying drawing wherein like reference characters designate like parts throughout the several views and more particularly to FIG. 1 thereof the numeral **10** generally indicates a bomb comprising a casing **11**. The bomb **10** is a conventional type bomb and is releasably supported on the bomb rack **12** by the conventional release means indicated by the numeral **13** whereupon the bomb may be released at will from an aircraft in flight toward a target by the bombardier, the bomb rack **12**, being preferably mounted on the wing of the aircraft.

The present invention relates to an electrical fuze arrangement adapted to either explode the bomb instantaneously upon the instant of impact or to explode the bomb in time delayed relation with respect to the instant of impact. The arrangement comprises a fuze **22** disposed within the nose of the bomb and electrically connected to a switch device generally indicated by the numeral **17** by a pair of cables **18—19**, the switch being disposed within a well or recess **21** formed in the casing **11** and secured thereto in any suitable manner. Although fuze **22** is shown as being disposed in the nose of the bomb, it is to be understood that the fuze may be disposed in any feasible location within the bomb, or a

plurality of fuzes may be disposed in different portions of the bomb. Switch 17 is of the break-away contact type and is connected to a suitable source of electrical energy, or charging circuit, 5, the charging circuit being carried by the aircraft and adaptable to have the polarity of the voltage applied to the contacts of switch 17 reversed at the discretion of the bombardier, as will subsequently be apparent from the description of FIG. 2. From the foregoing, it will be understood that the switch 17 provides means whereby D.C. electrical energy, flowing in one direction or in the opposite direction, may be transferred from a source of power 5 arranged within the aircraft to the fuze 22 whereupon the fuze is adapted to be actuated from an initial safe position to an armed position in time delayed relation with respect to the release of the bomb from the aircraft in flight. The operation of the aforesaid fuze arrangement will be more clearly apparent with reference to the circuit arrangement of FIG. 2 in connection with the following detailed description thereof.

Referring now to FIG. 2, the selectively reversible polarity charging source 5, indicated generally in dotted lines, includes a D.C. source of energy 1, such as a battery, master switch S1 and a double-pole-double-throw switch S2. Source 1, although shown as a battery, may be any type of unidirectional potential source known to those skilled in the art. In applying the energizing potential to switch 17, master switch S1 is closed and then switch S2 is selectively operated to engage either contacts *a*—*c* or contacts *b*—*d* in order to obtain the polarity desired at break-away stationary contacts of switch 17. Switch 17 has a pair of stationary contacts 6—7 supported by the aircraft in any suitable manner and adapted to be engaged by contacts 8—9 in time delayed relation with respect to the release of the bomb from the aircraft. The contacts 8—9 are secured to the bomb and are located a predetermined distance from contacts 6—7 while the bomb is in the bomb rack. Upon the bomb being released, contacts 8—9 engage contacts 6—7 thereby supplying the charging potential to the fuze circuit 22. It is to be noted that if switch S2 is thrown to engage contacts *a*—*c*, contact 7 is of positive polarity and contact 6 is of negative polarity; whereas, if switch S2 is operated to engage contacts *b*—*d*, contact 7 is negatively poled and contact 6 is positively poled.

In fuze circuit 22, a switch S3 connects condenser 15 to the contacts 8—9 whereby condenser 15 is charged according to the poled condition of contacts 8—9. Switch S3 is a normally closed switch having expedient arrangements (not shown) associated therewith whereby switch S3 is opened after a predetermined time has elapsed after release of the bomb, in order to disconnect condenser 15 from contacts 8—9 thereby preventing condenser 15 from being grounded to the casing of the bomb. Although shown as a switch, switch S3 may be any type of time delayed actuator mechanism well known in the art of bomb fuzes which will open after a predetermined time interval after release of the bomb to prevent grounding of the charge storage circuit.

A resistor 20 connects condenser 15 to condenser 16, resistor 20 in conjunction with condenser 15 being, in essence, a time delay circuit having a time constant such as to charge condenser 16 after the bomb has dropped a sufficient distance from the airplane. Any time delay circuit of the type generally utilized in fuze circuits may be substituted for resistor 20 in order to prevent an undesired explosion of the bomb. The preceding description of the fuze is of general utility and is well known to those skilled in the art of bomb fuze design. The present invention is directed to a novel arrangement of variable time acting detonators connected to the storage condenser 16 through an impact switch 25 and is more fully described in the succeeding paragraphs.

An impact switch 25 contacts condenser 16 to a pair of discharge circuits connected in parallel, one discharge circuit consisting of a slow acting electroresponsive detonator or primer 23 connected in series with a current limiting resistor 27 and the other discharge circuit including a fast acting electroresponsive detonator or primer 24 connected in series with a rectifier 26. The fast acting detonator 24 may have a short delay time of ignition such as 10 milliseconds for example, or may be instantaneously ignitable upon current flowing therethrough; the slow acting detonator 23 is designed to have a longer delay time of ignition, such as 50 milliseconds for example, than the fast acting detonator 24. The rectifier 26 is preferably of the copper oxide type, although diodes may effectively be utilized.

