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ARMING AND FIRING CIRCUIT

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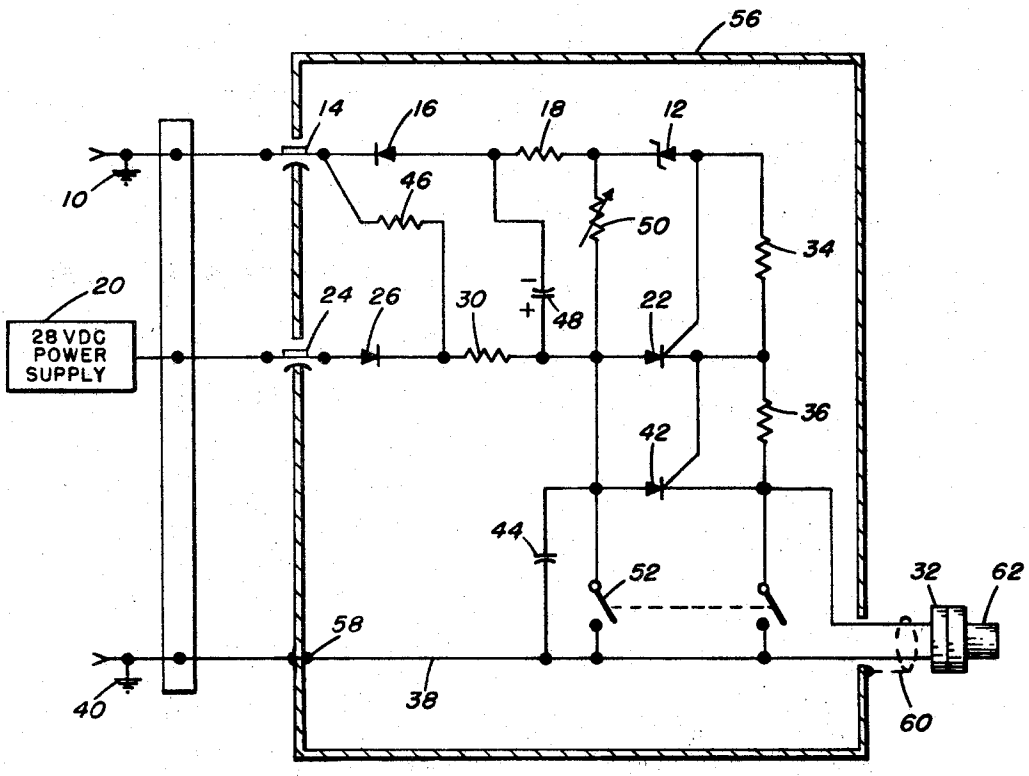

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ARMING AND FIRING CIRCUIT

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ABSTRACT OF THE DISCLOSURE

The specification and drawing disclose a time delay fail-safe firing system utilizing two SCR's and a capacitor discharge firing circuit to enable the SCR's. The firing circuit is initiated when the power and ground circuits are broken thereby causing the capacitor to discharge through the gate circuit of the SCR and then causing the SCR to conduct and thereby detonate the load.

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 firing circuits for electronic fuze systems and in particular to timing circuitry employing semi-conductor devices to provide a safe, compact and reliable circuit for the purpose intended.

More specifically, the invention relates to an ignition circuit for detonating explosives in which a predetermined time delay may be produced between the disconnection of the circuit from the related electrical system and the detonation of the explosive charge.

Such a circuit would, for example, be incorporated with a positive destruct system in aircraft equipment that is designed to be jettisoned or dropped while in flight such that at a predetermined time after jettisoning the circuit will detonate the explosive charge associated therewith.

The description of the use is for illustrative purposes only and it will be understood that such a circuit is readily adaptable for use with any load that would require a signal at a predetermined time after the circuit was disconnected from the associated electrical system.

Such a circuit must be compact and as efficient as possible due to the severe space limitations and the high reliability requirements imposed by the aircraft environment. It is also desirable that such a circuit will not be susceptible to stray electromagnetic radiation which might accidentally detonate the associated explosive charge and that the circuit will drain very little current from the associated electrical system.

