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[54] INTRUSION ALARM SYSTEM

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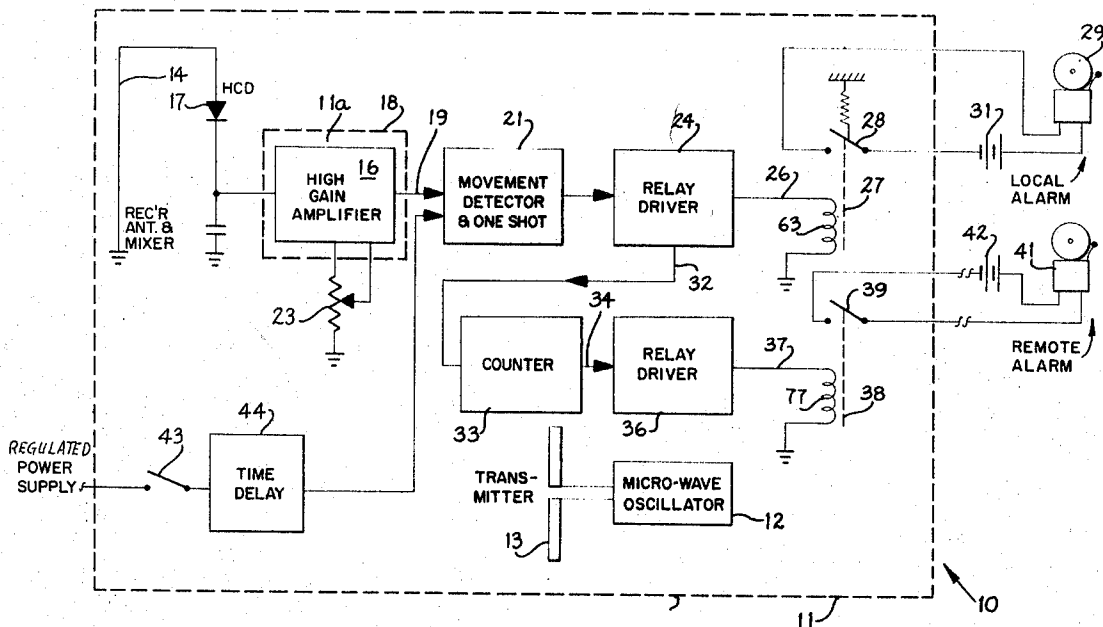
