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[54] SAFE

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abandoned.

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[58] Field of Search 340/261, 258 R, 258 D;
307/117, 290, 252 K, 252 J, 252 H, 252 A;
235/92 J, 92 A, 92 NG

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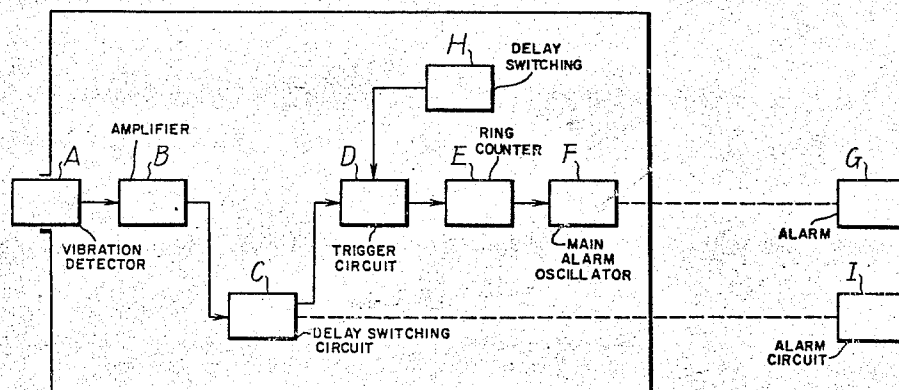
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[57]

ABSTRACT

A safe having means for detecting a vibration caused by an intruder and producing a signal in response to the detected vibration, electric circuit means operating in response to the vibration when it lasts for more than a certain period of time, and means actuated by the electric circuit means to raise an alarm.