Accordingly, it is an object of the present invention to provide an electrical circuit capable of producing a time lag of the aforesaid nature.

Another object of the present invention is to provide an electrical circuit capable of producing a signal at a predetermined time after the circuit has been disconnected from the associated power supply and electrical grounds.

A further object of the present invention is to provide an electrical circuit for use with electronic fuze systems and which circuit will produce a time lag of the aforesaid nature.

Still another object of the present invention is to provide a new and improved circuit for use with a fuze system which will produce a predetermined time delay between the initiating occurrence and the detonation of the explosive charge that is associated with the fuze system.

Yet another object of the present invention is the provision of a firing circuit for use with electronic fuze

systems which circuit is not susceptible to stray electromagnetic radiation which might accidentally detonate the associated explosive charge.

Still a further object of the present invention is to provide a firing circuit which will have a low current drain on the electrical system in which it is connected.

Other objects, advantages and novel features of the present invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawing wherein:

The figure shows a schematic of the circuit of the present invention with the associated casing.

Referring now to the drawing in detail, the ground **10** is electrically coupled to the cathode of Zener diode **12** via the positive plate of a first feed through capacitor **14**, diode **16** and resistor **18**. The 28 volt direct current power supply or potential source means **20** is electrically coupled to the anode of a first silicon controlled rectifier **22** via the positive plate of a second feed through capacitor **24**, diode **26** and current limiting resistor **30**. The anode of Zener diode **12** is electrically coupled to one terminal of plug **32** via resistors **34**, **36** and is also electrically connected to the control gate of the first silicon controlled rectifier **22**. A lead **38** electrically connects a second terminal of plug **32** with ground **40**. The anode of the first silicon controlled rectifier **22** is electrically connected to the anode of a second silicon controlled rectifier **42** and to the positive plate of firing capacitor **44**. The negative plate of firing capacitor **44** is electrically connected to ground **40** via lead **38**. The cathode of the first silicon controlled rectifier **22** is electrically connected to the control gate of the second silicon controlled rectifier **42** and also to the line between resistors **34** and **36**. The cathode of the second silicon controlled rectifier **42** is electrically connected to the same line and the same terminal of plug **32** as the anode of Zener diode **12**.

A resistor **46** is electrically connected between the cathodes of diodes **16** and **26**. The negative plate of timing capacitor **48** is electrically connected to the cathode of Zener diode **12** via resistor **18**. The positive plate of timing capacitor **48** is electrically connected to the cathode of Zener diode **12** via potentiometer **50** and is also electrically connected to the anode of silicon controlled rectifier **22**. The timing capacitor and potentiometer **50** form a network means for producing a time lag of predetermined duration as will hereinafter be described. A two pole single throw switch **52** electrically grounds, when closed, the positive plate of firing capacitor **44** and both the anode and cathode of the second silicon controlled rectifier **42** such that the circuit is incapable of operation and thus acts as an "arm-safe" switch.

The entire circuit is shown in case **56** which together with feed-through capacitors **14** and **24** acts as a filter means to eliminate any stray electromagnetic radiation from affecting the circuit. The negative plates of feed-through capacitors **14** and **24** are shown attached to the case **56** and with the case **56** grounded at **40** via connection at **58**. The leads extending beyond casing **56** to plug **32** are encased in shielded cable which is grounded to the casing **56** as indicated at **60**.

The plug **32** is shown connected to a detonator **62** for illustrative purposes only and it will be obvious that the circuit of the present invention could be employed with any load which requires a signal or needs to be controlled at a determined time after the circuit has been disconnected from the power supply means.

