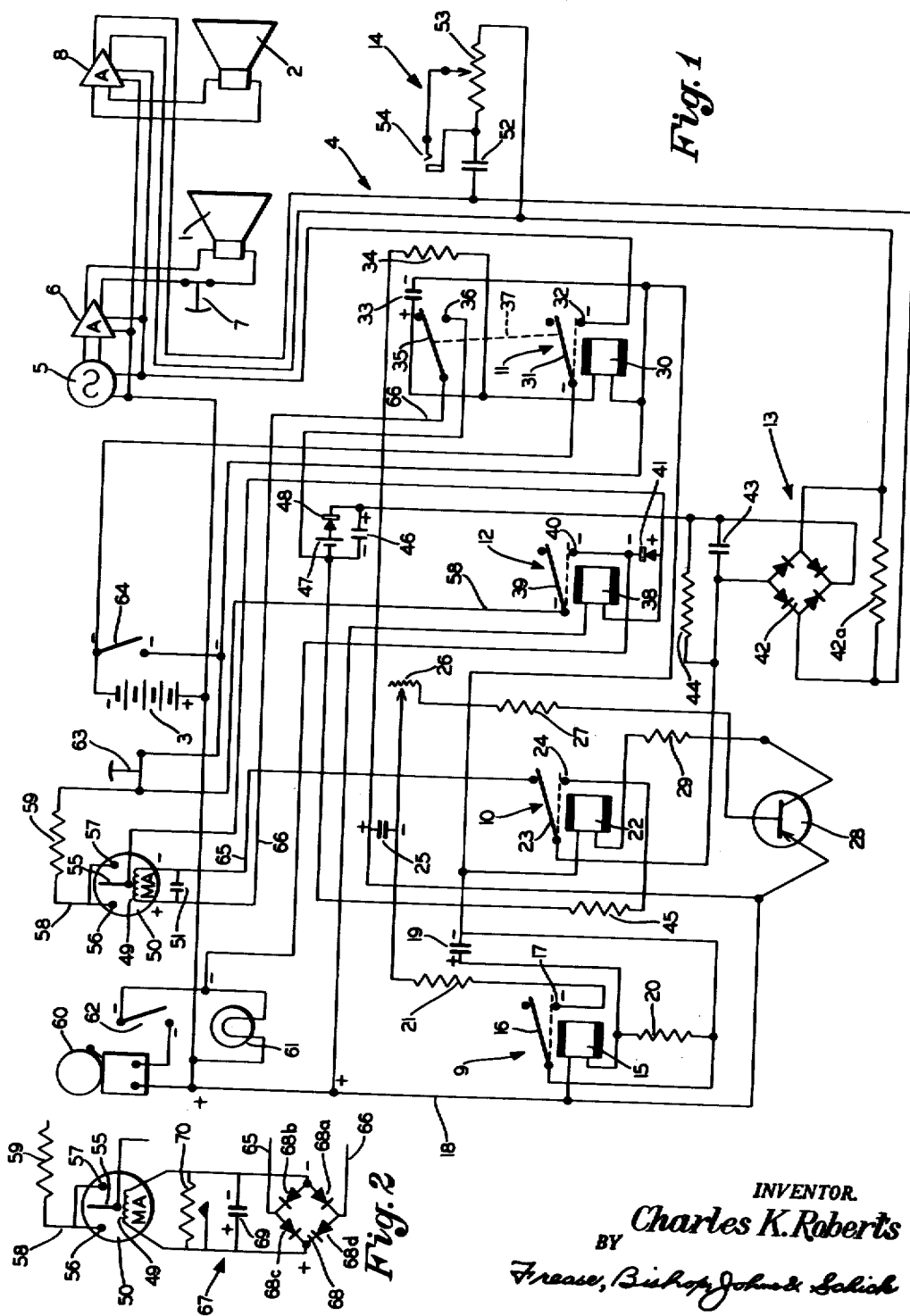


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SONIC ALARM SYSTEM

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SONIC ALARM SYSTEM

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The present invention relates to an electronic alarm system or device for the protection of closed areas, such as vaults and security rooms. More particularly, it pertains to an alarm system using sonic (sound) wave lengths whereby a constant sound pattern is created which, if varied due to an increase or decrease in volume, sets off an alarm because of changes in the sound pattern within the protected area.

