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MEMORANDUM REPORT M66-14-1

AN ELECTRONIC TRIGGERING DEVICE FOR BOOBY TRAP AND PERIMETER DEFENSE APPLICATIONS

BY

WILLIAM A. DITTRICH

AMCMS CODE 5543.12.46802.01

DA PROJECT NUMBER 1W542703D346

NOVEMBER 1965

UNITED STATES ARMY
FRANKFORD ARSENAL
PHILADELPHIA, PA.

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Small Caliber Engineering Directorate

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Philadelphia, Pa. 19137

ABSTRACT

A simple, inexpensive electronic trigger device has been designed, fabricated, and tested for use in demolition, booby trap, and perimeter defense applications. The interruption of a minute current caused when a fine trip wire is broken is used to switch an electric current to a detonator, claymore mine, alarm or similar device. Tests conducted to date show its feasibility. Recommendations for additional work include final selection of operation current and voltage as determined by user requirements, and tests to assure conformance with environmental specifications.

INTRODUCTION

In special warfare applications a need exists for a system to detect enemy forces approaching a perimeter defense line or to protect an area by triggering mines or similar devices when the area is intruded. Trip wire systems have been used for years for such applications but they offer the disadvantage of being relatively easy to locate and disarm and, in the case of a warning device where the wire is used to initiate a signal to the sentry, the trip wire will alert the enemy intruder as well.

To improve on the basic mechanical trip wire concept, a simple electronic control circuit has been designed, fabricated, and tested to permit the electrical firing of claymore mines, explosive charges, or for triggering alarms and signal lights when an extremely thin electric wire is broken. The circuit makes use of a silicon controlled rectifier which switches the battery voltage to the detonator when it senses the change in a minute current flowing through the break wire. The low current permits the use of wire almost as thin as human hair which is difficult to detect and easily broken. In addition, the low current drawn by the circuit will permit its operation for months from the firing battery while still providing the self sterilizing feature of eventually discharging the battery to prevent detonator firing.

DESCRIPTION OF DEVICE

The electronic triggering device consists of a controlled rectifier, resistor, capacitor, and indicator lamp housed in a plastic capsule. A photo of the device is shown in figure 1. Of the six leads emanating from the device, two are attached to a battery of 4-1/2 to 7-1/2 volts (e.g., BA-31 or BA-34), two leads to the detonator, electric blasting cap or alarm bell, and two to the break wire circuit. The break wire resistance may be as high as 200 ohms permitting as much as 75 feet of AWG #44 wire (0.002" diameter) or 700 feet of AWG #34 (0.006" diameter) wire to be used in the break wire circuit. While the actual break wire should be no heavier than AWG #34 to permit easy breakage and make detection difficult, long lengths of heavier wire may be used between the break wire and the firing device. For example,