3 Claims, 2 Drawing Figures



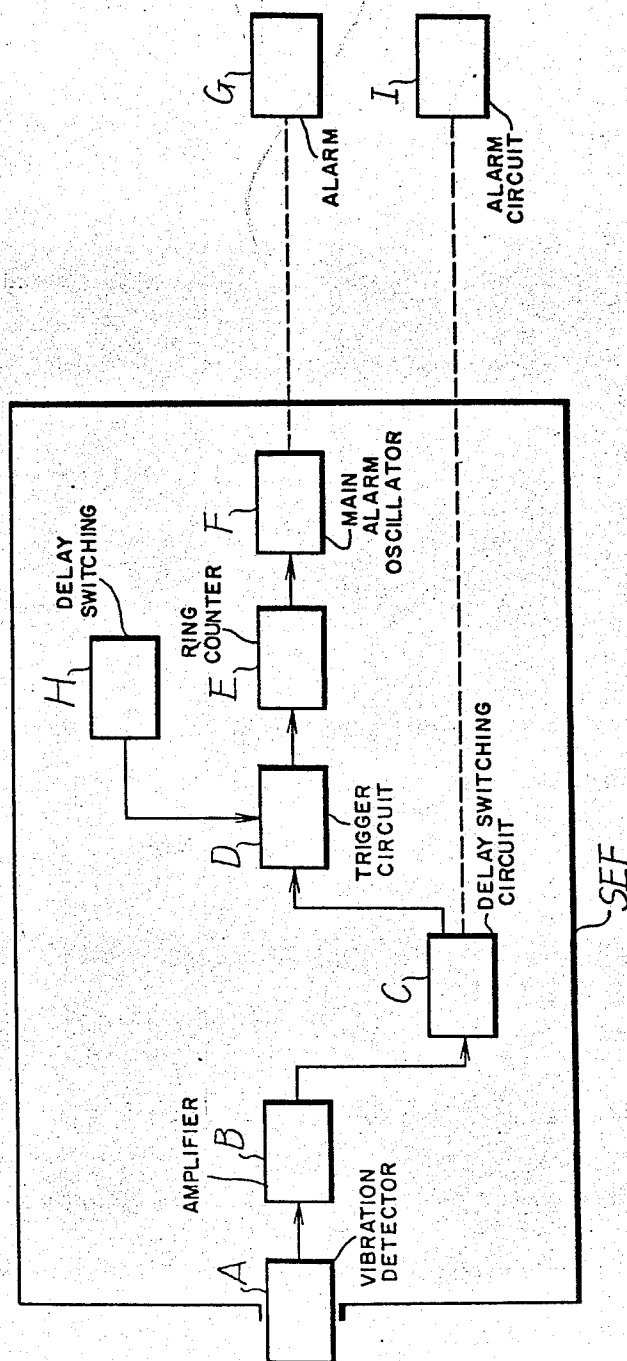


Fig. 1

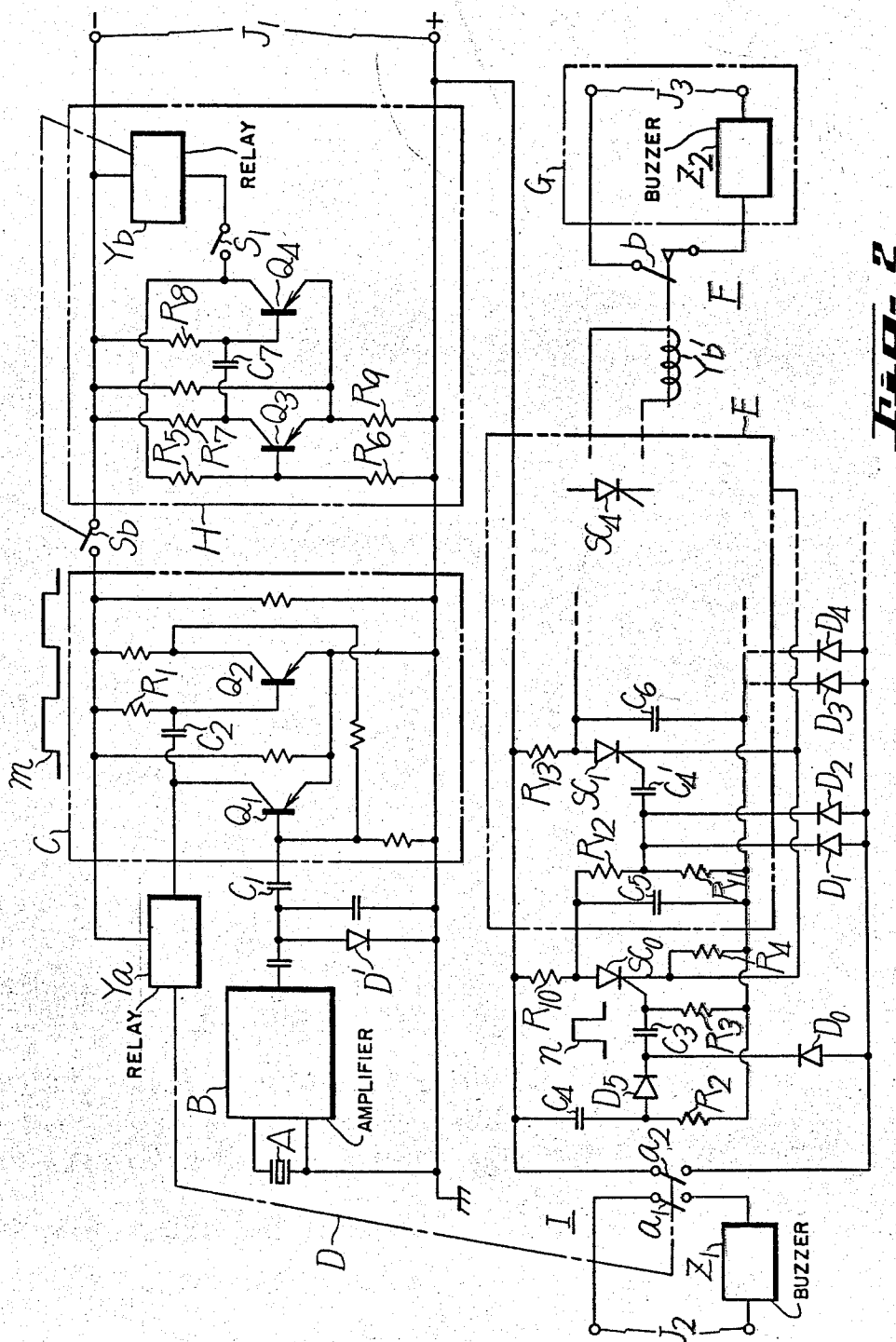
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1 SAFE

