# United States Patent [19]

**Finger**

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[54] **MINE FUZES**


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[73] Assignee: **The United States of America as represented by the Secretary of the Army,** Washington, D.C.



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[52] **U.S. Cl.** ..... **102/19.2,** 102/8

[51] **Int. Cl.** ..... **F42c 7/02**

[58] **Field of Search** ..... 102/8, 9, 16–18, 102/19.2, 70.2; 89/1



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[57] **ABSTRACT**

An electric land mine fuze comprising a detonator for initiating the detonation of an explosive, a firing capacitor for accumulating and storing a voltage, a power supply connected to said firing capacitor for charging said firing capacitor to a voltage sufficient to fire said detonator, first and second series connected normally open function switch means operated by the passage of a vehicle and electrically connecting said firing capacitor to said detonator whereby the voltage stored on said firing capacitor is transferred to said detonator causing said detonator to fire when said first and second function switches are closed by the passage of a vehicle, and a short-term voltage memory device connected between said first and said second function switches for storing the firing voltage from said firing capacitor when said first function switch closes before said second function switch thereby causing detonation when said first and said second function switches are sequentially actuated.


**9 Claims, 5 Drawing Figures**

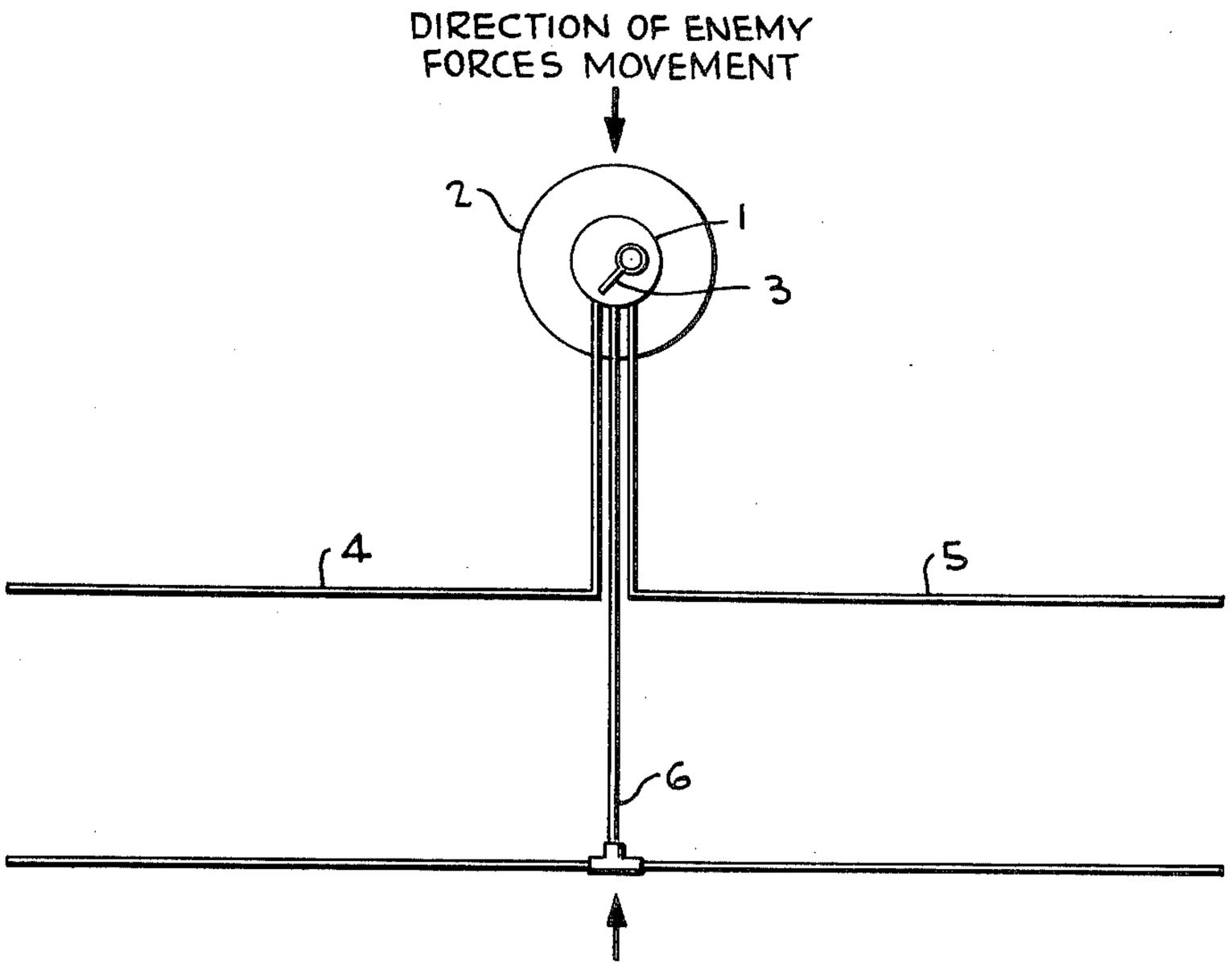

FIG. 1

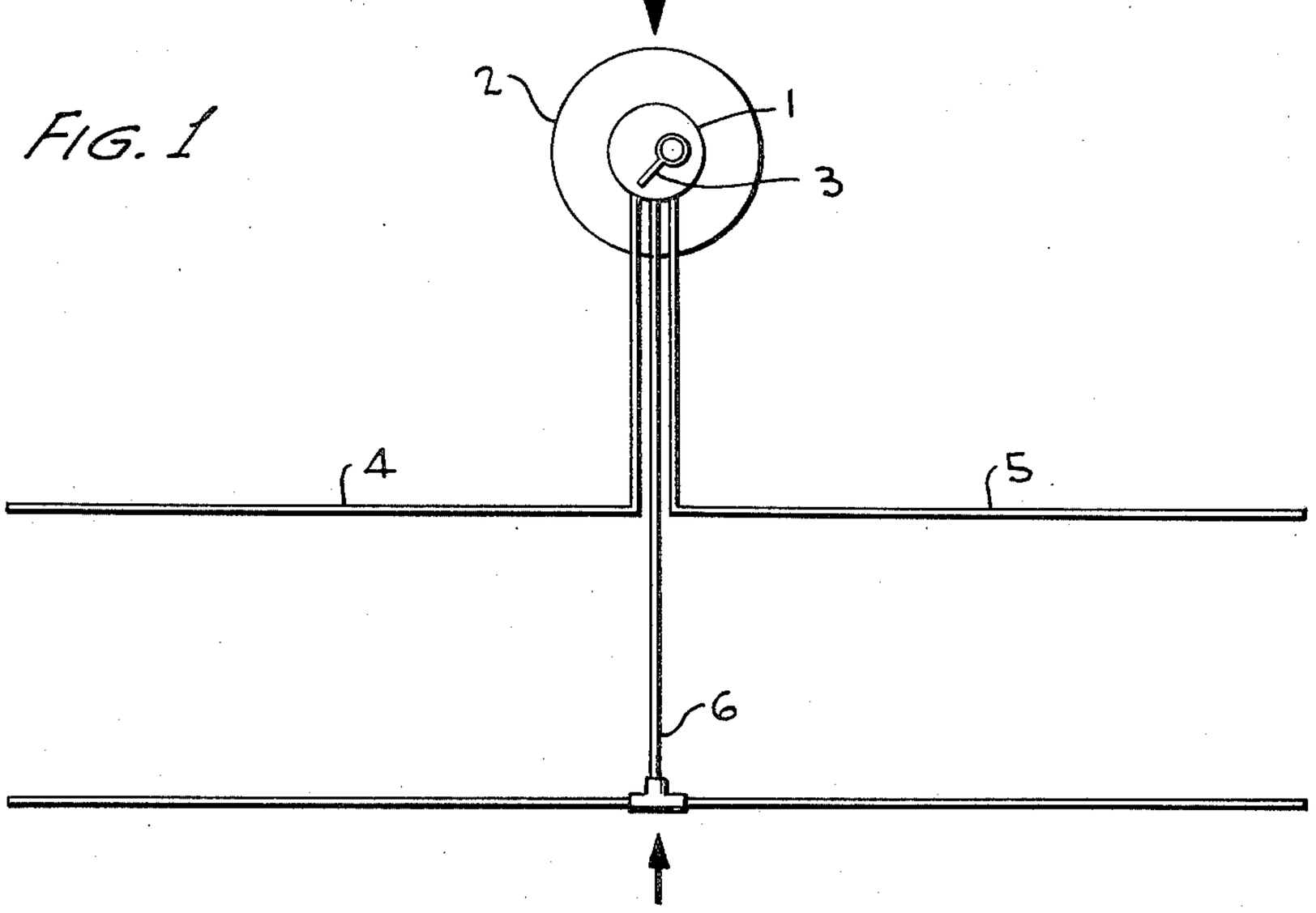


FIG. 2

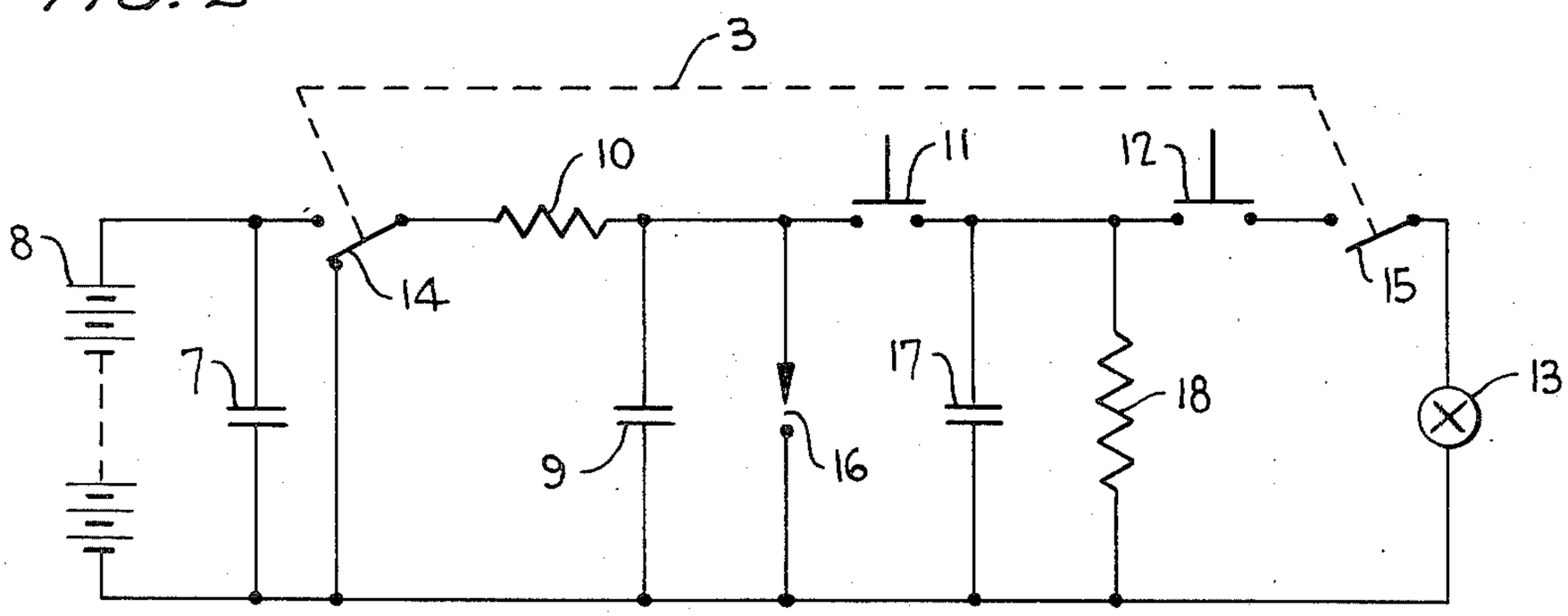


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FIG. 3

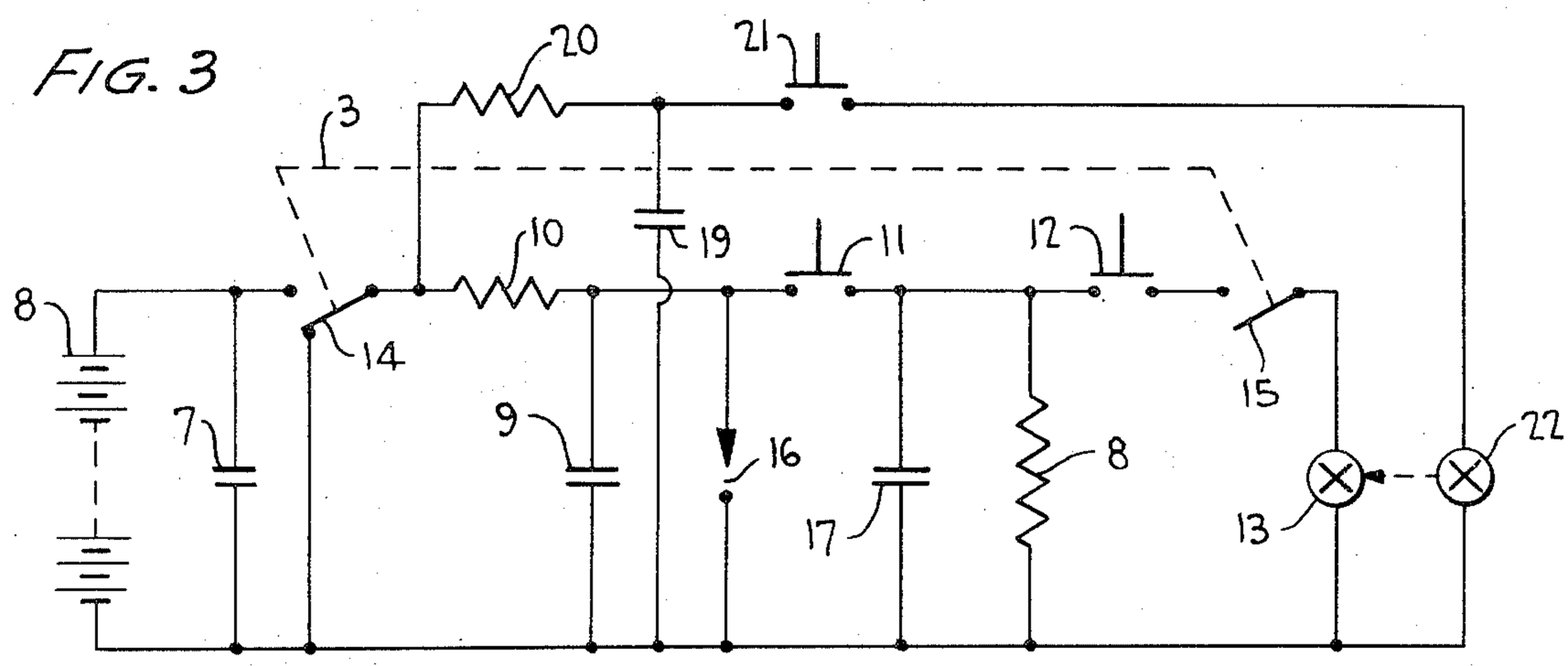



FIG. 4

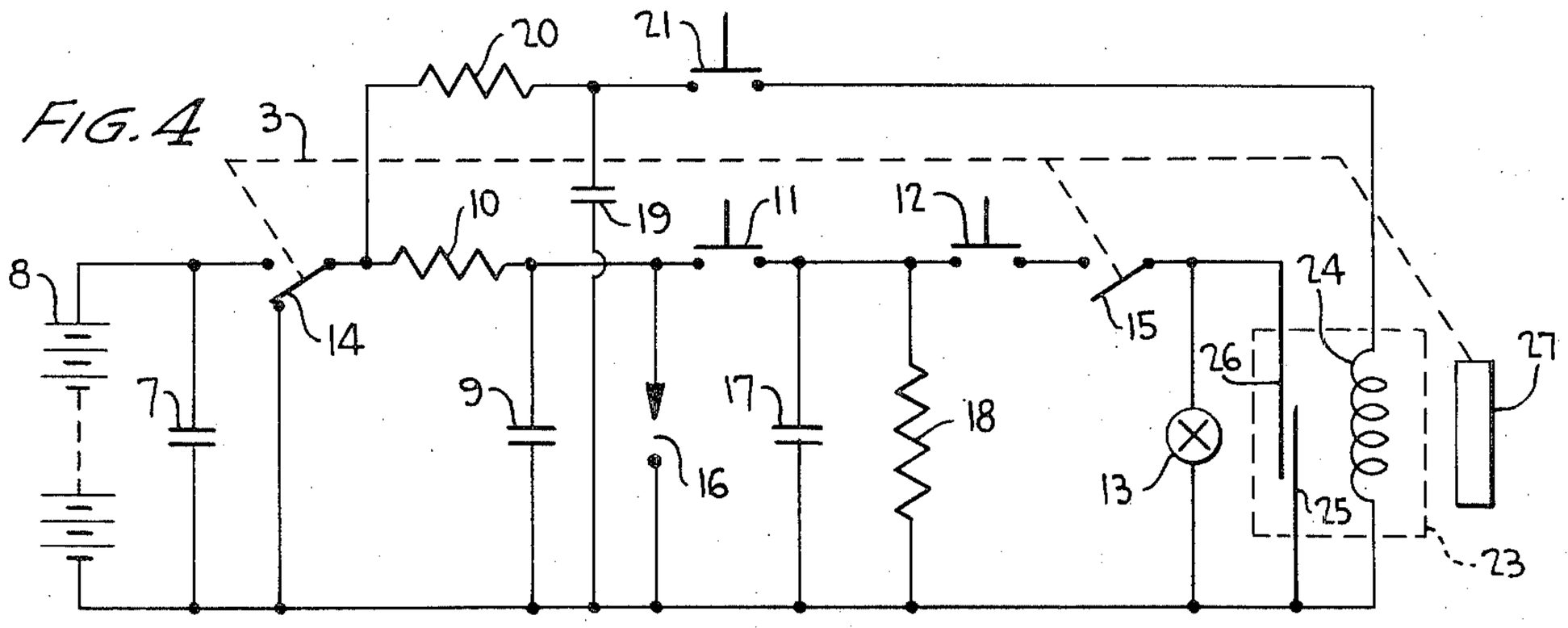
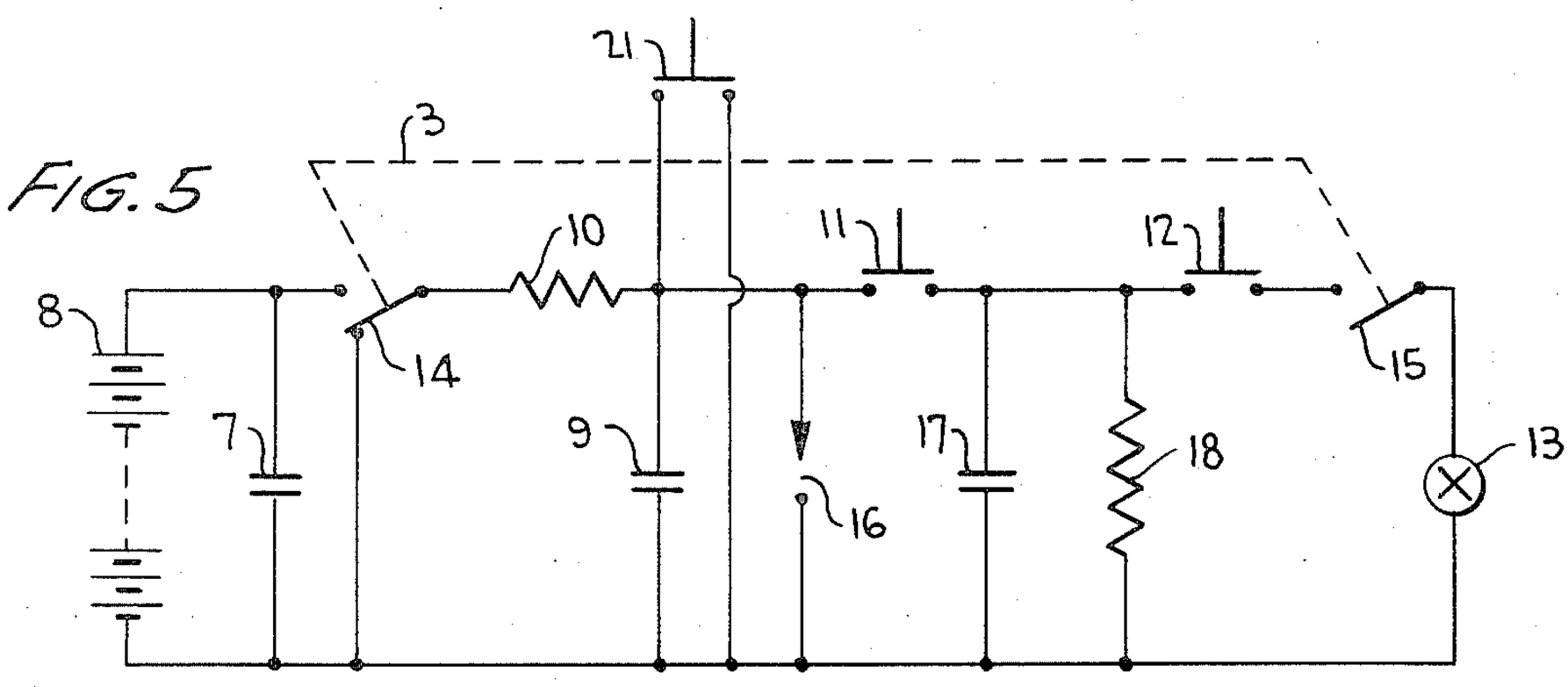