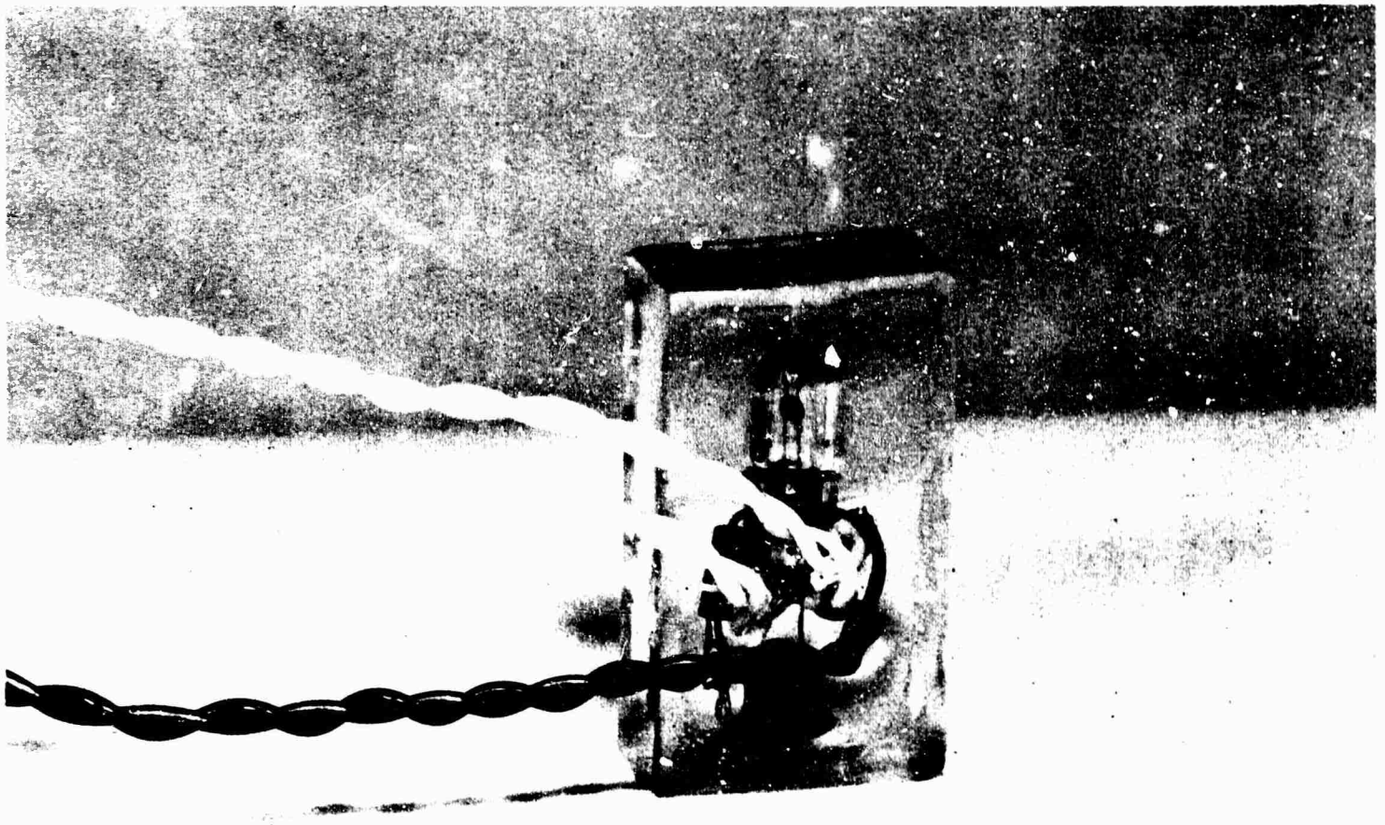


Figure 1. Electronic Triggering Device

one-half mile of blasting or field telephone wire may be used between the device and the break wire if break wire length is limited to 400 feet of #34 wire or 50 feet of #44 wire. This setup method can be useful in an alarm application where the device is coupled to a buzzer or light to indicate the presence of an enemy.

Breaking the wire switches the battery voltage across the lamp and the external firing or alarm circuit. The current carrying capacity of the device is 0.5 ampere continuous or over 5 amperes for short times such as that involved in firing a detonator. While the system is active, with the break wire intact, the current drain is quite low, in the order of 2 milliamperes. A battery such as a BA-31, 3 penlite cells in series or similar power sources will operate for 30 days or more with enough reserve to fire standard detonators such as a J2 blasting cap. Since a continual current drain exists on the battery, the circuit will eventually render itself safe as the battery is exhausted. The time required for a BA-31 battery to discharge to the point where it will no longer fire a detonator will be between one month and one year. Larger capacity batteries such as a BA-200/U may be used for longer operating times. A circuit diagram of the device is shown in figure 2.

