United States Patent [19]

Derk

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[45] **Sept. 11, 1973**

[54] **ELECTRONIC SQUIB FIRING SEQUENCER**

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[52] **U.S. Cl.** ..... **102/70.2 R,** 102/82

[51] **Int. Cl.** **F42b 22/30,** F42c 9/00

[58] **Field of Search** ..... 102/70.2 R, 82, 70 R, 102/28 P; 181/.5 FS

[56] **References Cited**

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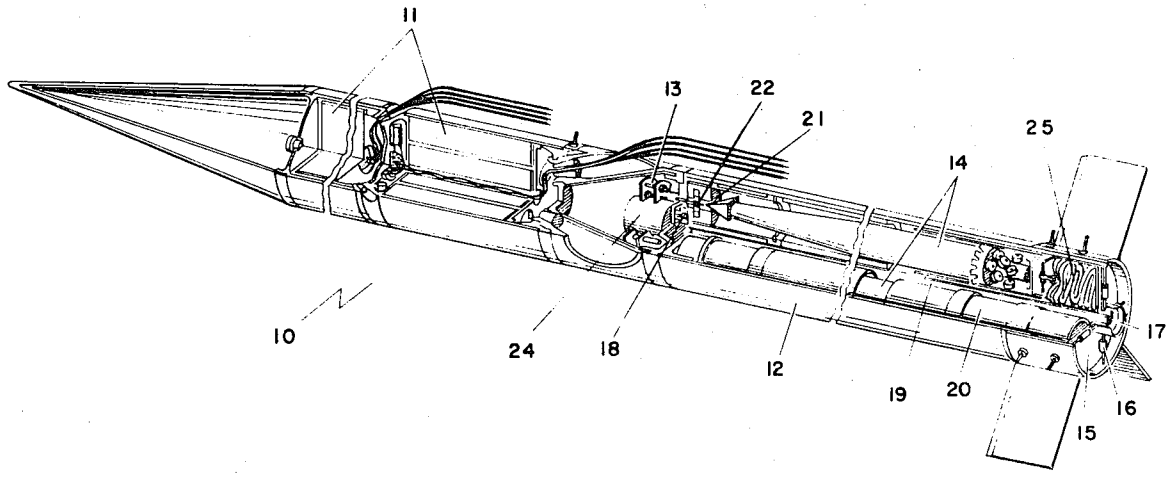
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[57] **ABSTRACT**

In a projectile carrying a plurality of payloads which are to be sequentially ejected, an electronic circuit for selectively firing ejection charges, which comprises a series of interlocked switches that are held in one position by the presence of the projectile backplate. Upon release of the backplate the switches assume a second position and thereby permit the application of voltage to an R-C network in which the capacitors charge up to a voltage sufficient to overcome a zener diode that in turn activates a silicon controlled rectifier via its conrol electrode. The rectifier is connected in series with an electrical energy source, ground interlock switches and a squib so as to fire the same sequentially after some selected period set by each of the R-C networks. The ground interlocks being connected so as to effectively short circuit the squibs prior to release of the backplate.

7 Claims, 2 Drawing Figures



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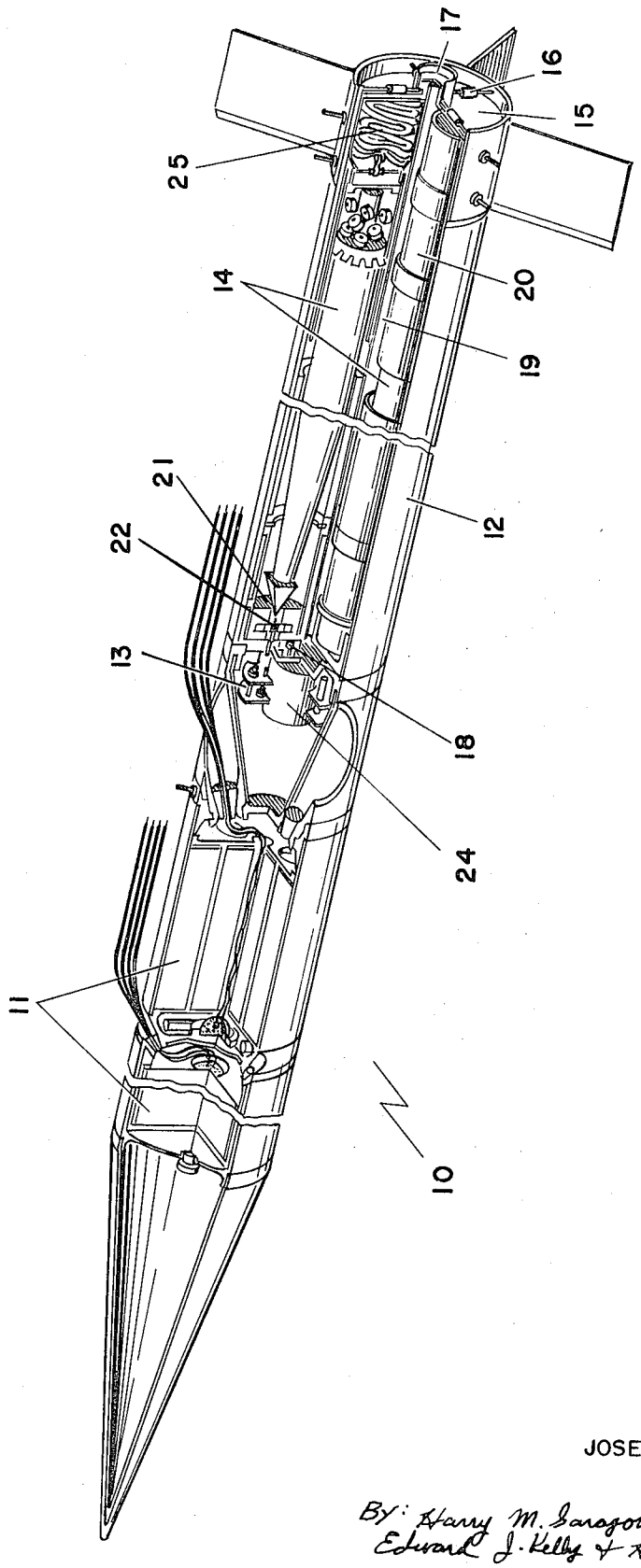