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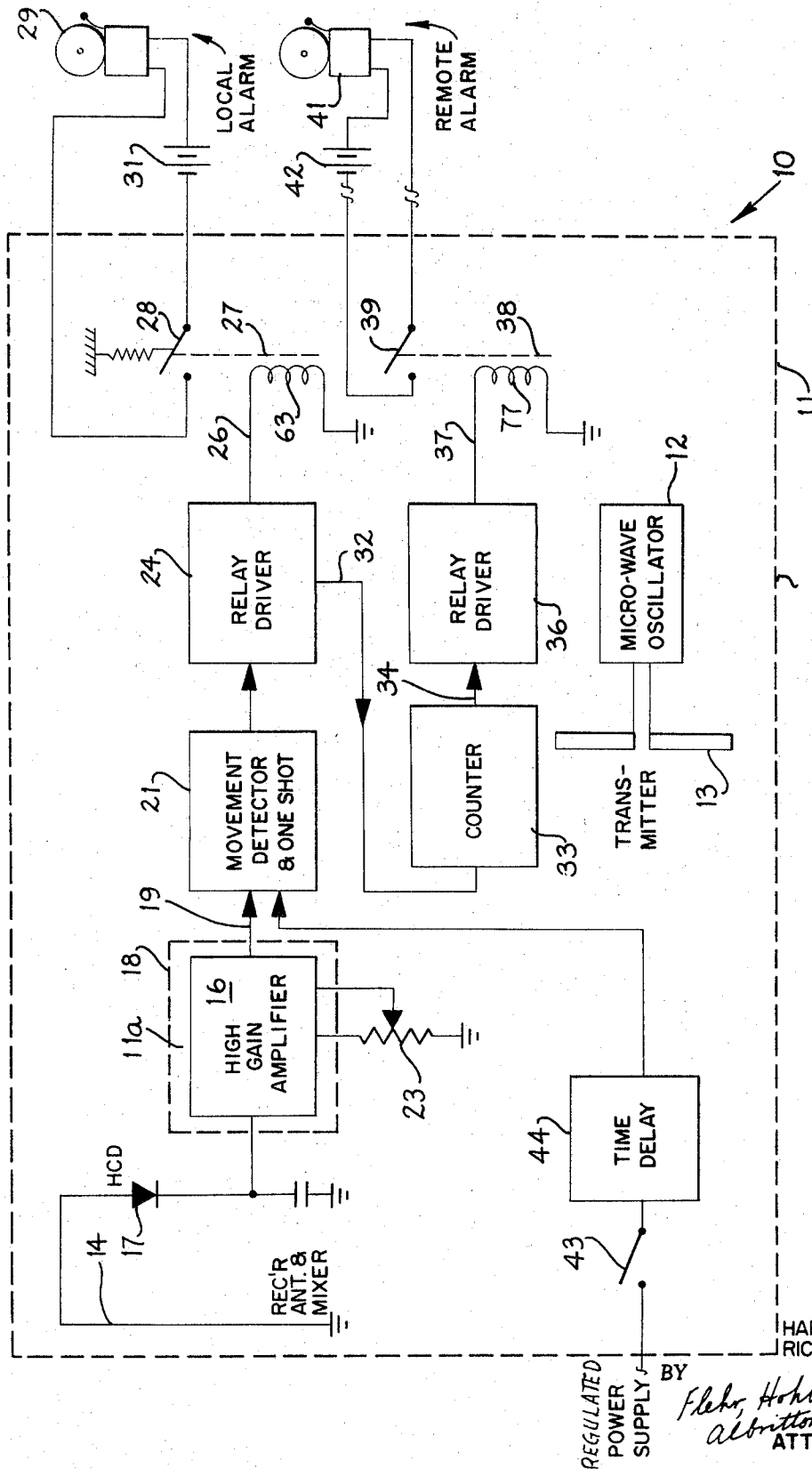
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ABSTRACT

