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DETONATION CIRCUIT FOR MULTIPLE SENSITIVITY FUZE

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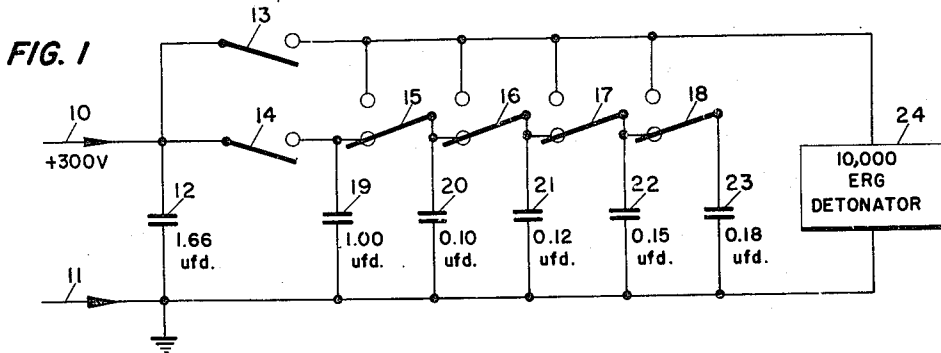


FIG. 2

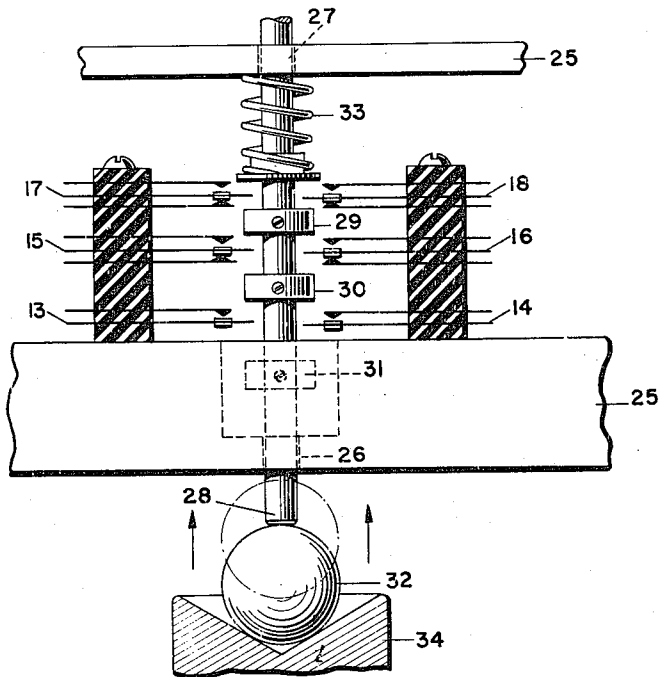
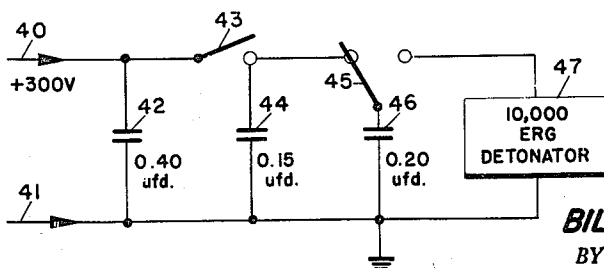


FIG. 3



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DETONATION CIRCUIT FOR MULTIPLE SENSITIVITY FUZE

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(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.

This invention relates to a sequential energy transfer system, and more particularly to a mechanical inertia responsive system which makes circuit connections and sequentially transfers electrical energy to ignite a detonator within a fuze of a missile at specified values of missile deceleration.

A detonation switch mechanism for a fuze of a missile which has an air trajectory or an air trajectory followed by entry into water and a subsequent run under water is disclosed in an application for a Water Discriminating Fuze, Serial No. 405,264, filed January 20, 1954 by H. D. Saunderson.

The present invention, which replaces the mechanical integrator switch devised by Saunderson, achieves a similar result by electrical means and like said integrator does not allow the detonator to ignite during water entry of the missile, increases the sensitivity of the fuze as the missile velocity decreases, and also allows the detonator to ignite whenever the missile impacts the target regardless of the position of the missile on its trajectory.

Essentially the multiple sensitivity fuze of the present invention comprises an electrical detonation circuit and switching mechanism whereby a capacitor, which is charged prior to launching of said missile, transfers an electric charge to a chain of capacitors as switches are actuated by the mechanical movement of a member whose inertia decreases as the velocity of said missile decreases, thereby causing the detonator to ignite upon missile impact with the target at progressively lower decelerations and also causing detonation to occur whenever said missile deceleration exceeds a specified minimum value.

One object of the present invention is to provide an improved detonation fuzing circuit for a missile having an air-water trajectory which will by electro-mechanical switching means become more sensitive as the missile velocity decreases.

Another object of the present invention is to provide a detonation circuit for a multiple sensitivity fuze which is composed of few moving parts to insure reliability of operation, is simple to construct and may be easily aligned and adjusted.