FIG. 1

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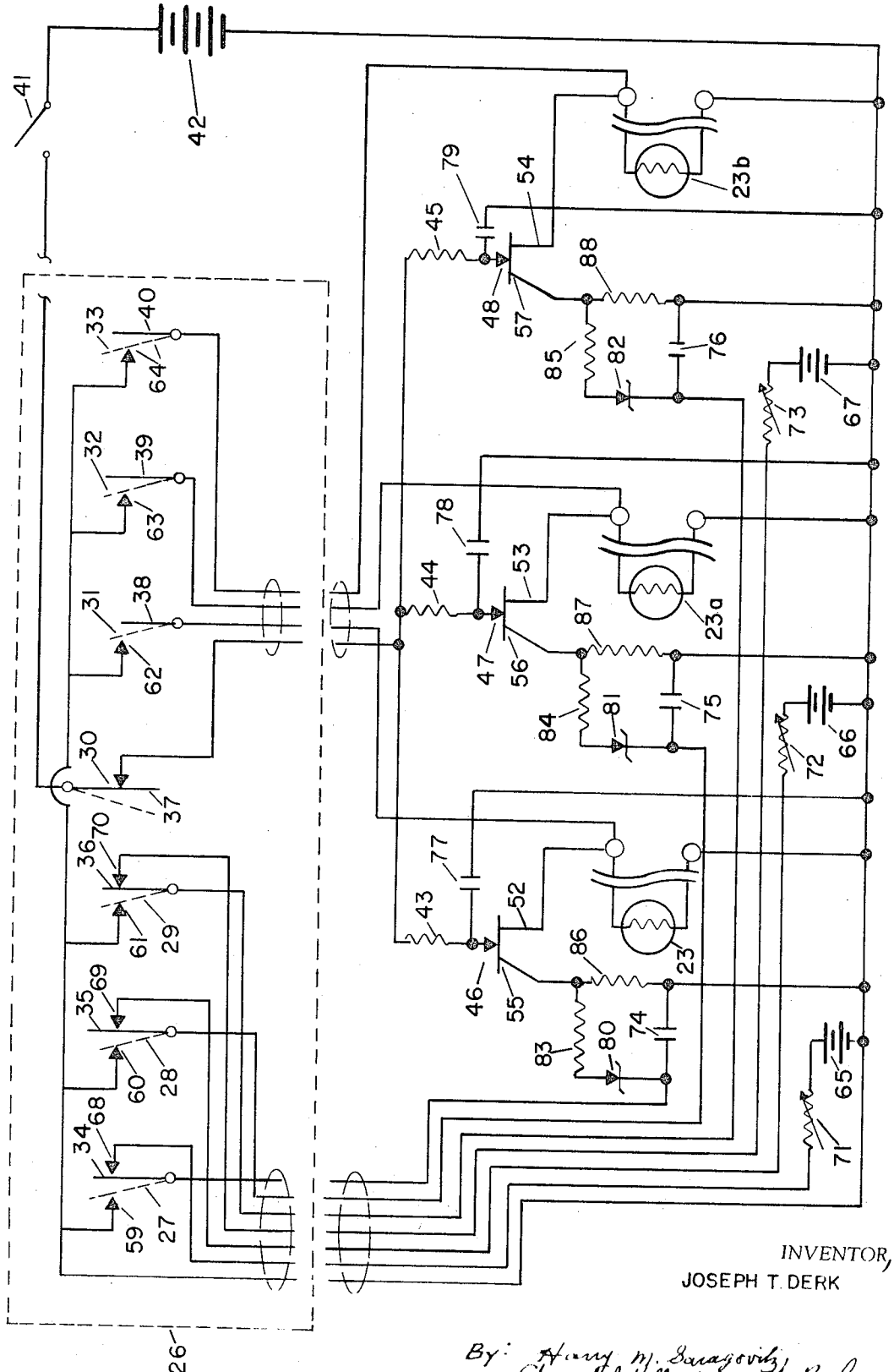