An intrusion alarm system for monitoring a spacial zone to detect the occurrence of movement of an object within the zone consists of an oscillator providing R.F. signals from a radiating antenna coupled to the oscillator to propagate an R.F. field of signals within the zone being monitored, and a chassis having a portion shielded from the R.F. propagation of the antenna and disposed adjacent the antenna. The system further includes a receiving antenna adjacent the chassis for receiving the signals and modulations thereof caused by movement of an object within the field. A high gain amplifier, carried by the shielded portion of the chassis, amplifies the modulations of the received signals. Detecting means coupled to the amplifier provides an output signal in response to the amplified modulations. The output signal is adapted to activate means for manifesting occurrence of a moving object within the zone. Both local and remote alarms are actuated by the detecting system, the remote alarm being actuated only upon the occurrence of a predetermined number of detected movements.

6 Claims, 3 Drawing Figures



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FIG. 1

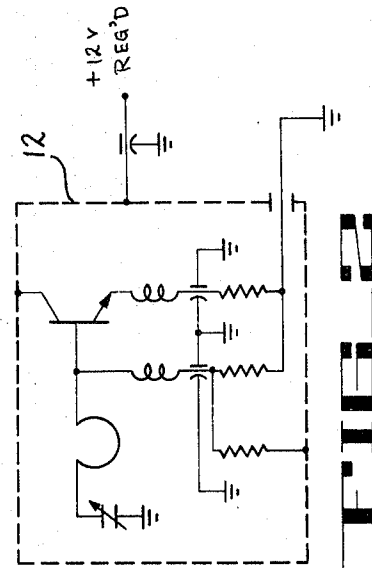
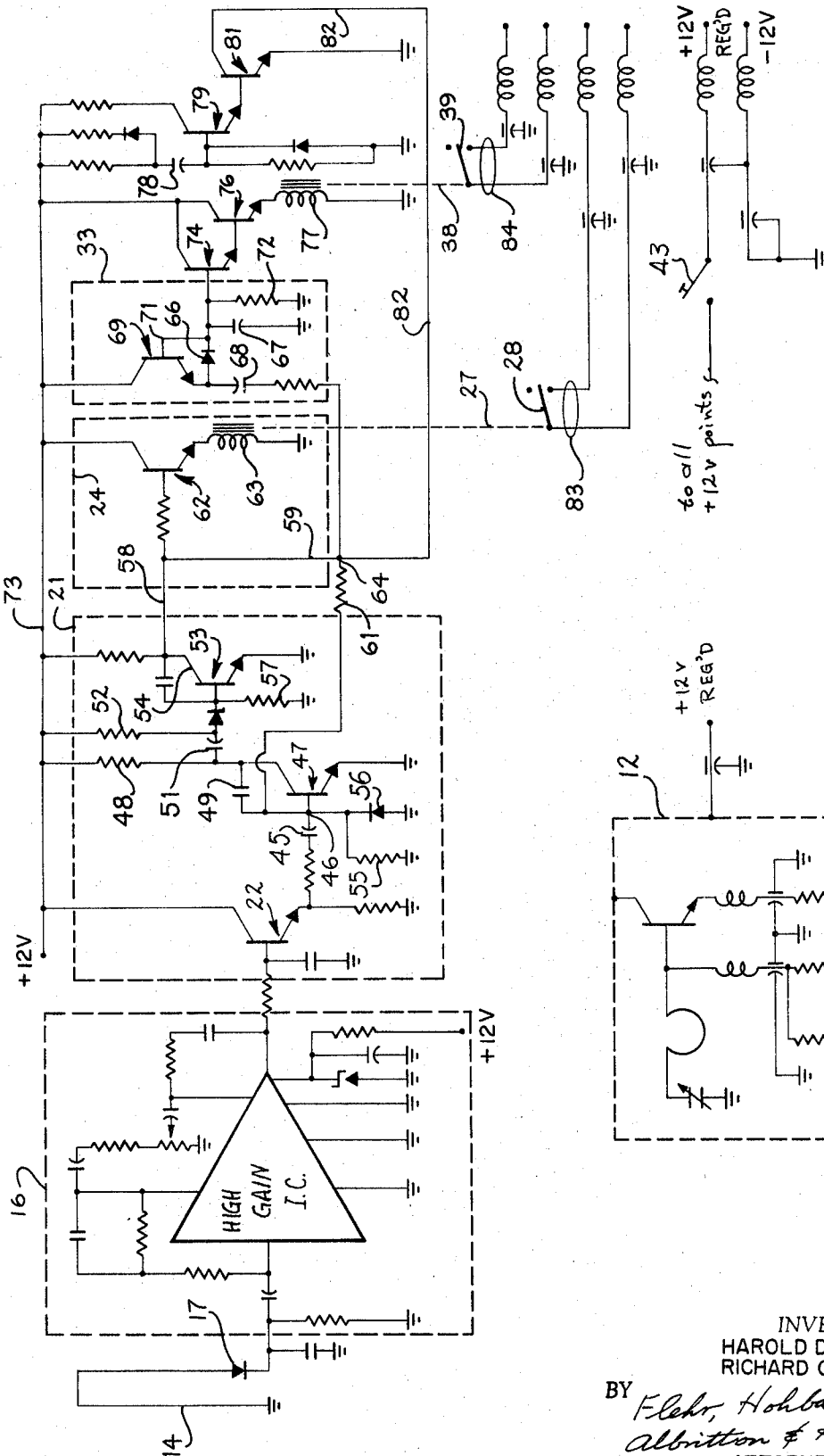


FIG. 2

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INTRUSION ALARM SYSTEM

BACKGROUND OF THE INVENTION

This invention pertains to an alarm system for monitoring a spacial zone to detect the occurrence of movement of an object within the zone. The system is particularly useful in electronically detecting the presence of an intruder in premises under surveillance of the system.