The alarm system provides sound protection combined with standing sound waves which trigger an alarm if disturbed by movement of a thing or person within the protected area.

Various devices for monitoring a room or closed area have been developed in the past and have been unsatisfactory for various reasons. Some of the prior devices have used ultrahigh frequency which is inaudible and therefore does not act as a deterrent to a would-be entrant. An alarm system using audible sonic wave lengths continuously indicates to an unauthorized entrant that it is operating. Where high-frequency devices are used for protection of vaults, the noise of breaking in does not give an "early warning" and thereby prevent considerable damage to the vault wall or door, because the high-frequency systems are not responsive to the usual sounds created during an attempt to break through a wall or door. With an audible sonic alarm system, moreover, a would-be intruder hears the system in operation and, knowing its capabilities, is deterred from even trying to break in.

Moreover, other prior devices have not been tamper-proof. Many prior devices have usually included some of the components outside of the protected area which made the devices susceptible to defeat by manipulation. For example, many prior devices have been operated by an outside supply of electricity or have included control means whereby a person could turn off the system to prevent an alarm from operating when such person made an authorized entry.

Still other prior devices have been susceptible to other disadvantages which are overcome by the device of the present invention as set forth more clearly below. The present alarm system, for example, includes a delay turn-on means by which the operator when leaving the premises has a minimum of time, such as three minutes, after turning on the system, to leave the premises without the system setting off an alarm. The present device also overcomes the disadvantages of prior devices in regard to "fail-safe" features and life expectancy. The device is completely transistorized to save power. Each component monitors itself and causes an alarm if an improper function or failure occurs. Each component serves as a link in a chain and the failure or weakening of any one component creates an alarm; i.e., each component is in constant use and must function properly at all times. As will be explained below, the system includes a voltage divider that serves to bias a diode to insure that the system sets up properly and that an alarm will result if, after turning it on, it does not subsequently set up for operation in the proper range of sound sensitivity.

Other devices have included various costly components for creating and receiving standing waves for detecting unauthorized movements within the protected area. They have included antennas, two oscillators, frequency drift compensators, and the like.

In prior devices it has been necessary to make careful

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adjustments each time the equipment is turned on, to insure its being set in the proper sensitivity range or the system would respond only to an increase potential in the monitoring means, and not respond to a decrease. That fault made it possible to defeat those prior devices and compromise the purpose and intent thereof. For example, in some prior devices the pickup unit had to be located at a null point in the standing wave pattern because a change in arrangement of any object in the area would cause the standing wave pattern to shift, and thus the null point would shift. Also a change in frequency requires readjustment of the entire system. The device of the present invention has overcome those shortcomings and provided positive checks in the new and improved circuitry, and this device can turn itself on and set itself up in the proper range of sensitivity automatically. If for any reason the device cannot achieve a balance, it will sound an alarm giving complete fail-safe monitoring of its own circuitry. Another improvement is the characteristic of the monitoring circuit to give alarm on a slight increase or decrease in the monitoring means. The system will accept very slow changes in the standing wave pattern and ambient sound level within predetermined limits to prevent false alarms.

The device of the present invention combines the features of detecting sound and movement, and establishes a standing wave pattern of low frequency, such as between 50 and 15,000 cycles per second. The device detects any (1) movement of persons within the protected area, (2) movement of doors, partitions, or large objects within the protected area, and (3) increase or decrease in sound above the normal or ambient level. On the other hand, the system will not cause a false alarm in response to movements of small animals such as mice, normal variations of temperature, and very low frequency sounds such as the rumble of thunder, traffic noise, etc. which may occur outside of plate glass windows that enclose a protected area such as a supermarket.