FIG. 5

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# MINE FUZES

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 to me of any royalty thereon.

This invention relates generally to mine fuzes, and more particularly to anti-vehicle electric land mine fuzes of the belly-attack variety and to improvements in electric land mine fuzes which permit the safe passage of friendly vehicles while at the same time denying safe passage of enemy vehicles.

The development of anti-vehicle land mines has in the past required compromises in many desired features to produce a serviceable yet economical mine fuze. At a time when stock-piling of weapons is required to enable the military forces to respond to changing international conditions in a minimum amount of time, it is desirable that mine fuzes have a long shelf-life and yet be serviceable with little or no maintenance or adjustment. After a mine has been emplaced, it is desirable that the fuze be resistant to nuclear and chemical explosive mine clearing techniques which may be employed by enemy forces while at the same time it is desirable that the fuze be highly reliable against enemy vehicles.

A number of fuzes have been developed which have been serviceable, but all have involved some compromise in design. Mine fuzes which have many of the more desirable features usually are too sophisticated and expensive for generalized applications and require specialized handling and personnel training.

It has long been obvious to those concerned with the use of both barrier and defensive mine fields that many times it would be desirable for a friendly force to have the option of transiting its own minefield. At the same time, it is equally necessary to maintain the integrity of the field and deny to the enemy movement across the area. With the advent of more fluid battlefield conditions, hasty implantation and recovery of mine fields, increased mobility of tank units and greater enemy firepower, it is of increasing importance that field units be able to exit an area in any direction and not be hemmed in by their own protective minefields.

In the past, the movement of friendly forces over a minefield has been through marked routes or by various mine-clearing methods. Either of these methods involved tedious execution for a successful transit. This is further aggravated under low visibility conditions or during enemy attack. Furthermore, enemy use of a marked route is not always denied.

A number of methods and devices have been proposed to provide friendly forces with the option to transit their own defensive minefields. However, all the methods and devices thus far proposed are sophisticated and require modification of individual vehicles. Additionally, the devices previously proposed are expensive to produce and require periodic field maintenance to maintain operability.

It is therefore an object of the present invention to provide an inexpensive and highly reliable anti-vehicle land mine fuze which is resistant to nuclear and chemical explosive mine clearing techniques.

It is another object of this invention to provide an electric land mine fuze which has a long shelf-life and requires no maintenance or adjustment and which may



be quickly and easily emplaced with relative safety by military personnel having minimum training.

It is still another object of the invention to provide an improvement in electric land mine fuzes which will allow the movement of friendly forces over their own defensive minefields and yet will maintain the integrity of the minefields against incursions by enemy forces.