A further object of the present invention is to provide a fuze with electrical means for integrating the deceleration of a missile on water entry and which allows the detonator to ignite whenever the missile impacts a target regardless of the position of the missile in its trajectory.

Still another object of the present invention is to provide a multiple sensitivity fuze that may be used on certain missiles for discrimination between hulls or bulkheads of ships, tanks and other targets.

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

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detailed description when considered in connection with the accompanying drawings wherein:

Fig. 1 is a schematic diagram of a detonation circuit illustrating one preferred embodiment of the present invention employing a chain of five capacitors;

Fig. 2 is an enlarged side elevational view of one structural embodiment of the switches shown in Fig. 1, combined into a single switching mechanism with an inertia ball and cone actuator; and

Fig. 3 is a schematic diagram of my detonation circuit in a simplified form for use in a fuze that discriminates between hulls and bulkheads of a target.

Referring now to the drawings in detail wherein like reference numerals designate the same elements, in Fig. 1 reference numerals 10 and 11 designate the leads of an input circuit which is connected across capacitor 12. Single-pole single-throw switches 13 and 14 and single-pole double-throw switches 15, 16, 17 and 18 comprise the switch mechanism shown in Fig. 2 and which will be described infra. Capacitors 19, 20, 21, 22 and 23 are preferably of the low leakage type and are each connected with one connection to the grounded lead 11 of the input circuit. The other lead of capacitor 19 is connected to the lower contacts of switches 14 and 15. Capacitor 20 is connected to the switch arm of switch 15 and the lower contact of switch 16. Capacitors 21 and 22 are similarly connected to the switch arms of switches 16 and 17 respectively, and to the lower contacts of switches 17 and 18 respectively. Capacitor 23 is connected to the switch arm of switch 18. The switch arm of switch 13 is connected to the junction of input lead 10 and capacitor 12, and the contact of switch 13 connects to the upper contacts of switches 15, 16, 17 and 18 and to detonator 24. The switch arm of switch 14 also connects to the junction of input lead 10 and capacitor 12, and the contact of switch 14 connects to the junction of the contact of switch 15 and capacitor 19.

In Fig. 2 is shown a preferred mechanical form of switch mechanism in which the switches 13, 14, 15, 16, 17 and 18, shown in Fig. 1, are mounted on a supporting frame 25 that has bearings 26 and 27 through which shaft 28 can move longitudinally against compression spring 33 in the direction of flight and deceleration indicated by the arrow. Switch actuating collars 29, 30 and 31 are made of any rigid insulating material, such as Bakelite, and are securely mounted by set screws or the like on shaft 28, being positioned thereon in such a manner that when the shaft 28 is moved in the direction indicated by the arrow, collar 29 sequentially actuates switches 18 and 17, after which collar 30 sequentially actuates switches 16 and 15, and thereafter collar 31 sequentially actuates switches 14 and 13.

Spherical mass 32 is mounted in a suitable conical member 34 and is in contact with the end of shaft 28. If desired a ball and cone mechanism may be utilized such as the one illustrated in Fig. 6 of the application by H. D. Saunderson for a Water Discriminating Fuze, Serial No. 405,264, filed January 20, 1954.

In the operation of my sequential energy transfer system for detonation, capacitor 12 is charged through input circuit 10 and 11 before or at the moment the missile is released from the launcher. If the missile, while airborne, impacts the target, a momentarily large deceleration of the missile takes place and the inertial force acting on the mass 32 causes said mass and the shaft 28 to move in the direction indicated by the arrow and the collars 29, 30 and 31 to move the switch arms of switches 18, 17, 16, 15, 14 and 13 to their respective upper positions. With all switches in their upper positions, capacitors 23, 22, 21, 20 and 19 and detonator

24 are connected in parallel across charged capacitor 12 and said detonator ignites.

If the missile enters water prior to target impact, the inertial force due to missile deceleration causes the mass 32 to move the shaft 28 for a part of its stroke, the switches 18, 17, 16, 15 and 14 move in sequence to their respective upper positions and the capacitor 19 is then charged from capacitor 12. As the deceleration of the missile decreases due to water entry and underwater travel, inertial force on mass 32 decreases and said mass and shaft 28 return to their normal position causing switch 14 to open and switches 15, 16, 17 and 18 to return in sequence from their respective upper positions to their respective lower positions. When the switch arm of switch 15 returns to the lower position, capacitors 19 and 20 are connected in parallel and a portion of the charge on capacitor 19 is transferred to capacitor 20. Similarly, when switches 16, 17 and 18 return to their respective lower positions, capacitors 21, 22 and 23 are connected in parallel in sequence with capacitors 19 and 20 and a portion of the charge on the capacitors which are connected in parallel is transferred to the next connected capacitor. It will be noted that the energy which is stored in capacitor 12 is greatly in excess of that required to ignite the detonator and that the energy subsequently stored in each of capacitors 19, 20, 21, 22 and 23 is more than sufficient to ignite the detonator.