It has been found that low frequency sounds set up more definite wave patterns which have greater susceptibility to change than do high or ultrahigh frequency wave lengths. Although high and ultrahigh frequency waves are more penetrable, they are most susceptible to being defeated by the use of microwave absorbers than are low frequency or sonic sound waves. Unlike low frequency sounds which are stopped by the usual building construction such as walls, high frequency waves penetrate glass windows of markets and the like and are therefore susceptible to extraneous movements created beyond the protected area, for which reason false alarms are just as liable to occur as a genuine alarm.

The sonic alarm system of the present invention includes the combined protection of fire, sound, and movement detection in the protected area within predetermined adjustable limits. The system has the flexibility of responding only to sound to trip an alarm, or to a combination of sound, motion, and fire. It also has the characteristics of maximum response to movement and fire detection with less sound sensitivity. Moreover, the system detects fire in two ways; that is, a response to the crackling noise of fire, and a response to the change in the standing wave pattern caused by the flame and/or hot gaseous formations in the area due to a fire. In addition, the output tone during its operation always provides the sound pickup amplifier with a given output voltage which must exceed a bias of voltage on a diode that serves as a lower limit fail-safe feature. Moreover, since every monitoring component is in constant use, the failure of any one will cause an alarm.

Finally, the system includes a delay system for turning it on and obtaining a balanced wave pattern before

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it becomes effective for operating an alarm. Such a balanced pattern of sonic waves is distinguished from the so-called "Doppler effect." In present sonic alarm systems, the alarm is actuated by changes in volume or pressure of the sound pattern while the "Doppler effect" is dependent upon changes in frequency between transmitted waves and reflected waves, which in turn are dependent upon the speed with which an object or intruder moves within the protected area. However, with the system of this invention, no matter how slow an object is moved a change will occur in the standing wave pattern and cause a great change in the pickup amplifier.

Accordingly, it is a general object of the present invention to provide a sonic alarm system or device of improved construction and operation as compared with prior known devices and which is completely transistorized with controlled sensitivity, which has been reliable, and which overcomes all known disadvantages and difficulties existent in prior known devices.

It is another object of this invention to provide an improved alarm system which uses low frequency sound waves which operate to deter a would-be intruder from damaging or defacing the walls or doors of the enclosed area because he realizes the futility of such an attempt.

It is another object of this invention to provide an improved alarm system which is tamperproof because all components are contained within the walls of the enclosed protected area and cannot therefore be manipulated into inoperativeness by an unauthorized person.

It is another object of this invention to provide an improved alarm system which is "fail-safe" because all monitoring components are in continual operation and the failure of any one of the components creates an alarm.

It is another object of this invention to provide an improved alarm system which employs means for detecting audible noise as well as standing wave detection of movement of objects within the area being protected.

It is another object of this invention to provide an improved alarm system which protects itself to the extent that none of the components are outside of the protected area and which cannot be defeated by the use of sound-absorbing material.

It is another object of this invention to provide a sonic alarm system which includes electronic means for delaying actual operation of the system for a prescribed period of time to permit authorized personnel to leave the protected area after turning on the system.

It is another object of this invention to provide an improved sonic alarm system which is completely transistorized and which includes a self-contained supply of electricity for operating the system independent of an outside source.

These and other objects and advantages apparent to those skilled in the art from the following description and claims may be obtained, the stated results achieved, and the described difficulties overcome by the discoveries, principles, apparatus, parts, elements, combinations, and subcombinations which comprise the present invention, the nature of which is set forth in the following general statement, a preferred embodiment of which—illustrative of the best mode in which applicant has contemplated applying the principles—is set forth in the following description and shown in the drawings, and which is particularly and distinctly pointed out and set forth in the appended claims forming part hereof.

The nature of the improvements in the sonic alarm system of the present invention may be stated in general terms as including a battery operated unit having a tone generator and sound receiver with associated amplifiers, an alarm relay meter including a coil, an indicator operated by the coil, and spaced contacts separately engageable by the indicator, an amplifier power delay relay for delaying operation of the amplifiers and for closing the

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circuit to the meter relay until a standing wave pattern of ambient sound is created between the tone generator and sound receiver, an alarm meter by-pass relay for temporarily opening the circuit through the alarm meter relay, a time delay initiator relay for temporarily supplying current to the alarm meter relay by-pass and for charging a capacitor which continues to operate the alarm meter relay by-pass relay after the time delay initiator relay ceases to function, monitoring means including a lock-in alarm relay for closing a circuit through the contacts of the alarm meter relay and including a balancing capacitor in parallel with a bias battery and limiting diode, the monitoring means also including a four-way rectifier bridge having a filter capacitor associated therewith in series connection with the coil of the alarm meter relay and the sound receiver amplifier, whereby changes of voltage output of the sound receiver amplifier create an alarm caused by changes in the sound pattern of the enclosed area.