It is a further object of the instant invention to provide a simple and inexpensive improvement in land mine fuzes which permits friendly forces the option to transit their own minefields.

According to the present invention, the foregoing and other objects are attained by providing a detonator which is fired by the discharge of a firing capacitor in response to the overpassage of a vehicle, a shock sensitive switch for deactivating the fuze in response to an explosion to prevent sympathetic explosion, and means connected to a fuze for sensing the movement of friendly vehicles toward the fuze and for deactivating the fuze when such movement is sensed.

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

FIG. 1 shows the emplacement of a land mine with a fuze according to the invention;

FIG. 2 shows a schematic diagram of an electrical circuit of an electric land mine fuze according to the invention;

FIG. 3 shows a schematic diagram of the electrical circuit shown in FIG. 2 modified to form another embodiment of the present invention;

FIG. 4 shows a schematic diagram of the electrical circuit shown in FIG. 2 modified to form still another embodiment of the invention; and

FIG. 5 shows a schematic diagram of the electrical circuit shown in FIG. 2 modified to form a further embodiment of the instant invention.

Referring now to the drawings wherein like reference numerals designate identical or corresponding parts throughout the several figures, and more particularly to FIG. 1 wherein the fuze 1 is shown attached to a mine 2 emplaced as part of a defensive perimeter for friendly forces. The handle 3 on the fuze 1 permits the manual safing and arming of the fuze. Pneumatic function tubes 4 and 5 connected to the fuze 1 are arranged in a line which is substantially perpendicular to the expected direction of enemy forces movement. The fuze 1 works on the same principle as gasoline station announcing bells. Its pneumatic system consists of three chambers separated by two pressure-operated switches. Two of these chambers are the function tubes 4 and 5, and the third and central chamber is the case of the fuze 1. Each pneumatic switch consists of a glass cylinder and a carbon piston which carries a conducting disc. The piston lifts the disc to contact two rivets. Slow air leakage is possible past the pistons to provide equalization of any pressure differences due to temperature variation and other factors. In use, vehicle overpassage of either of the function tubes 4 or 5 distorts the cylindrical shape of part of the tube. This results in a decreased volume and increased pressure in the chamber defined by the tube causing the actuation of its associated pneumatic switch. For detonation of the fuze to occur, it is necessary that both function tubes 4 and 5 be distorted. This assures that the vehicle causing detonation will be over the mine 2 when detonated

by the fuze 1. The mine is therefore designed to attack the belly of the vehicle causing its total destruction rather than merely disabling the vehicle. Reliability of detonation is enhanced by looping the left hose around the mine and extending it to the right and looping the right hose around the mine and extending it to the left. Arranged in this manner detonation will still occur even when the tread of the vehicle passes directly over the fuze. A third pneumatic tube 6 in the shape of a T has its stem connected to the fuze 1 and extends toward the area of friendly forces concentration and has its cross joined to the outward extremity of the stem and arranged perpendicular to the expected direction of friendly forces movement. The tube 6 is the deactivate tube and, when distorted by a vehicle overpassage, causes the deactivation of the fuze 1 rendering the mine 2 safe permitting successful transit of the minefield. The reliability of operation by the deactivate tube 6 is greater than that for operation by function tubes 4 and 5 since only one wheel or tread need distort the tube 6. The arrangement of function tubes 4 and 5 shown in FIG. 1 provides an additional fail-safety feature. A vehicle approaching from the area of friendly forces concentration would not be impaired or would suffer only minimal damage even if the mine operated since the offset provided by the arrangement of function tubes 4 and 5 would place the explosion ahead of the vehicle. Effectiveness against enemy vehicles is maintained since the explosion would occur under a vehicle approaching from the area of enemy forces concentration.

FIG. 2 shows a schematic diagram of the electric detonating circuit of a fuze according to the present invention which employs only the two function tubes 4 and 5 shown in FIG. 1. The power supply of the circuit comprises a storage capacitor 7 connected in parallel with battery 8. Firing capacitor 9 is charged through resistor 10 by the power supply. Pneumatic switches 11 and 12 when closed by the distortion of the function tubes 4 and 5 provide a discharge path for the firing capacitor 9 through the detonator 13. When the firing capacitor 9 discharges through the detonator 13, the detonator fires and initiates the explosion of the mine to which the fuze is attached. Ganged safety and arming switches 14 and 15 are actuated by movement of the handle 3 shown in FIG. 1. The handle 3 has a safe position and an armed position. When in the safe position the switches 14 and 15 are in the position shown in FIG. 2. Switch 14 disconnects firing capacitor 9 from the power supply and provides a discharge path through the resistor 10, and switch 15 disconnects the detonator 13 from firing capacitor 9. A shock responsive switch 16, such as the non-resonant inertia type commonly used to disarm mines, is connected across firing capacitor 9 and serves to prevent sympathetic detonation by nearby explosions. Shock switch 16 is designed to have a sensitivity such that it will not be activated by the vibrations produced by the heaviest tank but that it will be activated by the shock waves produced by a nearby explosion. A short-time analog memory comprising capacitor 17 and resistor 18 is provided between switches 11 and 12. Its purpose is to insure detonation when the function hoses 4 and 5 are traversed on an oblique angle causing switch 11 to close and open before switch 12 closes. When switch 11 closes and switch 12 remains open, firing voltage is transferred to capacitor 17. The resistor 18 provides a long time constant discharge path for capacitor 17. If switch 12 closes before capacitor 17 has discharged to a voltage less than firing voltage, detonation will still occur.