FIG. 2

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ELECTRONIC SQUIB FIRING SEQUENCER

The invention described herein may be manufactured, used and licensed by or for the Government for governmental purposes without the payment to me of any royalty thereon.

BACKGROUND OF THE INVENTION

The present invention relates to system for ejecting a plurality of payloads from a projectile and more particularly pertains to an electronic circuit for sequentially initiating the payload release at selected intervals and incorporates therein malfunction, safety interlocks.

In the field of sequential payload ejection, it has been the general practice to employ some pyrotechnic delay composition whose initiation was dependent of the activation of an explosive used to blow off the backplate. This method has proved unsatisfactory in that the ejection times were unpredictable and without proper function times, plural payloads would be simultaneously ejected resulting in an action which defeated the primary delivery purpose. In addition, where the payloads were deployed with parachutes, fouling thereof occurs in many instances. This problem has been satisfactorily overcome by the present invention.

SUMMARY OF THE INVENTION

The general purpose of this invention is to provide a sequential squib firing circuit for payload ejection that has all the advantages of similarly employed prior art devices and has none of the above described disadvantages. To attain this, the present invention provides, for each payload, a unique circuit arrangement interlocked with the backplate and which includes an R-C network coupled to overcome a Zener diode and whose charging commences upon the release of said plate. The diode is connected to turn on a silicon controlled rectifier which in turn permits the squib to be fired from an electrical source. Each R-C network includes selected components to allow independent setting of the time period between plate release and payload ejection.

An object of the present invention is to provide a simple, reliable, safe and inexpensive squib firing sequencer circuit for initiating the ejection of payloads from a projectile at selected intervals.

Another object is the provision of an electronic circuit for sequentially firing a plurality of squibs which, circuit is capable of withstanding setback forces of 30 g's.

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.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view, partially in section, of a missile in which the subject invention is employed; and,

FIG. 2 is a schematic of an embodiment made in accordance with the principle of this invention.

DESCRIPTION OF A PREFERRED EMBODIMENT

The missile **10** of FIG. 1 carries at its nose end a pair of dual thrust rocket motors **11** while the remaining portion of the missile is provided with a payload chamber **12** that contains the ejection control system **13** as well as three payloads **14** (two of which are shown).

The rear end of the missile is closed by a backplate **15** that is held in position by four radial release pins **16** whose central area carries a piston arrangement **17** communicating with a forward black powder charge **18** through blast tube **19.** Each payload is housed in a launch tube **20** and at the forward end thereof includes an ejection piston **21** that is activated by an ejection charge **22** in which is disposed a squib **23,** so that when the squib is activated it will fire the charge and the expanding gases will displace the piston rearwardly against the nose of the payload, driving or ejecting the payload after the backplate has been released. The sequence for removal of the backplate is as follows: A mechanical time fuze **24** is activated at a prescribed time after launch, based on the desired range and it initiates an explosive train in the charge **18** generating a pressure wave which travels down the blast tube **19** and acts against the backplate piston arrangement **17** to blow off the backplate. The three small payload charges **22** are sequential ignited by the subject embodiment of this invention, namely, the electronic squib firing sequencer or ejection control system **13** and each one in turn acts on the payload ejection piston to launch the payloads. These payloads are provided with attached drogue parachutes **25** which are deployed as soon as the load clears the missile and serve to limit the impact velocity of the payload.