The preferred embodiments of the invention are illustrated by way of example in the accompanying drawings wherein:

FIGURE 1 is an electrical circuit showing the connections between the various components; and

FIG. 2 is a fragmentary circuit showing another manner in which the alarm relay can be used.

In FIG. 1 the alarm system includes tone generating means 1, sound-receiving means or pickup unit 2, a power supply unit or battery 3, and alarm control means generally indicated at 4. The tone generating means 1 is provided with an oscillator 5 and an amplifier 6. The oscillator 5 generates alternating currents of from 50 to 15,000 cycles per second and preferably 1000 cycles per second. The tone generator 1 emits a sound into the protected area that creates a sound pattern of standing waves or ambient sound. A normally closed test switch 7 is disposed between the amplifier 6 and tone generator 1.

The sound-receiving means or pickup unit 2 is adapted to receive the sound and, through an amplifier 8, sets up a balanced potential throughout the alarm system. In addition, the sound-receiving means 2 may detect other sounds or soundless movements of an intruder interfering with the stable sound pattern that are of sufficient magnitude to alter the voltage level or potential in the system and thereby trigger the alarm.

The power supply unit or battery 3 is preferably a conventional storage battery of 12-volt capacity. As shown in FIG. 1, the battery 3 provides power to all components of the system.

The alarm control means 4 includes a plurality of smaller circuits including a time delay initiating circuit generally indicated at 9, an alarm meter by-pass circuit 10, a power delay circuit 11, a lock-in alarm relay circuit 12, monitoring means 13, and a listening circuit 14. The delay initiator circuit 9 operates for a short time, such as two seconds, to initiate the alarm meter by-pass circuit 10. The delay initiator circuit 9 includes a relay 15 with an armature or blade 16 and a relay contact 17, a wire 18, a capacitor 19, a capacitor leak resistance 20, and a series limiting resistance 21.

The alarm meter by-pass circuit 10 includes a relay 22 having an armature or blade 23 and contact 24 for opening the circuit through a meter relay 50 and providing a path for charging current to a balancing capacitor of the alarm meter relay. In addition, the circuit 10 includes a capacitor 25, a variable resistance 26, a limiting resistance 27, a switching transistor 28, and a series limiting resistance 29.

The power delay circuit 11 delays operation of the amplifiers 6 and 8 when turning both on and off so that the alarm meter by-pass circuit 10 is closed to prevent a false alarm during the initial "on" and "off" periods of the system. Moreover, the power delay circuit 11 opens the meter relay circuit 10 to insure that no current passes

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through the alarm meter relay during the normally off periods from the bias battery 47 through the diode 48. That action also prevents the balancing capacitor 46 from discharging through the meter relay as the system is turned off. The power delay circuit 11 includes a relay 30 having an armature or blade 31 and a contact 32. The circuit 11 also includes a capacitor 33, a voltage dropping resistance 34, as well as a second armature or blade 35 operative with a contact 36, which blade 35 is mechanically connected (not electrically) to the armature 31 as shown by the dotted line 37.

The lock-in alarm relay circuit 12 includes a relay 38 having an armature or blade 39 and contact 40, which relay handles heavier current for the alarm and provides a hold-in feature for sustaining the alarm until the circuit is reset. The circuit 12 also includes a lock-in diode 41.

The monitoring means 13 includes a four-way bridge rectifier 42, a load resistance 42a, a filter capacitor 43, a load resistance 44, a by-pass limiting resistance 45, a balancing capacitor 46, a bias battery 47, a limiting diode 48, the contact switch 35, a meter coil 49 of an alarm meter relay 50, a filter capacitor 51, and the armature 23 of the relay 22.