Heretofore, systems have been employed wherein a field of radiation is propagated electronically so that any moving object within the field will create variations or modulations in the signal waves propagated and in this manner, the presence of such movement is readily detected. As the frequency of the propagated field is increased, the range becomes shorter and, accordingly, it is obviously desirable to provide an R.F. (radio frequency) field at a sufficiently high frequency so as to limit the surveillance in a manner to preclude the generation of false alarms. For example, if the system is intended to monitor the activity within a residence, it is obvious that traffic passing in front of the residence should not be a proper cause for activating an alarm associated with the surveillance system.

While raising the frequency of the field radiated by the system serves to limit or reduce the zone monitored by the system, the desirability of increasing the frequency is, in large part, offset by problems which are thereby created. For example, where the radiating antenna is supported upon the chassis of the electronic equipment, it has been the practice in the past to employ the chassis as the counter-pole for a quarter wave length antenna, thereby making the antenna relatively unobtrusive. However, at the higher frequencies, the circulating current on the chassis of the apparatus is spuriously picked up by components of the apparatus to provide false signals so as to require the introduction of additional equipment and devices to escape the problem.

SUMMARY OF THE INVENTION AND OBJECTS

In general, an alarm system has been provided characterized by use of an oscillator for providing R.F. signals along with a radiating antenna coupled to the oscillator so as to propagate an R.F. field in the zone to be monitored. A chassis for housing the electronic components associated with the system includes a portion which is shielded from the R.F. propagation of the broadcast antenna. The shielded portion of the chassis may be disposed adjacent to the broadcast antenna, and, in a preferred embodiment, the chassis, itself, can be employed to support and carry the broadcast antenna. Further, a receiving antenna is provided for receiving the propagated signals (and modulations thereof) as may be caused by any movement of an object within the propagated R.F. field. The receiving antenna preferably, for example, is also carried or supported by the chassis so as to provide a relatively compact unit.

High gain amplifier means carried by the shielded chassis portion amplifies modulations of the received signals from the receiving antenna. A detecting means carried by the chassis is operably coupled to the amplifier means and provides an output signal in response to the amplified modulations from the high gain amplifier. The output signal is adapted to activate means for manifesting occurrence of the moving object within the zone being monitored.

Preferably, both a local and a remote alarm are employed in conjunction with the above system and an electronic counting means is employed between the local and remote alarms in a manner for counting each successive output signal from the detecting means occurring within a predetermined time period so that upon registering a predetermined count in the counting means, the remote alarm will then be activated. Thus, although the local alarm may be activated upon each occurrence of detection of movement within the zone under surveillance, the remote alarm will only be activated when it is relatively certain that there is substantial activity in the zone being monitored.

In addition to the above, means are provided whereby after the first indication of movement has been sensed by the system, the system becomes more sensitive to detecting subsequent movement. Accordingly, after the first indication of movement is detected, the system will detect additional movement even at a greater range.

It is, accordingly, a general object of the invention to provide an improved alarm system of the type employing electronic surveillance.

It is a further object of the present invention to provide an alarm system of the foregoing type employing a local and remote alarm wherein the remote alarm is only activated after the local alarm has been operated a predetermined number of times.

It is another object of the invention to provide an alarm system of the above type wherein after first detection is made of movement within the zone being monitored, the system becomes more sensitive to detecting additional movement.

Yet another object of the invention is to provide a highly compact alarm system of the above type wherein a radiating broadcast antenna, receiving antenna and electronic amplifying and detecting means may all be carried by a chassis common to all.

A further object of the invention is to provide a surveillance system of the above type operating in the UHF range with means interposed between the receiving antenna and high gain amplifying means for suppressing noise without masking the signals or field being monitored.

The foregoing and other objects of the invention will become more apparent from the following description of a preferred embodiment.

BRIEF EMBODIMENT OF THE DRAWINGS

FIG. 1 is a schematic block diagram layout showing the alarm system according to the invention;

FIG. 2 shows a detailed schematic diagram for a microwave oscillator construction adapted to be coupled in broadcast relation to a transmitting antenna;

FIG. 3 is a schematic electrical diagram according to the invention as shown in block diagram form in FIG. 1.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring to FIG. 1, a chassis 11 supports a microwave oscillator 12 coupled to a broadcasting antenna 13. Preferably, oscillator 12 operates in a UHF range on the order of 915 MHz to 1.5 GHz. The oscillator consists of a tuned single stage transmitter with a balanced link coupled output operating at a frequency on the order of 915 MHz.