Assuming the rectifier 26 to be poled as illustrated in FIG. 2, rectifier 26 will present a low impedance to a charge from power source 5 which is positive at contact 7 and negative at contact 6, that is, when switch S2 is thrown to engage contacts *a*—*c*. Under this condition, as soon as impact switch 25 closes upon impact the capacitor 16 discharges simultaneously through the circuit including slow acting detonator 23 and through the circuit including fast acting detonator 24 by virtue of the fact that rectifier 26 is poled to present a low impedance to the current thereby permitting current flow therethrough. Since detonator 24 is energized upon impact, it will instantaneously ignite the fuze and explode the bomb if an instantaneous type of detonator is used, or, if a short time delayed detonator, of 10 milliseconds delay for example, is used, then the bomb will explode in time delayed relation with respect to the reference instant of impact as determined by the time delay characteristic of detonator 24. Since detonator 23 has a time delay longer than detonator 24, detonator 23 will play no part in the explosion of the bomb under the above condition.

If switch S2 is thrown to engage contacts *b*—*d* and thereby poling contact 7 negatively and contact 6 positively, rectifier 26, if poled as illustrated in FIG. 2, will present such a high impedance to the current being discharged from capacitor 16 upon closure of impact switch 25 as to virtually present an open circuit thereto thereby preventing current flow through detonator 24. Under this condition, the current flow will be substantially only through the circuit including detonator 23 and the bomb will explode at a period after impact as determined by the long time delay character of detonator 23.

It is to be understood that rectifier 26 may be poled in any manner desired and the bomb marked accordingly as to give an indication to the bombardier for fast or slow acting detonation.

From the foregoing, it will be apparent that a new and improved selectively variable timing fuze has been devised for use in a bomb wherein a detonating timing circuit is controlled by the polarity of the charge applied to the fuze, which polarity may be discretionally selected by the bombardier, to ignite the fuze instantaneously upon impact or in time delayed relation with respect to the instant of impact, as may be desired by the bombardier.

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 the 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 in the United States is:

1. In a timing circuit, a capacitor, a polarity selective charging circuit for establishing an initial potential polarity condition on said capacitor, a first circuit including normally inactive electroresponsive means initially activated at a predetermined time with respect to a reference instant of time and discriminating means for passing only current of a preselected polarity through said first circuit, a second circuit including normally inactive electroresponsive means initially activated at a time greater than said predetermined time with respect to said reference instant of time, said second circuit being of such character as to

present a conductive path to currents of said preselected polarity and of a polarity opposite to said preselected polarity, and a normally open switch operative at said reference instant of time to connect said first and second circuits across said capacitor whereby the electroresponsive means of said first and second circuit are selectively operated in accordance with the initial potential polarity on said capacitor.

2. The timing circuit of claim 1, wherein said timing circuit forms the ignition circuit of a bomb and wherein the electroresponsive means of said first circuit comprises an instantaneously electroresponsive detonator and wherein the electroresponsive means of said second circuit comprises an electroresponsively time delayed detonator.

3. The timing circuit of claim 2 wherein said discriminating means is a unilateral conductive device which is connected in series with said instantaneously electroresponsive detonator to form said first circuit and poled to present a low impedance to currents of said preselected polarity and a high impedance to currents having a polarity opposite to said preselected polarity.

4. The timing circuit of claim 1 wherein said timing circuit forms the ignition circuit of a bomb and wherein the electroresponsive means of said first and second circuit comprise detonators having different electroresponsive delay times.

5. The timing circuit of claim 4 wherein the detonator in said first circuit has a shorter electroresponsive delay time than the detonator in said second circuit.

6. In a fuze for a bomb, in combination, a capacitor, a charging circuit having polarity reversible selective means associated therewith for charging said capacitor with a potential of preselected polarity, a normally open firing switch, an electroresponsive detonator, a unilateral rectifier current carrying device poled to pass current of a predetermined polarity, and a discharge circuit for said capacitor, said discharge circuit interconnecting said switch, said electroresponsive detonator and said rectifier in series whereby the detonator is selectively operated upon closure of said switch in accordance with the polarity of the charge on said capacitor.

7. A claim according to claim 6, further including a second detonator connected to said switch and to said

capacitor, said second detonator being slow acting in response to a flow of current therethrough whereby the fuze is detonated instantaneously or in time delayed relation with respect to the operation of said switch selectively in accordance with the polarity of the charge on said capacitor.

8. In a selectively variable timing fuze for a bomb, a capacitor, a selectively reversible polarity charging circuit for establishing a preselected potential polarity condition on said capacitor, a first series circuit comprising an electroresponsive detonator and an unidirectional current conducting device arranged to permit the flow of current through said electroresponsive detonator only for current having a predetermined polarity, a second series circuit arranged to pass current of said predetermined polarity and of a polarity opposite to said predetermined polarity, said second circuit including a slow acting detonator electroresponsively time delayed with respect to said electroresponsive detonator, and a normally open firing switch operative to simultaneously connect said first and second series circuits across said capacitor whereby the instant of detonation of the fuse with respect to the operation of said switch is determined selectively in accordance with the polarity of the charge on said capacitor.

9. A circuit of the character disclosed comprising, a charging circuit adaptable to be energized by a current of preselected polarity and including a condenser and resistor connected in series, a capacitor connected across said charging circuit whereby said capacitor is charged with the current of said preselected polarity, a pair of discharge circuits connected in parallel, one of said circuits including a fast acting detonator and a rectifier connected in series, the other of said circuits including a slow acting detonator, and a normally open switch operative to connect said pair of circuits across said capacitor whereby said capacitor discharges selectively through said pair of circuits in accordance with the polarity of the charge on said capacitor.

References Cited in the file of this patent

UNITED STATES PATENTS

1,841,983 Ruehlemann ---------- Jan. 19, 1932