The listening circuit 14 is provided to permit monitoring of the system whenever desired. It includes a capacitor 52, a variable resistance 53, and a phone jack 54.

In addition to the meter coil 49, the alarm meter relay 50 includes a relay indicator 55 which is actuated by the coil 49, as well as contacts 56 and 57. The contacts 56 and 57 are in turn connected to the negative battery terminal through the alarm relay reset switch 63. The armature 39 is supplied with negative current through the reset switch. The resistance 59 in line 58 is provided to limit the current in the meter relay contact circuit. Thus, when the circuit through the meter coil 49 is closed, a sufficiently large sound or movement in a protected area will create an increase or decrease in voltage output of the amplifier 8 in the system, which causes the indicator 55 to move and contact either contact 56 or 57 and thereby energize the coil of the relay 38 and create an alarm.

In addition to the foregoing, the system includes an alarm bell 60, an alarm light 61, as well as a switch 62, and a reset switch 63 is provided in the circuit, including the resistance 59.

Finally, the circuit is provided with an on-off switch 64. The switch 64 may be used in conjunction with an automatic timer or it may be in the form of a key-switch situated at the entrance door to the enclosed area. In either form, the switch 64 is used to turn the alarm system on and off at specified times. Thus an authorized person or persons can enter the protected area without initiating a false alarm, together with the attendant activities following therefrom, such as police rushing to the protected area in response to a false alarm.

The alarm system in FIG. 1 may be used to protect an enclosed area having stable conditions such as a vault with heavy walls that absorb the exterior sounds of traffic and the like. To operate the system the on-off switch 64 is closed causing current to flow through the coil of the relay 15 which moves the armature 16 to engage the contact 17 and close the time delay initiator circuit 9. This supplies negative potential through the limiting resistance 21 to charge the electrolytic capacitor 25. The charge potential placed on the capacitor 25 is applied through the limiting resistances 26 and 27 to the switching transistor 28, causing current to flow through the limiting resistance 29 to the relay 22, causing the armature 23 to close on the contact 24. That action opens the circuit through the coil 49 of the alarm meter relay 50 and closes the circuit through the load resistor 45 to the balancing capacitor 46.

The relay 15 functions for approximately two seconds, because the armature 16 opens when the capacitor 19 be-

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comes fully charged, thus preventing further current from flowing in the coil of the relay 15. The resistance 20 shunting the capacitor 19 provides the necessary leakage path to discharge said capacitor when the switch 64 is open during periods of inoperation of the system.

The action of closing the on-off switch 64 also initiates a delaying action in the relay 30 but does not immediately close the armature 31 on the contact 32. Current flows through the limiting resistance 34 and the resulting voltage drop is applied to charge the capacitor 33. As the capacitor 33 becomes fully charged, a greater potential is available to the coil of the relay 30, causing the armature 31 to close. In that manner the circuit is closed through the oscillator 5, the amplifier 6, as well as the amplifier 8, with 12-volt D.C. power from the battery 3.

The tone generator 1 emits a continuous audible note that saturates the protected area with sound and establishes a pattern of standing waves. The audible note has a wave length of between 50 and 15,000 cycles per second and preferably 1000 cycles per second. The pickup unit 2 continuously samples the sound level which is constant if no intrusion or movement occurs within a protected area. Due to a time delay, however, initiated previous to the action of the time delay relay 15, movements of the operator in turning on the system and leaving the area do not actuate the alarm system. The delay period is utilized to warm up the amplifiers 6 and 8 and balance charge on the capacitor 46.

The output of the amplifier 8 as influenced by tone output 1 and standing wave pattern of the enclosure is applied to the load resistance 42a in the form of A.C. power leading to the bridge rectifier 42. The alternating potential from the oscillator is rectified to direct current (D.C.) and filtered by the capacitor 43 which is shunted by parallel load resistance 44, the series limiting resistance 45, balancing capacitor 46, a bias battery 47, and a diode 48.