CROSS REFERENCES TO RELATED APPLICATIONS

This is a continuation, of application Ser. No. 887,210 filed Dec. 22, 1969 and now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to a safe equipped with an alarm device, and more particularly to a safe having a device which raises an alarm by detecting vibrations caused when an intruder goes near the safe or he intrudes into a room where the safe is placed.

2. Description of the Prior Art

Almost all the conventional safes provided with an alarm device raises an alarm in response to, for example, only one vibration and consequently they have a fatal defect such that an accidental touch on the safes leads to a false alarm.

While, there have also been proposed safes of the type which detect an intruder and give an alarm by wireless but these safes are defective in that general electric noise sounds a false alarm.

SUMMARY OF THE INVENTION

A primary object of this invention is to provide a safe having an alarm device which is free from such drawbacks as above mentioned.

Another object of this invention is to provide a safe having an alarm device which raises an alarm when a vibration is produced continuously, for a predetermined period of time or intermittently a predetermined number of times.

Other objects, features and advantages of this invention will become apparent from the following description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows in block form a safe with an alarm device of this invention, the alarm device being provided in association with the safe; and

FIG. 2 is a circuit connection diagram showing one example of the alarm device depicted in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to the drawings one example of this invention will hereinafter be described in detail.

Reference character SEF indicates generally a safe to which an alarm device is attached. Reference character A designates a vibration detector or vibration sensitive element, which is a pressure-sensitive element such as a so-called piezoelectric element formed of Rochelle salt, ceramic or the like. In this case, it is preferred to use a pressure-sensitive element which has a frequency characteristic such that it detects only vibrations or sound waves of relatively high frequencies but does not pick up gentle vibration of the safe itself due to, for example, earthquake shock or the like. The pressure-sensitive element may be substituted with, for example, an electromagnetic, moving-coil type or like microphone which is desired to have a characteristic such that it picks up sounds (vibrations) of relatively high frequencies but does not respond to vibrations of very low frequencies. In the event of using a pressure-

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sensitive element designed for detecting vibrations of a wide frequency range, suitable means such as a high-pass filter which cuts off a low-frequency range of, for example, less than 30 Hz is provided on the output side of the pressure-sensitive element. The pressure-sensitive element A is mounted on the door of the safe or on the inside thereof or disposed in a room where the safe is placed. The electric output of the detector A corresponding to a vibration picked up thereby is amplified by an amplifier B and is then applied to a delay switching circuit C. The delay switching circuit C produces a signal of a constant duration irrespective of the duration of the signal fed thereto. Namely, even when supplied with a signal of a short duration of less than 4 seconds produced corresponding to a vibration detected by the detector A, the circuit C produces a signal of a constant duration of, for example, about 4 seconds and, further, when supplied with a signal of a relatively long duration, the circuit C produces a desired number of signals, each having the predetermined duration (about 4 seconds).

The delay switching circuit C drives a trigger circuit D which is preferred to be actuated by a relay and its contacts operated by the delay switching circuit C. The trigger circuit D is a circuit from which is applied in pulse form to a circuit next thereto a signal corresponding to the number of vibrations picked up by the detector A or a signal which consists of a number of pulses representative of the duration of the vibration. On the output side of the trigger circuit D there is disposed a ring counter E for reading out the number of the vibrations. The output of the trigger circuit D is counted by the ring counter E. Namely, when the detector A picks up a predetermined number of vibrations the ring counter E counts the number and when the detector A picks up a signal of a relatively long duration the vibration is converted by the delay switching circuit C into signals of a predetermined duration and the number of the resulting signals is counted by the ring counter E and a main alarm oscillator circuit F is selectively activated in accordance with the number of the outputs of the ring counter E. Thus, an alarm signal is transmitted to a predetermined location to operate an alarm device G, for example, a bell or the like which is located, for instance, in a guardman's room remote from the safe SEF. It is preferred to provide a circuit I which raises a warning signal at every detection of such a vibration as previously mentioned. In the case where the setting operation of this device is likely to produce a vibration to cause accidental actuation of the device, it is desirable to set the device to initiate its operation a certain period of time after the setting of the device. To this end, it is preferred to employ a delay switching circuit H in association with the trigger circuit D.

