

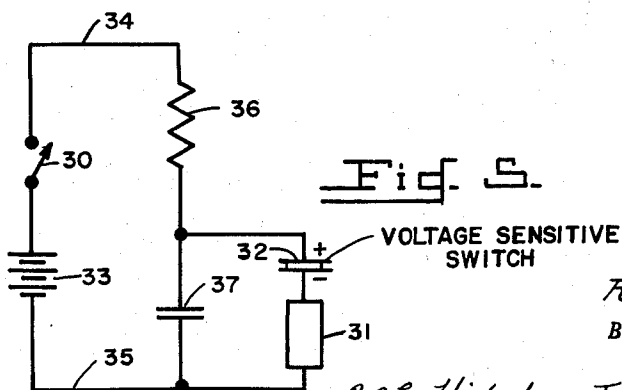
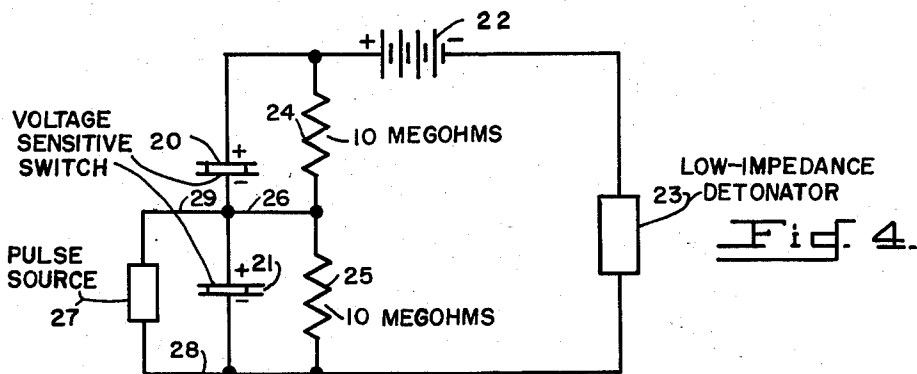
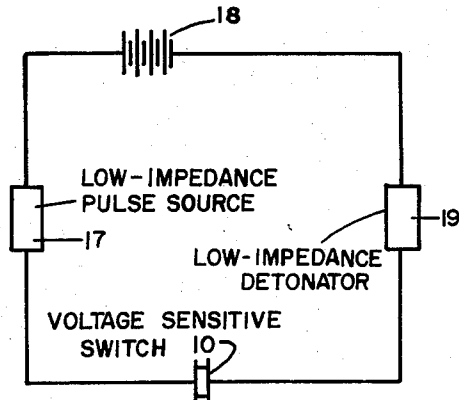
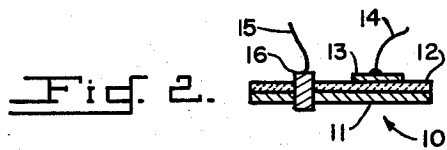
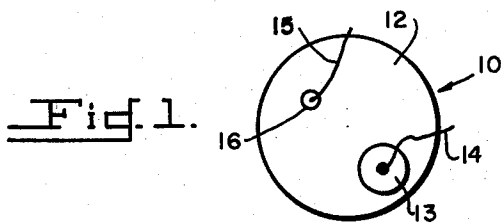
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CIRCUITS FOR A VOLTAGE-SENSITIVE SWITCH

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2,909,122

## CIRCUITS FOR A VOLTAGE-SENSITIVE SWITCH

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1 Claim. (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 for governmental purposes without the payment to us of any royalty thereon.

This invention relates to means for actuating detonators in ordnance fuzes, and in particular to a circuit including a single shot voltage responsive capacitive switch.

It is an object of this invention to provide a circuit for the activating of a detonator and with this circuit including a single shot voltage responsive switch to displace the thyatron customarily employed in detonator activating circuits.

It is an object of this invention to provide a detonator activating circuit in which the customary thyatron is displaced by a single shot voltage responsive switch of very small dimensions, of rugged construction, sealed against atmospheric conditions, and capable of being made at a cost which is very low in comparison with the cost of a thyatron.

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

Figure 1 is a plan view of the voltage responsive switch of this invention,

Figure 2 is an exaggerated sectional view of the voltage responsive switch of this invention,

Figure 3 is a wiring diagram showing the voltage responsive switch of this invention connected in circuit with a detonator,

Figure 4 is a wiring diagram showing a pair of voltage responsive switches of this invention connected in circuit with a detonator,

Figure 5 is a wiring diagram showing the voltage responsive switch of this invention in circuit with a detonator and with time delay means.

In Figures 1 and 2 there is shown a voltage responsive switch which comprises a piece of substantially pure aluminum 11, about the size of a dime, and on which there is formed an anodized film 12, formed in a six percent by weight chromic acid bath. On the exceedingly thin anodized film 12 there is placed a thin layer of silver 13, deposited through a screen as is customary in printed circuits, and after its having been deposited, the assembly is baked to remove the solvent in the deposited material. The silver deposit has a diameter of about a quarter of an inch. A wire 14 is soldered to the silver layer, and a wire 15 is connected to the aluminum base 11, at a spot 16, where a hole has been punched through the base to expose the metal of the base, and the wire 15 makes contact with the exposed area by a rivet or by being crimped in the hole.

The assembly is next coated with a final coating of a plastic so that only the wires are visible.