The radiating antenna 13 is a center-fed folded dipole coupled to the oscillator tank coil with a balanced link for proper match. The use of a half-wave balanced radiating antenna eliminates R.F. currents from circulating on the chassis so that the high gain amplifier can be housed in the same chassis as the oscillator and radiating antenna.

A detection loop or receiving antenna 14 consists of a quarter-wave vertical antenna at D.C. ground to eliminate radiated low frequency noise and A.C. pick-up or hum. A high gain amplifier 16 is diode coupled to receiving antenna 14 by means of a hot carrier diode 17. The hot carrier diode 17 serves to minimize the 1/F noise while not masking the high frequency signal which can be received on antenna 14. Thus, diode 17 has a high frequency band pass to the range of 4 GHz.

Amplifier 16 is disposed within a shielded portion 11a as represented schematically by the shielding 18. In this manner, notwithstanding the presence of microwave oscillator 12 on chassis 11, the high gain amplifier 16 will pick up only signals received via receiving antenna 14 and diode 17.

Amplified signals from amplifier 16 are fed via line 19 to a combined Movement Detector Unit and One Shot or pulse stretching circuit 21. The movement detector unit 21 functions on the basis of detecting a predetermined threshold volt-

age on line 19 (FIG. 1) whereby upon sensing a predetermined voltage thereon, an output pulse is developed.

Amplifier 16 provides a very high gain A.C. amplification on the order of 85 DB with a rolled off frequency response starting at 10-30 cycles to cut off before 60 cycle hum can enter. As will be seen further below with respect to FIG. 3, an emitter follower transistor circuit 22 is employed for isolation and current gain to the threshold detector unit 21. Amplifier 16 has a gain control 23 so that the unit 10 can be set for a range as low as 1 foot or to a maximum range, such as a 35 foot spherical radius. However, the range can actually extend as far as 150 feet.

After detector 21 has been activated by the occurrence of movement within the field being monitored, the one shot portion of circuit 21 changes state for a predetermined, preset time and also serves to cause the detector to become more sensitive to any further movement of objects within the monitored zone. Thus, after the first signal excursion caused by an intruder into a residence under surveillance, the unit will automatically become more sensitive whereby the intruder must depart at a greater distance away from the unit to avoid further activating its alarm.

Thus, if the intruder triggered the alarm at a range of 25 feet, he would have to move out to a distance on the order of 40 feet to escape detection of the more sensitive detector as conditioned in response to the first intrusion signal.

The first intrusion signal sensed by detector 21 serves to activate a relay driver 24 so as to develop a current in coil 26 which pulls in the armature 27 for operating the contact 28 of a switch disposed in a suitable local alarm circuit. Thus, a local alarm 29 is schematically shown as a buzzer or bell operated by a battery 31 but this could equally be merely any one of a number of alarms manifesting detection of movement in the monitored zone, such as, for example, the turning on of house lights or a radio or other distraction intended to dispatch an uninvited intruder.

Relay driver 24 further feeds a pulse on line 32 to a counting circuit 33. After a predetermined number of pulses via line 32 have been counted by a counter 33, an output pulse is provided via line 34 to activate another relay driver 36. Counter 33 as shown in detail further below in regard to FIG. 3, constitutes an integrating circuit arranged to accumulate a charge on a capacitor as later described.

Relay driver 36, once activated, provides a current on line 37 to pull in its armature 38 whereby to close the switch 39 and operate a remote alarm 41, again shown merely as a buzzer or bell activated by a battery 42 or other power supply means, but serving to manifest the existence of the movement conditions which have activated the alarm.

In arming the system 10, an arming switch 43 is closed in a line leading to a suitable power supply so as to interpose a time delay function by means of the circuit 44 as described further below.

