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3,170,399

RADIO REMOTE CONTROL MINE CIRCUIT WITH NO CURRENT DRAIN

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1 Claim. (Cl. 102-19.2)

(Granted under Title 35, U.S. Code (1952), sec. 266)

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

This invention relates to remote control devices for detonating mines and more particularly to a radio operated remote control device wherein there is no current drain.

In the usual electronic remote control devices of the class operated by remotely generated radio pulses, it is necessary to use one or more electron tubes to amplify the received signal in order to obtain sufficient power to trigger the circuit or associated mechanical device. The filaments of such electron tubes are conventionally heated by means of a primary or secondary battery, which is thus under constant drain and consequently the life of which is relatively short. The electron tubes also require a plate supply battery which causes no serious problem since under the operating conditions in the field, the life of the plate supply battery is generally equal to the shelf life of the battery. However, the relatively short life of the filament battery is a serious problem in certain military applications, such as a mine to be planted in enemy territory and detonated by remote control at some future time.

An object of the invention is an electronic remote control circuit in which no batteries are employed.

Another object of the invention is a mine provided with a simple and inexpensive remote control receiver which shall have a comparatively long and unattended life due to the fact that there is no battery drain except when the receiver is being operated by a remote signal.

Another object of the invention is a simple and inexpensive remote control electronic device for causing detonation of mines without requiring the use of batteries.

Another object of the invention is a remote control receiver for detonating mines which shall be comparatively free from the effects of temporary interference.

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

FIGURE 1 is a longitudinal sectional view of an embodiment of the invention.

FIGURE 2 is a schematic diagram of one form of the electronic device of the invention.

FIGURE 3 is a schematic diagram of a modification of the electronic device wherein greater sensitivity is obtained.

Briefly the invention, several embodiments of which are hereinafter described, consists of a circuit responsive to remotely generated radio frequency signals and so designed that no current flows in the circuit when no signal is received. There are two major types of the invention. The one type requires no battery and the other type requires the use of a battery which is in an open circuit until a signal is received. The operating life of the first type of circuit is infinite and that of the second type is limited only by the shelf life of the battery. The sensitivity of the second type is somewhat greater than that of the first type, thus permitting its operation at greater dis-

tances for a given radio transmitter power output or with a lower power output at a given distance.

Referring now to the drawings wherein FIGURE 1 shows an embodiment of the invention, the reference numeral 1 generally indicates a mine comprising a casing 2 having an explosive charge 5 and a partition 3 therein. The partition 3 separates the explosive charge from the electronic components and supports a detonator 4 therein. An antenna 6 in an insulating housing 7 is positioned in one of the walls of the casing 2 so as to be flush with the outside surface of the wall as indicated by 16. The electronic components of the remote control receiver are mounted on a subpanel 8 fixed in the compartment 9 formed by the partition 3 and an end 2a of the casing 2. The compartment is filled with an insulating compound 10 which holds the electronic components rigidly in the compartment and provides water proofing. To prevent premature detonation of the mine during storage or while in transit, a metallic screw 12 is threaded through the antenna 6 into the casing 2 to connect the free end of the antenna to the casing and thereby shortcircuit the coil 13. When the mine is readied for use the screw 12 is removed.

FIGURE 2 of the drawings shows a schematic diagram of the remote control receiving circuit of the invention in which the predetermined radio frequency resonant means comprises an antenna 6 connected to the antenna terminal of the inductor 13 which has its ground terminal connected to the casing 2 of the mine. The inductor is tuned to a predetermined frequency by means of capacitor 13a. A rectifier 14 has one of its terminals connected to the antenna terminal of the inductor and its other terminal connected to a detonator 4 which is in turn connected to the plate member of a cold-cathode gas-filled diode 15. The rectifier is so connected as to produce a voltage of the desired sign at its terminal remote from the antenna connection. A capacitor which is charged by the current from the rectifier has one terminal connected to the rectifier and its other terminal to the cathode of the diode 15. The cathode of the diode 15 is grounded to the casing 2.

In operation, the electromagnetic waves of predetermined frequency, generated by a radio frequency transmitter traverse the antenna 6 and cause an alternating current to flow in the inductor 13. This alternating current is rectified by the rectifier 14 which in turn charges the capacitor. The capacitance of capacitor 17 is chosen in consideration of either a prolonged or a series of signals of predetermined frequency and level at the receiver so as to obtain a desired charging time and thereby avoid premature detonation of the mine by interfering signals.

The charging time may also be accomplished by substituting an RC network for the capacitor 17. When the voltage of the capacitor is equal to or greater than the firing potential of the gas-filled cold-cathode tube, the gas in the tube ionizes and the capacitor 17 discharges through the detonator and tube. The detonator then functions to actuate the explosive charge in the mine.

FIGURE 3 of the drawings is a schematic diagram of the circuit of the invention wherein a cold-cathode gas-filled triode 18, having a detonator in its anode circuit, is substituted for the diode 15 to obtain greater sensitivity. Although the unattended life of the modification is determined by the shelf life of the battery 19, the circuit affords greater sensitivity because the grid of the gas-filled triode 18 is used as a triggering means. The battery 19 is used to maintain a voltage of any desired value below the tube's breakdown voltage on the anode of the tube and also provides a bias voltage for the grid of the tube. For a given negative bias on the grid of triode 18, a relatively small positive voltage from the capacitor 17 will cause the triode to fire. However, it is understood that the sensitivity may be controlled as desired by varying the grid bias. The capacitor is charged, as hereinbefore

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described in connection with FIG. 2, but in the modification the capacitor's voltage is applied to the grid to cause ionization of the gas in the triode. When the triode fires a current flows in its anode-cathode circuit to function the detonator and cause explosion of the explosive charge in the mine.

I claim:

A radio operated remote control mine adapted to detonate only in response to a radio frequency signal of predetermined frequency and intensity which is present for a predetermined time, said mine comprising in combination: a casing; an explosive charge, a partition, and electronic components in said casing, said partition separating said explosive charge from said components; a detonator supported in said partition and adapted to actuate said explosive charge; an insulating housing formed in one of the walls of said casing; a longitudinal antenna positioned in said insulating housing so as to be flush with the outer surface of said casing; a subpanel on which said components are mounted; and an insulating compound filling the compartment in which said components are placed, said compound rigidly holding said components and providing waterproofing therefor; said electronic components comprising: an inductor and a first capacitor in parallel forming a resonant circuit tuned to said predetermined frequency, one end of said resonant circuit being connected to said casing which serves as circuit ground, and the other end of said resonant circuit being connected to one end of said antenna, a rectifier and a second capacitor in series connected in parallel across said resonant circuit, said second capacitor being chosen so that a sustained current for said predetermined time from said

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resonant circuit is required to charge said second capacitor, a gas-filled cold-cathode triode having an anode, a grid and a cathode, said grid and cathode being connected in parallel with said second capacitor, a battery providing grid bias voltage and anode voltage to said triode, said detonator being electrically connected in said anode-cathode circuit; the application to said antenna of a sustained radio frequency signal of said predetermined frequency and intensity for said predetermined time producing an alternating current in said resonant circuit which is rectified by said rectifier and charges up said capacitor during said predetermined time to a voltage which overcomes said grid bias voltage, the gas in said triode thereupon ionizing and causing current to flow in said anode-cathode circuit functioning said detonator, actuating said explosive charge, and thereby detonating said mine.

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