The capacitance of a switch of the above approximate dimensions is of the order of .002 microfarad. The capacitance depends upon the area of the electrodes opposed to each other, upon the nature of the dielectric be-

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tween them and the thickness of the dielectric, and in the present case the film is exceedingly thin. The capacitance can, of course, be made smaller by reducing the area of the silver layer, but the dimensions given herein have been found acceptable for the present purpose.

The base plate 11 is usually stamped from thin strips of substantially pure aluminum which are anodized by being placed in a six percent by weight of chromic acid bath, and which have current passed through them for about twelve minutes. The strips are next washed carefully to remove the electrolyte, and they are then dried in an oven, and after being dried the silver electrodes are placed on the anodized film. After the wires 14 and 15 have been secured to the switch assembly the assembly is dipped in an epoxy-stearamide mixture to give mechanical strength and to provide moisture-vapor resistance.

In Figure 3 the voltage responsive switch 10 is shown in a circuit which comprises a low-impedance pulse source 17, a bias battery 18, and a low impedance detonator 19, and with the elements connected in series. The switch 10 has a normal resistance of the order of 3000 megohms, and when the film is ruptured and the switch is closed by a pulse of voltage from the pulse source in addition to that of the bias battery the resistance of the switch drops to a fraction of an ohm, so that the bias battery is now directly in circuit with the detonator and a current of several amperes flows in the circuit to activate the detonator.

In one run of switches assembled for use to activate the detonator the biasing voltage is of the order of ten volts and the added pulse voltage is of the order of three volts. It will be understood that these voltages given are not by way of limitation, for in the making of these switches quite acceptable switches may require a higher voltage and a higher pulse voltage, within the limits of manufacturing tolerances, when they are used to activate a detonator.

When the film 12 breaks down, and the switch becomes closed, the switch remains as a low resistance device so that the bias battery can send ample current to the detonator.

In Figure 4 there is shown two of the voltage responsive switches 20 and 21 in series with a bias battery 22 and a detonator 23. Voltage equalizing means comprise a resistor 24 and a resistor 25 connected in parallel with the switches 20 and 21, and their midpoint connection is connected to the midpoint connection between the switches, by a wire 26. A source of pulses of voltage is connected by wires 28 and 29 to the switch 21. The resistors 24 and 25 usually have a resistance of the order of ten megohms, but this value is not critical just so long as it is high, and in the order of megohms. The switches have each a normal resistance of thousands of megohms.

It will be noted that the pulse source looks into the resistance of the switch 21 and its shunting resistance 25, and that the remainder of the circuit has a high impedance because of the high resistance of the switch 20 and its shunting resistor 24. We may take the resistance of the battery and of the detonator as being very low, and but for the inserted resistance of the switch 20 and the resistor 24, the battery and the detonator would appear as substantially a short circuit across the pulse source. The bias battery voltage is that calculated to be the sum of the biasing voltages of the two switches.

When a pulse of voltage is received from the pulse source 27, it looks into the capacitance of the switch 21, and the capacitance expedites the arrival of the pulse. The capacitance of the switch is immediately charged, and the pulse breaks down the film between the silver area and the base material of the switch. When the switch 21 breaks down then the whole voltage of the battery 22 is

impressed across the switch 20, and it immediately breaks down. Then we have the battery 22 sending current in amperes through the two low impedance elements 20 and 21 to the detonator 23.

The battery voltage impressed across the switch 20 when the switch 21 breaks down is so much higher than the normal bias voltage necessary for switch 20, it is not essential that the switches 20 and 21 have equal characteristics, and this characteristic of the circuit facilitates the use of switches that have not been made to very close tolerances.

In Figure 5 there is shown a circuit in which there is a time delay between the instant of closing a switch 30 and the activating of a detonator 31 through a voltage responsive switch 32. A battery 33 is connected through the switch 30, or other circuit closing device, and through wires 34 and 35 through a resistor 36 and a capacitor 37 so that the capacitor becomes charged when the switch is closed. When the charge on the capacitor has risen to a value at which its voltage is equal to the breakdown voltage of the voltage responsive switch 32, the switch breaks down, and the charge on the capacitor discharges through the detonator 31 to activate the detonator.

The time delay introduced by the resistor 36 and the capacitor 37 may be readily calculated for any desired circumstance, and, of course, the energy content of the capacitor can be made readily adequate to fire the detonator.

It will be apparent that the embodiments shown are only exemplary and that various modifications can be made in construction and arrangement within the scope of the invention as defined in the appended claim.

We claim:

A time delay detonator activating circuit for ordnance fuzes comprising in combination: a battery, a circuit closing device, a resistor, and a capacitor in series circuit relation, said battery charging said capacitor through said resistor when said device is closed, and the series combination of a voltage responsive switch and a low-impedance detonator connected in parallel across said capacitor, said switch comprising a base of substantially pure aluminum having an exceedingly thin anodized film on one side thereon and having a thin layer of silver of a relatively smaller area secured to said anodized film, said layer of silver forming one electrode of said switch and the non-anodized side of said base of aluminum forming the other electrode of said switch, said switch substantially insulating said capacitor from said detonator as long as the voltage on said capacitor is less than the predetermined voltage required to break down said film of said switch, said battery having a voltage which is sufficient to charge said capacitor at least to said predetermined voltage, whereupon said film will break down causing the resistance across said switch to drop to a very low value, the capacitor thereupon discharging through said detonator causing activation thereof.

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