A description will be made in connection with one example of the circuit construction embodying this invention.

Referring to FIG. 2, a description will be given first of one example of the delay switching circuit C. Namely, the output of the amplifier B is rectified by a diode D' and its rectified output is applied to a transistor Q₁. A transistor Q₂ is connected to the transistor Q₁. The collector of Q₁ is connected through a capacitor C₂ to the base of the transistor Q₂. The base of Q₂ is connected to the negative electrode of a power source J₁ through a resistor R₁ and a switch Sb described later. The transistors Q₁ and Q₂ are designed to constitute a

kind of a bistable multivibrator and the capacitor C_2 and the resistor R_1 form a time constant circuit of the bistable multivibrator. Namely, the transistors Q_1 and Q_2 are interconnected in a manner to be alternately switched on and off to produce rectangular waves m at regular time intervals as shown at the top of the figure. Connected to the output side of the transistor Q_1 is a relay Ya, whose contacts a_1 and a_2 are adapted to be opened and closed under the control of the transistor Q_1 . The relay Ya and its contacts a_1 and a_2 correspond to the trigger circuit D previously described with FIG. 1.

The operation of the delay switching circuit C will be described. When a signal derived from the amplifier B is rectified by the diode D' to make the right-hand side of the capacitor C_1 negative relative to its left-hand side, the transistor Q_1 is switched on and the transistor Q_2 is switched off. This switching is determined by a time constant circuit consisting of the capacitor C_2 and the resistor R_1 and the rectangular wave current indicated by m is applied to the relay Ya to achieve make-and-break of its contacts a_1 and a_2 in accordance with the curve m .

In the event that a signal of a short duration is fed to the delay switching circuit C to switch the transistor Q_1 , the relay Ya conducts at least for a period of time corresponding to the duration of a first one of the rectangular wave signals m to close the contacts a_1 and a_2 , thereby to constitute a closed circuit of a power source J_2 —a buzzer Z_1 —the contact a_1 —the power source J_2 , causing the buzzer Z_1 to produce an alarm. Even in the case of a signal whose duration is shorter than that of one rectangular wave m , the buzzer Z_1 is made to ring for a period of time corresponding to the duration of one rectangular wave m .

When the delay switching circuit C is supplied with a signal of a sufficiently long duration, the transistors Q_1 and Q_2 serve as a bistable multivibrator for a period of time corresponding to the duration of the signal, that is, they are alternately switched on and off to produce an output such as indicated by the curve m to activate the relay Ya intermittently in accordance with the curve m , causing its contacts a_1 and a_2 to make and break correspondingly.

The ring counter E used in this invention may be a usual one. In the present example, however, the ring counter E is made up of four active elements such as thyristors SC_1 to SC_4 and at every arrival of a pulse the ring counter E repeats conduction and non-conduction as usual. In this case a thyristor SC_0 is connected to the stage preceding the thyristor SC_1 of the ring counter so as to ensure that the first thyristor SC_1 is caused to initiate its operation by a first signal and that the following thyristors are sequentially controlled to be conductive and nonconductive. To this end, there are provided a capacitor C_4 and a resistor R_2 , the capacitor C_4 being charged by the power source J_1 when a power source switch S_b for closing the circuit of the power source J_1 is closed and the resistor R_2 passing therethrough the charging current. When the capacitor C_4 is charged in accordance with the time constant determined by the capacitor C_4 and the resistor R_2 , a pulse n depicted in the figure is applied to the control electrode of the thyristor SC_0 to switch it on first.