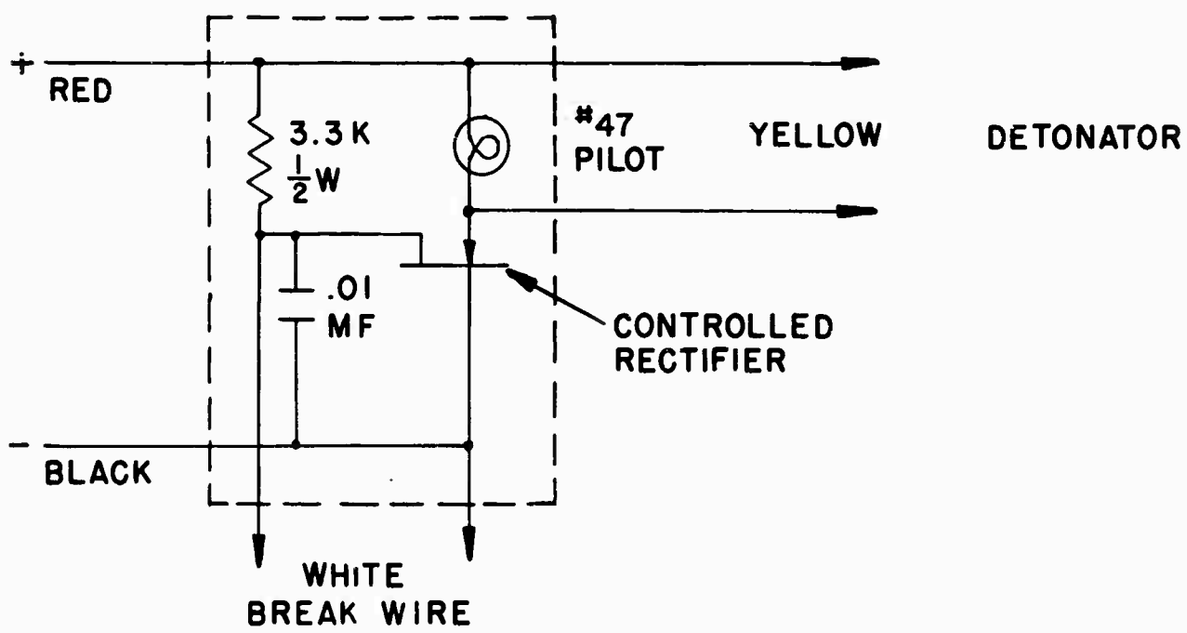
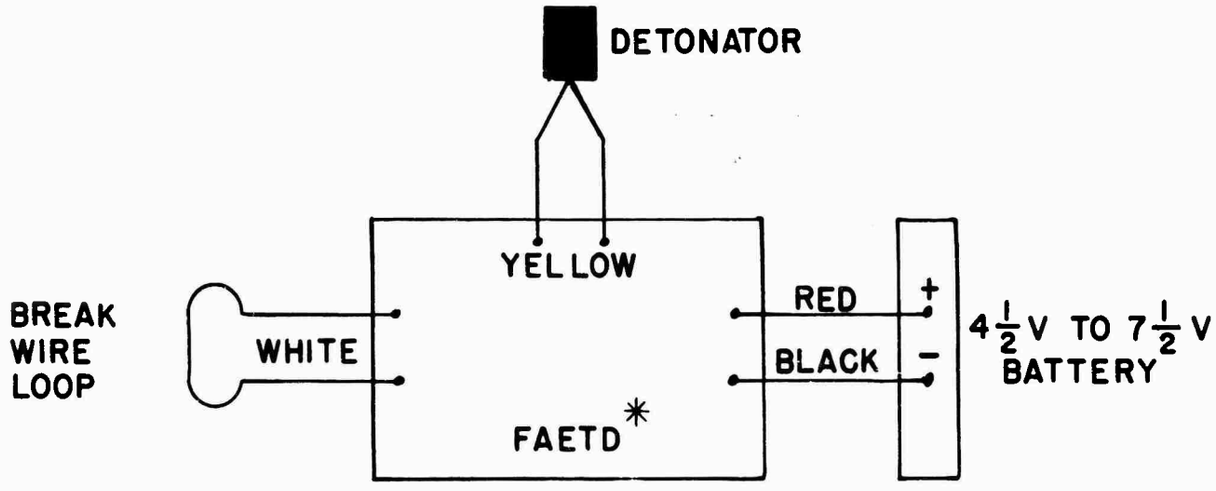


Figure 2. Circuit Diagram of Frankford Arsenal Electronic Triggering Device

The parts are encapsulated in an epoxy case to provide a moisture resistant package capable of withstanding -65 to +165° F temperature extremes. Total cost of parts in small quantity lots was under $2.00. In quantity production it is estimated that the device could be manufactured for between $1.00 and $2.00 per unit.

SETUP PROCEDURE

A wiring diagram for applying the device is shown in figure 3.



*Frankford Arsenal Electronic Triggering Device

Figure 3. Wiring Diagram of FAETD

The following steps should be used in setting up the device:

1. String out break wire and attach ends to white leads. (If break wire is enameled, clean ends with a knife or sandpaper).

2. Attach battery leads (red to positive; black to negative) and observe indicator light. If light is on, the break wire is broken or improperly connected. Recheck break wire circuit and reset system by removing one battery lead and reconnecting. Repeat procedure if light still goes on.

3. With battery connected and light off, open one break wire (white) lead. The light should go on. If it does not, battery or device is defective and should be replaced.

4. Reconnect break wire circuit and reset the device by again removing one battery lead and reconnecting it. The light should now be out.

5. If light is out when battery is connected, the detonator may be attached safely to the yellow leads. When disabling the device, detach the detonator first.

TEST RESULTS

Preliminary tests have been conducted on the device to determine minimum operating voltage to set off an electric detonator (J2 cap), the battery life, the maximum resistance of the firing circuit and similar variables. It was determined that a supply voltage of at least 4.5 volts was required to fire a cap reliably considering the voltage loss of .75 volt in the rectifier. Considering the firing current drawn by the gate of the rectifier an external break wire circuit resistance of 200 ohms or less was found permissible. Ten firing tests were conducted using 3 penlite cells in series as a power source, 75 feet of #44 wire in the break wire loop, and a J2 blasting cap as a load. All caps functioned. No temperature tests were conducted but all components are capable of operation at 200° F or greater. Tests to determine effects of RF radiation on the system, environmental tests, as well as electrical tests on a larger sample of the devices would be required to complete any development task, however.

CONCLUSIONS

The electronic triggering device described above should offer a safe, reliable and useful means of activating booby traps, alarms, mines and similar tasks in sabotage and unconventional warfare. The device could be produced with minimal development effort.

RECOMMENDATIONS

1. It is recommended that a sample lot be procured and evaluated to assure meeting user and military environmental requirements.

2. The device can be made in other current and voltage ratings with no difficulty. An investigation should be made to determine the need for a higher voltage device capable of triggering several detonators from a high voltage battery, or the need for a higher current device capable of operating a powerful klaxon horn or similar warning device.

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