FIG. 3 shows a schematic diagram of the circuit shown in FIG. 2 modified to cause permanent deactivation of the fuze when the deactivation tube 6 is traversed by a vehicle. Storage capacitor 19 is connected to be charged through resistor 20. Pneumatic switch 21 when closed by the distortion of the deactivate tube 6 provides a discharge path for the storage capacitor 19 through detonator deactivation device 22. When the storage capacitor 19 discharges through the device 22, the device 22 is actuated causing the permanent deactivation of the detonator 13. The device 22 may for example be a bellows actuator which, when actuated, would remove the detonator from the in line position.

The circuit shown in FIG. 4 permits manual reactivation of the detonator 13 after the deactivate tube 6 has been traversed. In this circuit the detonator deactivation device 22 shown in FIG. 3 is replaced by latching relay 23. When pneumatic switch 21 is closed the storage capacitor 19 discharges through the actuating coil 24 of the relay 23 causing contacts 25 and 26 to close thereby short circuiting the detonator 13 and rendering it safe. The contacts 25 and 26 remain closed after switch 21 opens again due to latching magnet 27. Latching magnet 27 is connected to the handle 3. When the handle 3 is moved into the safe position when the fuze is manually disarmed, magnet 27 is rendered ineffective to influence the contacts 25 or 26. This may be accomplished for example by magnetically shielding the magnet or physically removing the magnet from the vicinity of the contacts. Thus, the reactivation procedure comprises the steps of moving the handle 3 into the safe position and then moving the handle 3 back into the armed position.

The circuit shown in FIG. 5 automatically reactivates the detonator 13 after a predetermined time period. In this circuit the pneumatic switch 21 is connected across the firing capacitor 9. When the switch 21 is closed by the distortion of deactivate tube 6, the capacitor 9 is instantly discharged. After a period of time determined by the RC time constant of resistor 10 and capacitor 9, the firing capacitor again is charged to a potential which will fire the detonator 13.

It will be apparent that the embodiments shown are only exemplary and that various modifications can be made in the construction and arrangement within the scope of the invention. For example, trip wires or photoelectric detectors might be used instead of the pneumatic tubes and pneumatic switches. 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 and desired to be secured by Letters Patent of the United States of America is:

1. An electric land mine fuze comprising a detonator for initiating the detonation of an explosive, a firing capacitor for accumulating and storing a voltage, a power supply connected to said firing capacitor for charging said firing capacitor to a voltage sufficient to fire said detonator, first and second series connected normally open function switch means operated by the passage of a vehicle and electrically connecting said firing capacitor to said detonator whereby the voltage stored on said

firing capacitor is transferred to said detonator causing said detonator to fire when said first and second function switches are closed by the passage of a vehicle, and a short-term voltage memory device connected between said first and said second function switches for storing the firing voltage from said firing capacitor when said first function switch closes before said second function switch thereby causing detonation when said first and said second function switches are sequentially actuated.

2. In an electric land mine fuze having a detonator for initiating the detonation of an explosive, a firing capacitor for accumulating and storing a voltage sufficient to fire the detonator, and normally open function switch means operated by the passage of an enemy vehicle and electrically connecting the firing capacitor to the detonator whereby the voltage stored on the firing capacitor is transferred to the detonator causing the detonator to fire when the function switch is closed by the passage of an enemy vehicle, the improvement comprising normally open deactivate switch means operated by the passage of a friendly vehicle and connected in parallel with said detonator for causing the deactivation of the detonator when the deactivate switch is closed by the passage of a friendly vehicle.

3. In an electric land mine fuze having a detonator for initiating the detonation of an explosive, a firing capacitor for accumulating and storing a first voltage sufficient to fire the detonator, and normally open function switch means operated by the passage of an enemy vehicle and electrically connecting the firing capacitor to the detonator whereby the voltage stored on the firing capacitor is transferred to the detonator causing the detonator to fire when the function switch is closed by the passage of an enemy vehicle, the improvement comprising means for deactivating the detonator in response to an electrical signal, a storage capacitor connected in parallel with the firing capacitor for accumulating and storing a second voltage sufficient to cause the actuation of said means for deactivating the detonator, and normally open deactivate switch means operated by the passage of a friendly vehicle and electrically connecting said storage capacitor to said means for deactivating the detonator whereby an electrical signal proportional to said second voltage stored on the storage capacitor is transferred to the means for deactivating when the deactivate switch is closed by the passage of a friendly vehicle.