The capacitor 46 assumes a charge proportional to the rectified D.C. potential through the limiting resistance 45 comprising an alarm meter relay by-pass circuit. As the time delay relay 15 completes its cycle and releases the armature 16, the D.C. potential is applied to the meter relay coil 49 and since the capacitor 46 has assumed the charge of the D.C. potential, no current will flow through the meter relay coil 49.

The bias battery 47 and the diode 48 provide a lower operating point and prevent the alarm meter relay 49 from zero-balancing unless all components including the oscillator 5, amplifier 6, tone generator 1, amplifier 8, and pickup unit 2 are functioning properly to supply a given output from the amplifier 8 and the rectifier 42. That output must exceed in potential the voltage of the bias battery 47 such as 1.2 volts.

In the absence of sufficient output from the amplifier 8, the diode 48 can conduct current from the bias battery 47 to charge the capacitor 46, and, through the resistance 44 and the armature 23 of the relay 22, supply a sufficient current to the coil 49 to close the indicator 55 on one of the contacts 56 and 57 to cause an alarm. Current also flows through the limiting resistance 59 to the coil of alarm relay for the negative potential, causing the armature 39 to close and supply a hold-in current for the relay 38, as well as supply current to the alarm bell 60 and the alarm light 61.

The diode 41 prevents the contacts 56 and 57 of the meter relay 50 from being overloaded and provides a path through the contact 40 of the negative potential to the hold-in relay 38. The diode 41 prevents the load of the alarm meter contact circuit from being applied to the contacts 39 and 40. When the armature 39 closes the circuit through the contact 40, the negative potential is supplied through the diode 41 to hold or maintain the alarm relay 38 energized even though the contacts 56 and 57 open.

The normally closed switch 63 is used to reset the relay 38. Interruption of the circuit through the switch 63 causes the relay 38 to become de-energized and drop out, opening the contact 40. The normally closed test switch 7 is provided to interrupt the tone generator 1 causing the loss of the output signal and reducing the output of the amplifier 2, which in turn would reduce the rectified potential applied to the balancing capacitor 46, causing the capacitor to supply current through the meter relay coil 49 and the series resistance 44 back to the positive terminal of the capacitor 46, whereby one of the contacts 56 and 57 is closed through the indicator 55. The switch 62 is furnished to interrupt the alarm bell until the cause of alarm is determined and conditions are returned to normal.

The listening circuit 14 comprising a capacitor 52, a variable resistance 53 and a phone jack 54 is provided to allow a guard at a remote place to listen, either to the output of amplifier 8 and determine possible cause of alarm, or to the general operating condition of the tone generator 1 and the pickup amplifier 8.

The sonic alarm system of FIG. 1 is preferably used in areas such as vaults having thick walls, where stable sound conditions are readily maintained and where few, if any, exterior sounds, such as traffic noise, can enter to disturb the standing wave or sound level within the protected area. Under such conditions the alarm meter relay 50 responds to noises by deflecting the relay indicator 55 to the right contact 57. It responds to movement of anything within the protected area by deflecting the indicator to the left or right contact 56 or 57. In other words, a noise always increases the voltage in the system, while movement alone may increase or decrease the voltage with a corresponding deflection of the indicator 55.

Where the sonic alarm system is adapted for use in areas having more unstable conditions, such as in supermarkets where traffic noise and the like may more easily enter the protected area, an alarm meter relay 50 having a modified circuit 67 should be used, as shown in FIG. 2.

In FIG. 1, the meter coil 49 is connected between the wires 65 and 66 leading to the relay armatures 23 and 35, respectively. In FIG. 2, the meter coil 49 includes the additional circuit 67, designed to trigger an alarm only upon an accumulation of a succession of changes in the output of the detecting amplifier 8. The circuit may be adjusted to require any number of movements within the standing wave pattern or a very loud noise before it would actually trigger an alarm. The circuit 67 may be adjusted to any conditions of sensitivity with relation to sound and movement. As in FIG. 1, the static voltage is applied from the load resistance 44 to a full wave rectifier bridge 68, a filter capacitor 69, and a parallel load resistance 70, and the meter relay coil 49 and back to the balancing capacitor 46. An increasing voltage caused by disturbance in the standing wave pattern or the amplification of a sound disturbance is supplied through the bridge 68 to the alarm meter coil 49 and to its variable shunting resistance 70.