Having described the general environment and operation of the main elements, attention is now directed toward the subject inventive embodiment which comprises two separate physical structures but a single electrical system. A plurality of micro switches in a support **26** are positioned against the backplate so that they will assume their unbiased switch position when the plate against which they abut is removed. The remaining portion of the electronics is disposed forward of the payload with the squibs adjacent the ejection charges. The seven bias or micro switches **27–33,** as shown in FIG. **2,** with their movable arms **34–40** (for the dotted position) in the biased position as when in abutting relation to the backplate and for the solid showing with the backplate removed. Two switches are provided for each squib, with the main power switch **30** having its arm **37** connected through a single-pole single throw **41** switch to a battery **42** and its fixed contact connected to the anode resistor **43–45** of an asymmetrical conducting means such as silicon controlled rectifiers (SCR) **46–48.** With switch **30** open, no power is present at the SCR anodes **46–48** so that no current can flow from the anode to the cathode **52–54** even if the gate electrode **55–57** were accidentally energized. One stationary contact **59–64** of each control switch is connected to the ground or the negative side of the source or battery **42** as well as to negative side of batteries **65–67.** The other stationary contacts **68–70** of R-C gate switches **27–29** are connected via resistors **71–73** to the high or positive terminals of batteries **65-67.** The movable arms **34–36** of the gate switch are connected to charging capacitors **74–76** so that when the arm is released (backplate removed) it effectively places the battery across the delay means or R-C network (**71–74, 72–75, 73–76**) and commences charging of the capacitor. At the same time the movable arms **38–40** of squib switches **31–33** open from their fixed contacts and thereby remove ground from the squibs **23, 23*a*, 23*b*** and power switch **30** connects the positive terminal of battery **42** to anode resistors **43–45** and ground via ca-

pacitors 77–79. Charging capacitors 74–76 commence to charge toward the battery voltage at a rate dependent on their time constants or the values of resistance and capacitance. When the potential on each capacitor reaches the breakdown or conduction voltage of the Zener diode 80–82 it then conducts (discharges capacitor), via discharge divider resistors 83–85, 86–88 providing a voltage at their junction and on the SCR gates 55–58. This voltage is sufficient to turn the SCR "on" and conduction takes place between the anode and cathode through the squib 23 to the battery 42 negative. This passage of current through the squib fires it almost instantaneously. By properly adjusting the R-C time constant of each squib circuit, they can be made to fire sequentially with variable time differentials. The timing adjustment can most readily be accomplished by setting variable resistors 71–73 to the selected values.

The system operation can best be summarized as follows: The missile fuze timer fires a powder charge which blows off the backplate cover and releases the seven micro switches mounted on the rear of the missile. The switches are activated as the backplate is blown clear of the missile. Three of the switches serve to short out the squibs with the backplate in place while another three are utilized to activate the R-C time voltages across the capacitors when the backplate is blown off. The remaining switch maintains an open circuit for the firing voltage at the SCR anode and closes the circuit only upon release of the backplate. When one of the capacitors charges up sufficiently, the Zener diode conducts and the first SCR conducts from its anode to cathode and fires the first squib. The time interval is dependent on the R-C time constant and by appropriately selecting the resistance for each circuit, the squibs will be fired sequentially.

It should be understood, of course, that the foregoing disclosure relates only to a preferred embodiment of the invention and that numerous modifications or alterations may be made therein without departing from the spirit and the scope of the invention as set forth in the appended claims.

I claim:

1. A missile electronic firing system for sequentially activating a plurality of squibs for sequential ejections of payloads from the missile, which missile is provided with a mechanism for releasing the backplate thereof at some time after launch, said firing system comprising:

a plurality of squib firing circuits, one for each squib, and each circuit having included therein,

an asymmetrical electrical conducting means having a control element whereby when a specific voltage is applied thereto said conducting means will conduct between its input and output.

a source of electrical energy having a positive and a ground terminal,

an independently variable time delay means connected to said control element,

a first bias switch connected intermediate said source and said delay means and disposed in abutting relation to said backplate and activated by the release thereof to apply said source to said delay means,

a pair of terminals, one of said terminals connected to the output of said conducting means and the other terminal connected to said ground terminal of said source,

a main source of electrical energy connected across the input of each of said conducting means and said ground terminal of said source,

whereby when a squib is connected across each of said pairs of terminals the squibs will be activated at different times after said backplate is released which will cause said payloads to be ejected sequentially.

2. The system according to claim **1** wherein said delay means includes a series R-C connected resistor and capacitor and a Zener diode and a second resistor.

3. The system according to claim **2** wherein said conducting means is a silicon controlled rectifier.

4. The system according to claim **3** wherein said first bias switch includes a pair of stationary contacts and a movable pole biased to contact one of said contacts and physically deflectable to contact the other of said stationary contacts when in abutting relation to said backplate, said one contact connected to said ground terminal of said source and said other contact connected to said positive terminal of said source, said pole connected to said R-C junction.

5. The system according to claim **4** further including for each firing circuit a single pole-single throw bias switch in abutting relation to said backplate for connecting said ground terminal to said output of said silicon rectifier and removing the same when said backplate is released.

6. The system according to claim **5** further including another single pole-single throw bias switch connected intermediate said main source and the anode input of said silicon rectifier.

7. The system according to claim **6** wherein all of said bias switches are microswitches.

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