4. In an electric land mine fuze having a detonator for initiating the detonation of an explosive, a firing capacitor for accumulating and storing a first voltage sufficient to fire the detonator, and normally open function switch means operated by the passage of an enemy vehicle and electrically connecting the firing capacitor to the detonator whereby the voltage stored on the firing capacitor is transferred to the detonator causing the detonator to fire when the function switch is closed by the passage of an enemy vehicle, the improvement comprising means for permanently deactivating the detonator in response to a voltage signal, a storage capacitor connected in parallel with the firing capacitor for accumulating and storing a second voltage sufficient to actuate said means for permanently deactivating the detonator, and normally open deactivate switch means operated by the passage of a friendly vehicle and electrically connecting said storage capacitor to said means for permanently deactivating the detonator whereby the voltage stored on the storage capacitor is transferred to the means for permanently deactivating when the deactivate switch is closed by the passage of a friendly vehicle.

5. In an electric land mine fuze having a detonator for initiating the detonation of an explosive, a firing capacitor for accumulating and storing a first voltage sufficient to fire the detonator, and normally open function switch means operated by the passage of an enemy vehicle and electrically connecting the firing capacitor to the detonator whereby the voltage stored on the firing capacitor is transferred to the detonator causing the detonator to fire when the function switch is closed by the passage of an enemy vehicle, the improvement comprising a latching relay having first and second normally open contacts connected in parallel with the detonator and an actuating coil for closing said first and second normally open contacts in response to a current signal, a storage capacitor connected in parallel with the firing capacitor for accumulating and storing a second voltage sufficient to cause the actuation of said latching relay, normally open deactivate switch means operated by the passage of a friendly vehicle and electrically connecting said storage capacitor to said actuating coil whereby a current proportional to said second voltage stored on the storage capacitor is caused to flow through said actuating coil thereby causing said first and second contacts to close, latch, and short circuit the detonator rendering the fuze safe, and means for unlatching said first and second contacts.

6. In an electric land mine fuze having a case which houses a detonator for initiating the detonation of an explosive, a firing capacitor for accumulating and storing a first voltage sufficient to fire the detonator, normally open function switch means operated by the passage of an enemy vehicle and electrically connecting the firing capacitor to the detonator whereby the voltage stored on the firing capacitor is transferred to the detonator causing the detonator to fire when the function switch is closed by the passage of an enemy vehicle, a safety and arming switch electrically connected to the detonator for rendering the detonator safe when in a first position and for arming the detonator when in a second position, and a handle exterior to the case and having a safe position and an arming position and connected to the safety and arming switch for moving the safety and arming switch between the first and second positions, the improvement comprising a latching relay having first and second normally open contacts connected in parallel with the detonator and an actuating coil for closing said first and second normally open contacts in response to a current signal, a storage capacitor connected in parallel with the firing capacitor for accumulating and storing a second voltage sufficient to cause the actuation of said latching relay, normally open deactivate switch means operated by the passage of a friendly vehicle and electrically connecting said storage capacitor to said actuating coil whereby a current proportional to said second voltage on the storage capacitor is caused to flow through said actuating coil thereby causing said first and second contacts to close, latch, and short circuit the detonator rendering the fuze safe, and a latching magnet connected to the handle for maintaining said first and second contacts in closed position after being closed by said actuating when the handle is in the arming position, said latching magnet being ineffective to maintain

said first and second contacts in closed position when the handle is in the safe position.

**7.** In an electric land mine fuze having a detonator for initiating the detonation of an explosive, a firing capacitor for accumulating and storing a voltage sufficient to fire the detonator, and normally open function switch means operated by the passage of an enemy vehicle and electrically connecting the firing capacitor to the detonator whereby the voltage stored on the firing capacitor is transferred to the detonator causing the detonator to fire when the function switch is closed by the passage of an enemy vehicle, the improvement comprising normally open deactivate switch means operated by the passage of a friendly vehicle and connected in parallel with said firing capacitor for causing the discharge of said firing capacitor when said deactivate switch is closed thereby causing the deactivation of the detonator.

**8.** A land mine fuze which permits the safe passage of friendly vehicles over an area while at the same time denying safe passage of enemy vehicles over the area comprising a detonator, means for sensing the passage of a vehicle in the immediate vicinity of the fuze, means connected to said first mentioned means for sensing and to said detonator for firing said detonator when said first mentioned means for sensing senses the passage of a vehicle in the vicinity of the fuze, means for sensing the approach of a vehicle toward the fuze from an area of concentration of friendly forces, and means connected to said second mentioned means for sensing and to said detonator for deactivating said detonator when said second mentioned means for sensing senses the movement of a vehicle toward the fuze from an area of concentration of friendly forces.

**9.** The land mine fuze according to claim **8** further comprising means connected to said detonator for deactivating said detonator in response to the shock produced by a nearby explosion thereby preventing sympathetic detonation of said fuze.

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