In operation the application of power supply means **20** with the switch **52** in armed or open position will charge the positive plate of timing capacitor **48** and the positive plate of firing capacitor **44**. After the capacitors **48** and **44** are charged, the only source of continuous current drain will be through resistor **46** since potentiometer

50 will be almost an open circuit due to its large ohmic value in comparison to resistors 30 and 46, and the circuit will therefore be in a ready state. If the circuit is now disconnected from the power supply means 20 and grounds 10 and 40, the positive plate of capacitor 48 discharges at a predetermined time rate through potentiometer 50 until the potential across Zener diode 12 has risen to a predetermined value due to the negative plate of capacitor 48 becoming more positive, at which time the Zener diode 12 conducts and places a voltage on the control gate of the first silicon controlled rectifier 22. Rectifier 22 then conducts and places a voltage on the control gate of the second silicon controlled rectifier 42 thus allowing the second rectifier 42 to conduct. With the second silicon controlled rectifier 42 conductive, the firing capacitor 44 discharges through the rectifier 42 and actuates the squib of detonator 62. The explosive system is thus set off after a predetermined time delay. The circuit may be disarmed by simply turning off the power supply 20 from the circuit, while leaving grounds 10 and 40 connected, whereby the capacitors 44 and 48 are discharged through resistors 30 and 46 to ground 10. If switch 52 is closed or in the "safe" position, the firing capacitor 44 will not be charged and the circuit will be incapable of accidentally actuating detonator 62.

While applicants do not wish to be limited to any particular set of circuit constants, the following constants have proven to be useful in the particular circuit shown.

Capacitors 14, 24	6.8 microfarads.
Diodes 16, 26	GE type 1N538.
Resistor 46	1 kilohm.
Resistors 18, 30	270 ohms.
Capacitor 48	220 microfarads.
Potentiometer 50	25 kilohms.
Zener diode 12	GE type 1N1771A.
Silicon controlled rectifier 22	GE type 2N2323.
Silicon controlled rectifier 42	GE type C40F.
Capacitor 44	4000 microfarads.
Resistor 34	4.7 kilohms.
Resistor 36	15 kilohms.

Obviously many modifications and variations of the present invention are possible in 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 is:

1. A circuit for controlling a load comprising

electrical ground means;

a first and a second silicon controlled rectifier, each of said rectifiers having an anode, a cathode and a control gate, said cathode of said first rectifier connected to said gate of said second rectifier, the anodes of said first and second rectifiers electrically coupled to said ground means;

a firing capacitor electrically connected to said anode of said second rectifier;

a Zener diode electrically connected to said control gate of said first rectifier;

a resistance-capacitance network means electrically connected in parallel between said Zener diode and said anode of said first rectifier;

a potential source means electrically coupled to said circuit for charging both the capacitance of said network means and said firing capacitor whereby if the circuit is disconnected from both said potential source means and said electrical ground means the capacitance discharges through the resistance of said network means and causes said Zener diode to conduct after a predetermined time lag which in turn allows the first and second rectifiers to conduct and thus permits the firing capacitor to discharge through said second rectifier to a load to be controlled.

2. A circuit as described in claim 1 wherein said network means includes a timing capacitor having a positive and a negative plate, the positive plate being charged by said potential source means whereby the disconnection of said circuit from said potential source means allows the positive plate of said timing capacitor to discharge through the resistance of said network means to allow the Zener diode to conduct.

3. A circuit as described in claim 1 for use in an electronic fuze system having a detonator wherein:

said Zener diode includes an anode and a cathode, the anode being electrically coupled to the control gate of said first rectifier; and

said network means includes a timing capacitor and a potentiometer, said timing capacitor having a positive and a negative plate, both said timing capacitor and said potentiometer being electrically coupled in parallel between the anode of said first rectifier and the cathode of said Zener diode, said positive plate of said timing capacitor being charged by said potential source means whereby the disconnection of said circuit from said potential source means and said electrical ground means allows said positive plate to discharge through said potentiometer to make said Zener diode conductive and which ultimately results in said firing capacitor discharging through said second silicon controlled rectifier to said detonator of said fuze system.

4. A circuit as described in claim 3 including a switch electrically grounding said firing capacitor and said cathode of said second rectifier when said switch is closed.

5. A circuit as defined in claim 3 including filter means for eliminating the affects of any stray electromagnetic radiation.

6. A circuit as defined in claim 5 wherein said filter means includes a case shielding the components of the circuit and feed-through capacitors said feed-through capacitors being connected into the circuit before said first and second silicon controlled rectifiers.

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