Thus, after the arming switch 43 is closed, it is possible for the operator of the system to promptly leave the premises and thereby avoid sounding the alarm based on his own activity as he merely departs from the premises.

The above system arrangement is shown more particularly in FIGS. 2 and 3 whereby its construction will be readily evident to those skilled in the art.

As noted, the system requires a predetermined number of signal modulation detection events to activate the remote alarm 41 and this is done by means of employing a counting circuit 33. In addition, it has been mentioned that after the first indication of movement within the zone being monitored, the system becomes more sensitive. In each of the above two circumstances, it will be readily evident that the receiving antenna 14 feeds signals to the high gain amplifier 16 and that these signals are then transmitted via an emitter follower circuit 22 which serves to provide isolation.

When the output from amplifier 16 supplies a threshold voltage of a predetermined level, for example, on the order of 0.6 volt at the base electrode connection 46 of transistor 47,

transistor 47 will be biased into conduction to draw a current through the collector load resistor 48. A capacitor 49 serves to eliminate transient noise while the capacitor 51 is being charged. The time constant developed by resistor 52 and capacitor 51 serve to determine the rate at which capacitor 51 is charged and once capacitor 51 has become fully charged, transistor 53 is switched off causing the voltage at the collector 54 to step to a higher level, such as 6 volts.

Thus, the voltage on line 58 will be either at ground or 6 volts, depending upon whether or not transistor 53 is respectively in a conducting or nonconducting state. When transistor 53 is in a nonconductive state, the higher voltage on 58 is fed back via line 59 and resistor 61 to the base electrode connection 46 of transistor 47 so as to maintain transistor 47 in a conductive state for a period determined by the time constant of resistor 52 and capacitor 51 thereby stretching the pulse. Upon fully charging capacitor 51, transistor 47 will again be switched to an off condition.

The foregoing condition of line 58 when experiencing a higher voltage serves to bias the power transistor 62 into conduction for energizing the coil 63 operating armature 27 so as to activate an alarm described above.

Diode 56 on base of transistor 47 serves as a D.C. restorer preventing the voltage coupled through the input capacitor 45 from going more than one diode drop below ground, thus, increasing the useful input signal to transistor 47.

Operation is as follows:

A signal from amplifier 16 is coupled through emitter follower 22, through coupling capacitor 55 to point 46. Diode 56 prevents this signal from going negative, thus forcing it to go positive. If this signal is large enough to overcome the threshold voltage on transistor 47, the one shot 47 fires. This voltage must be of the order of 1.2 volts peak-to-peak, determined by the threshold voltage of diode 56 and the emitter base junction of transistor 47. When the one shot fires due to the above condition, feedback through line 59, resistor 61 to point 46 also charges the input capacitor 45 to about 0.6 volts above ground, effectively removing the original threshold voltage, thereby making the one-shot more sensitive to subsequent input signals from the amplifier. This condition remains for a time determined by the input capacitor 45 and resistor 55 from point 46 to ground.

Each time transistor 53 changes state, the pulse so produced is applied to diode 66 by means of line 59 and coupling capacitor 68. When this voltage rises above ground, capacitor 68, which is relatively smaller than capacitor 67, charges through diode 66, causing capacitor 67 to charge to a value commensurate with the relative values of the two capacitors. When transistor 53 again changes state to a conducting condition, diode 66 becomes reverse biased, thus preventing the voltage stored in capacitor 67 from discharging. As this action is repeated, the charge on capacitor 67 increases, causing the base of transistor 69 to conduct. The emitter of transistor 69 produces a voltage at the anode of diode 66 proportional to the voltage on its cathode, preventing it from becoming excessively reverse biased. This allows each pulse to provide an equal charge on capacitor 67, which increases in stair-step fashion until the voltage becomes great enough to cause transistors 74 and 76 to conduct enough current to pull in relay 77.

However, discharge resistor 72 serves to drain away a portion of the charge on capacitor 67 as it is being built up so as to require the buildup to occur within a relatively short predetermined period of time.

As noted above, when the system is turned on by means of the arming switch 43, a time delay circuit 44 is activated so as to provide a short period of delay to permit the operator of the system to leave the premises.