Namely, when the relay contact a_2 is closed only one differentiated pulse is generated through the capacitor C_4 and the resistor R_2 to trigger only the thyristor SC_0 ,

thus ensuring that counting starts from the thyristor SC_0 . Any one of the thyristors other than SC_0 , for example SC_1 , cannot be triggered by a signal which is integrated by a resistor R_{12} and a capacitor C_6 , attenuated by resistors R_{10} and R_{11} and leaking from a differentiation circuit consisting of a capacitor C_4' and a resistor R_{12} . Under such conditions, the capacitor C_5 is not charged but the capacitor C_4 remains charged and the cathode of a diode D_2 is in a reverse biased condition. Consequently, when an input trigger voltage is lower than the value of the reverse bias, the diode D_2 will not conduct but the thyristor SC_0 will conduct to cause the voltage drop of only the resistor R_{11} to be zero, so that the input pulse is fed through the diode D_1 and the capacitor C_4' to the thyristor SC_1 to cause it to conduct. Only the instance that the thyristor SC_1 becomes conductive, a differentiated pulse is generated across the resistor R_4 connected in common to the cathodes of the thyristors to make the cathode of the thyristor SC_0 positive instantaneously, by which the thyristor SC_0 having its anode held at zero potential is reversely biased to be turned off. The thyristor next to SC_1 is also turned off. In this manner, the counting advances one step in response to one input pulse. Subsequently, the thyristors sequentially conduct at every arrival of an input pulse and when the thyristor SC_4 has become conductive a relay Yb' is energized to close its contact b and hence provide a closed circuit of a power source J_3 —the buzzer Z_2 —the contact b —the power source J_3 , ringing the buzzer Z_2 .

The operation of the present device may be summarized as follows.

When a vibration of a relatively high frequency is picked up by the detector A, an electric signal corresponding to the vibration is supplied to the switching circuit C to cause it to actuate the relay Ya correspondingly as above described. In this case, however short the vibration may be, an output signal corresponding to it is derived from the delay switching circuit C for the time corresponding to one rectangular wave m to actuate the relay Ya, causing the buzzer Z_1 to raise a preliminary alarm and turning off thyristor SC_0 and to turn on thyristor SC_1 . Similarly, the present device operates at every occurrence of vibration and when the vibration has occurred four times the main alarm oscillator circuit G operates to sound the buzzer Z_2 .

In the event that a signal of a long duration is applied to the delay switching circuit C, an intermittent signal of a rectangular wave m is derived from the circuit C to ring the buzzer Z_1 and turn on and off the contact a_2 at every occurrence of the intermittent signal and when the intermittent signal produces four or more pulses or when the signal continues for a period of time of more than four pulses the buzzer Z_2 is similarly caused to ring to give an alarm for an intruder. Even when the signal does not continue for such a period of time, if it continues for a time long enough to actuate any one of the thyristors SC_1 to SC_4 , the main buzzer Z_2 is not actuated immediately but it is operated later when the signal is produced so many times or so long time as to operate the thyristor SC_4 .

In short, once the four stages of the thyristors SC_1 to SC_4 have been turned on and off in a sequential order, the buzzer Z_2 is rung to raise an alarm irrespective of whether the incoming signal is a series of short-duration signals or a continuous signal. Otherwise, the

buzzer Z_1 is energized to give a preliminary alarm at every changing over of each thyristor.

In order to avoid accidental operation of this invention device which might be caused by vibrations during the setting operation of the device, an operator's walking or other accidental vibrations, it is preferred to employ a delay switching circuit H.