During the underwater portion of the trajectory the missile may impact the target during or before the time that the sequence of movement of the switch arms of switches 15, 16, 17 and 18 to their lower positions is being completed. In such a case increased deceleration of the missile occurs and the switch arm of the switch next moved to the upper position by the movement of its associated collar 29 or 30 completes the circuit whereby the capacitor connected to said switch arm discharges through and ignites detonator 24. When the missile reaches its minimum deceleration, switches 15, 16, 17 and 18 are in their lower position and if said missile then impacts a target, switch arm of switch 18 moves from its lower position to its upper position and the charge resident in capacitor 23 causes the detonator to ignite.

A simplification of the detonation circuit for a multiple sensitivity fuze that may be used on a plunge bomb or other missile for discrimination between hulls or bulkheads of ships, tanks, and other targets is shown schematically in Fig. 3, wherein reference numerals 40 and 41 designate the leads of the input circuit which is connected to capacitor 42. The switch arm of single-pole single-throw switch 43 is connected to the junction of input lead 40 and capacitor 42 and the contact of said switch connects to the junction of capacitor 44 and one contact of single-pole double-throw switch 45. The switch arm of switch 45 is connected to capacitor 46 and the other contact of said switch is connected to detonator 47. The two switches 43 and 45 could be mounted in an inertia ball and cone actuated mechanism such as that shown in Fig. 2.

In operation capacitor 42 is charged at the plane or launched prior to or at the moment of release of the missile or bomb. A large deceleration occurs when the missile strikes the first bulkhead and the inertial force of the mass 32 within the switch mechanism, as before, causes movement of shaft 28 and attached collars to close switches 43 and 45 on their upper positions. Thereupon capacitor 42 transfers a portion of its charge to capacitor 44. After the missile has penetrated the first bulkhead, deceleration is reduced and the switch mechanism causes the switch arm to switch 45 to make contact in its lower position whereby capacitor 46 receives a portion of the charge on capacitor 44. When the missile next impacts another bulkhead or whenever the missile is subjected to another marked deceleration, switch

arm of switch 45 again moves to its upper position and the charge on capacitor 46 fires the detonator.

It will be understood that a greater or lesser number of capacitors with their associated switches and insulating collars may be used to sequentially transfer energy from a previously charged capacitor to vary the number of steps of sensitivity of a fuze and that the values of said capacitors and the voltage to which they may be charged may be adjusted to ignite the detonator in an extremely small interval after the missile impacts the target. The specific values given in the drawings are merely for the purpose of illustrating certain operative forms of the invention.

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 is:

1. A multiple sensitivity fuze for a missile having an air-water trajectory comprising a plurality of capacitors for storing electrical energy, a plurality of switches for selectively interconnecting said capacitors in parallel and connecting at least one of said capacitors to a detonator, one of said capacitors being adapted to receive an initial charge, a single-pole single-throw switch adapted to connect said one capacitor to the next adjacent capacitor, and another single-pole single-throw switch adapted to connect said one capacitor to a detonator, at least one single-pole double-throw switch adapted to connect said adjacent capacitor to certain others of said capacitors in parallel in one position and to the detonator in another position, means for mounting said switches in a staggered arrangement, and spring restrained inertia means adapted to actuate said switches sequentially in response to acceleration forces, whereby on water entry said single-pole double-throw switches are moved to the other position and the first of said single-pole single-throw switches is closed to transfer energy from the first capacitor to the second capacitor and as the deceleration decreases energy is sequentially transferred from one capacitor to another and at any time during the air or water phase the force of acceleration will connect a charged capacitor to said detonator through the second of said single-pole single-throw switches or one of said single-pole double-throw switches.

2. A multiple sensitivity fuze as set forth in claim 1 wherein said inertia means comprises a shaft having a plurality of collars mounted thereon for actuating said switches and a ball and cone actuator adapted to move said rod axially in response to changes in acceleration.

3. A multiple sensitivity fuze for discrimination between hulls and bulkheads of targets comprising a detonator, a plurality of capacitors for storing electrical energy, one of said capacitors being adapted to receive an initial charge, a single-pole single-throw switch adapted to connect said one capacitor to a second of said capacitors connected in parallel therewith, a single-pole double-throw switch adapted to connect said second capacitor to a third of said capacitors in one position and connect said third capacitor to said detonator in a second position, and spring restrained inertia means adapted to actuate said switches sequentially in response to acceleration forces, whereby on initial impact said single-pole single-throw switch is closed to transfer energy to said second capacitor and as the deceleration decreases said single-pole double-throw switch is returned to a position for transferring energy to said third capacitor and on a subsequent impact said single-pole double-throw switch moves to another position for transferring energy from said third capacitor to said detonator.

4. A sequential energy transfer fuze circuit comprising a plurality of electrical storage means, one of said storage means being adapted to hold an initial charge, additional means responsive to an initial deceleration

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force for transferring the initial charge to a second of said storage means, said additional means including means responsive to a subsequent deceleration for transferring the charge to at least one other of said storage means, and said additional means including means responsive to a later deceleration for connecting said charge across a load.

5. A sequential energy transfer fuze circuit as set forth in claim 4 wherein said means responsive to an initial deceleration force includes a plurality of switching devices. 10

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6. A sequential energy transfer fuze circuit as set forth in claim 4 wherein said storage means include capacitors and said load includes a detonator.

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