Referring to FIG. 3, the capacitor 78 begins charging upon closure of the arming switch 43 whereby after a predetermined time, transistor 79 is turned off to drive transistor 81 out of conduction thereby removing a feed-back signal via line 82 to point 64.

When arming switch 43 is closed, voltage is applied to all circuits of the unit including capacitor 78 which begins charging through transistors 79 and 81, holding them in conduction. Transistor 81 clamps line 82 to ground thus preventing signals from reaching relay driver transistor 62. When capacitor 78 has fully charged, current flowing through transistors 79 and 81 ceases, causing them to stop conducting and allowing normal operation of the system.

Finally, in activating the local and remote alarms via electrical leads 83, 84, respectively, the above system has been found to be sufficiently sensitive to movement within an area being monitored that it has become necessary to decouple each of the leads 83, 84 from the effect of current moving in the lines so that, as shown in FIG. 3, grounded capacitive decoupling is applied to each of these lines.

From the foregoing, it will be readily evident that there has been provided an improved alarm system of a type for sensing movement within an area being monitored.

By provision of the feed-back line 59, it is readily evident that even for a very short period of sensing movement, a sufficiently prolonged pulse will be developed in order to positively activate the alarm. Further, it is readily evident that a relatively prolonged intrusion or development of movement within the zone being monitored is required in order to activate a remote alarm whereas a local alarm may be activated upon even the slightest movement within the zone under surveillance. It is also evident that a number of alarm signals are required to be generated within a predetermined period of time in order to activate any such remote alarm.

We claim:

1. In an alarm system for monitoring a spacial zone to detect the occurrence of movement of an object therein, R.F. oscillator means for providing R.F. signals a one-half wave length, center-fed dipole radiating antenna means coupled to said oscillator means to propagate an R.F. field of said signals in said zone to be monitored, a chassis having a portion shielded from the R.F. propagation of the antenna and disposed adjacent said antenna, a receiving antenna adjacent said chassis for receiving said signals and modulations thereof caused by movement of said object within said field, high gain amplifier means carried by said chassis portion for amplifying modulations of the received signals, detecting means operably coupled to said amplifier means and carried by said chassis to provide an output signal in response to said amplified modulations, said output signal being adapted to activate means for manifesting occurrence of the moving object within said zone.

2. In an intrusion alarm system according to claim 1 further including first and second alarm means coupled to receive said output signal and provide a manifestation of the existence of the moving object within said zone, and counting means disposed between said first and second alarm means for counting each successive output signal occurring within a predetermined time period, said first alarm means being operated by each of said output signals and said second alarm means being operably coupled to said counting means to be operated by said counting means upon occasion of registering a predetermined count therein by said counting means.

3. In an intrusion alarm system according to claim 1 further including a hot carrier diode interposed between said receiving antenna and said high gain amplifier for responding to UHF frequencies while reducing noise with respect to said modulations and radiation pattern of said field.

4. In an intrusion alarm system according to claim 1 wherein said oscillator means and broadcast antenna serve to propagate an R.F. field of 0.9 to 1.5 GHz.

5. In an intrusion alarm system of a type for monitoring modulations of an R.F. field within a spacial zone under surveillance, means providing an output signal in response to detection of a first movement of an object within the zone, said means requiring a predetermined threshold voltage in order to provide said output signal, alarm means responsively coupled to be activated by said output signal and manifesting the occurrence of said movement, and means operatively responsive to said output signal and coupled to the first named said means serving to reduce said threshold voltage for a predetermined period of time in response to said output signal to more readily activate the first named said means thereafter in response to movement of an object in said zone during said period of time.

6. In an intrusion alarm system of a type for monitoring modulations of an R.F. field within a spacial zone under surveillance, means providing an output signal in response to detection of a first modulation of said field, said means including means requiring a predetermined threshold voltage to provide said output signal, alarm means responsively coupled to be activated by said output signal and manifesting the occurrence of said detection, and means operably responsive to said output signal and coupled to the first named said means serving to reduce said required threshold voltage in response to said output signal to more readily activate the first named said means thereafter in response to subsequent modulation of said R.F. field.

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