Referring to FIG. 2, one example of the delay switching circuit H will hereinbelow be described. Reference character S_1 indicates a manual switch having connected in series thereto a relay Yb which is connected to the minus side of the power source J_1 . The relay Yb serves to operate the power source switch Sb . The delay switching circuit H includes a kind of a bistable multivibrator with transistors Q_3 and Q_4 and in this case the circuit H is adapted not to actuate the relay Yb immediately when the switch S_1 is turned on. The time constant of the bistable multivibrator is determined by a capacitor C_7 and a resistor R_8 which are interposed between the transistors Q_3 and Q_4 . Reference characters R_5 and R_6 designate bias resistors for the base of the transistor Q_3 , R_7 a resistor incorporated in the circuit for charging the capacitor C_7 and R_9 a resistor interposed between the emitters of the transistors Q_3 and Q_4 and the plus side + of the power source J_1 . The operation of the above circuit will hereinbelow be outlined. In the steady state of the circuit H, the transistor Q_3 is in the off state and the base current of the transistor Q_4 flows but when the manual switch S_1 remains open the collector current of the transistor Q_4 does not flow. The capacitor C_7 , which is coupled with the resistor R_8 to determine the delay time, is always charged through the base and emitter of the transistor Q_4 . Further, the emitter voltage of the transistor Q_3 is held a little negative by the resistor R_9 so as to ensure that the transistor Q_3 is turned off. Closing the manual switch S_1 , a negative voltage is applied to the base of the transistor Q_3 to turn it on. When the transistor Q_3 is turned on, its collector current flows to cause a voltage drop across the resistor R_7 and this voltage change is applied through the capacitor C_7 to the base of the transistor Q_4 to hold it at a positive potential, so that the transistor Q_4 is turned off and no current is fed to the relay Yb . While, the base of the transistor Q_3 is supplied with a higher negative voltage and this voltage is maintained at the moment of reversal of the operation of the bistable multivibrator. The capacitor C_7 is discharged through the collector and emitter of the transistor Q_3 to make the base of the transistor Q_4 negative. Immediately when the base of the transistor Q_4 is rendered negative, the operation of the circuit is reversed and the relay Yb operates to return the collector potential of the transistor Q_4 to its saturated potential, thereby turning off the transistor Q_3 . With this delay switching circuit H, the device of this invention initiate its operation about 15 seconds after setting.

Consequently, the relay Yb does not operate immediately after the closing of the switch S_1 but initiate operation after a certain period of time, for example, approximately 15 seconds to turn on the power source

switch Sb . This leads to the normal operation of this invention device described above, so that if the operator leaves the device within about 15 seconds after setting, no accidental actuation of the device occurs due to vibrations caused by him.

As has been described in the foregoing, the device provided on the safe of this invention is designed to pick up mechanical vibrations or sound waves caused when an intruder approaches or touches the safe or enters a room where the safe is placed and to raise an alarm when the number and the duration of the vibrations have reached certain values, thus ensuring the protection of the safe from theft.

It will be apparent that many modifications and variations may be effected without departing from the scope of the novel concepts of this invention.

I claim as my invention:

1. A safe and alarm including: detecting and converting means mounted to detect vibrations of said safe and convert them into electrical signals; a first delay switching circuit connected to said detecting and converting means and producing an initial standard time length pulse when an output of said detecting and converting means is received and the length of said standard time length pulse being independent of the number and length in time of said electrical signals from said detecting and converting means and additional standard time length pulses not being produced from outputs of said detecting and converting means which occur during said initial standard time length and said first delay switching circuit producing additional standard time length pulses when the output of said detecting and converting means continues beyond said initial standard time length pulse; said first delay switching circuit including a transistor turned on by said detecting and converting means, a relay connected to said transistor and energized when said transistor is turned on, a switch closed by said relay when energized, a first silicon controlled rectifier turned on when said switch is closed; a counter means connected to said first silicon controlled rectifier of first delay switching circuit to count the number of standard time length pulses; a main alarm connected to said counter means and energized after a predetermined number of standard time length pulses have been produced, including a second delay switching circuit connected to said first delay switching circuit to supply power to it a predetermined time after said second delay switching circuit has received power, and including a preliminary alarm connected to said first delay switching circuit and energized each time a pulse is produced.

2. A safe and alarm according to claim 1 wherein said first delay switching circuit includes a second transistor connected as a multivibrator with said first transistor.

3. A safe and alarm according to claim 2 wherein said counter means includes a second silicon controlled rectifier controlled by said first silicon controlled rectifier of said first delay switching circuit.

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