The resulting increased voltage is applied through the diode 68b, then to the meter relay 49 and then through the diode 68d to charge the balancing capacitor 46. Similarly, a decrease caused by a loss of sound or a disturbance of the standing wave pattern causes the capacitor 46 to return a portion of its charge through the diode 68a again through the coil 49 and the shunting capacitor 69 through the diode 68c and thence back to load resistance 44 to complete the discharge circuit. The arrangement of the bridge rectifier 68 serves to cause the relay 49 to deflect to the right with an increase or a decrease in the voltage and successive increases or decreases will result in a higher reading of the indicator 55 because of the accumulated charge of capacitor 69.

The output of tone generator 1 creates a standing wave

pattern within an enclosed area. The pickup unit 2 samples the sound level in its immediate vicinity, converting said sound to electrical energy which is amplified by the amplifier 8 and appears as an alternating potential across the load resistance 42a. The movement of an intruder within an enclosure will cause a shift in the standing wave pattern and change the sound level in the vicinity of the pickup unit 2, causing a different input to the amplifier 8, resulting in a varying output to the load resistance 42a.

Briefly, when the system is turned on by the off-on switch 64, the relays 15 and 30 are operated. However, operation of the relay 30 is delayed with respect to relay 15 which closes the armature 16 on the contact 17, whereby the circuit through the relay 22 is closed. The relay 22 brings the armature 23 into engagement with the contact 24, thereby opening the circuit through the coil 49 of the alarm meter relay. At the same time, however, the relay 15 charges the capacitor 25 until the capacitor 19 is completely charged. When the capacitor 19 is completely charged the current ceases to pass through the relay 15, for which reason the armature 16 moves off the contact 17 and thereby opens the circuit through the relay 22. The foregoing operation takes place over a period of one to two seconds to permit the capacitor 25 to become completely charged in order to subsequently continue operating the relay 22 for a predetermined period measured by the setting of the variable resistance 26.

Meanwhile, the capacitor 33, having become fully charged, now permits current to pass through the relay 30, pulling the armature 31 into engagement with contact 32, as well as closing the switch 35 which is connected to the armature 31, as indicated by the dotted line 37. The delay in operating the relay 30 due to the capacitor 33 is sufficiently long to permit the relay 22 to open the circuit through the coil 49. However, it is not long enough to permit complete discharge of the capacitor 25. As a result of operation of the relay 30, the tone generator 1 and sound receiver 2 create a standing wave pattern within the protected area which becomes balanced as soon as the operator leaves the area. The time required for such balancing of the ambient sound within the area may be predetermined and set by adjusting the variable resistance 26 which delays complete discharge of the capacitor 25 and thereby maintains the relay 22 in operation.

Thereafter, when a balanced sound pattern is created without being subjected to changes due to initiating operation of the alarm system, the capacitor 25 becomes completely discharged, whereupon the armature 23 lifts from the contact 24 and closes the circuit through the coil 49.

Any subsequent changes in the standing wave pattern which are created by either movement of persons or things, or of sound within the protected area, result in voltage changes through the amplifier 8 which are transmitted through the bridge rectifier 42 to the balancing capacitor 46, whereupon the relay 38 actuates the armature 39 into engagement with contact 40, thereby closing the circuit through the alarm bell 60 and light 61 and sustains the alarm until the circuit is reset by operation of the switch 63.

When the system is turned off by opening the switch 64, the amplifier power delay relay 30 continues in operation due to discharge of the capacitor 33 for several seconds to permit the alarm system to stabilize before interrupting the standing wave pattern of sound in the area, and thereby avoid actuation of a false alarm.

A fire will create a disturbance in the standing wave pattern so as to shift the various pressure areas in the vicinity of the pickup unit 2 and cause an alarm. The pickup amplifier 8 is sensitive to sounds of a normal sonic frequency range. The sensitivity may be adjusted so as to cause an alarm from very low level noise within the

enclosure. By adjusting the output of the tone generator and the sensitivity of the pickup unit 2, it is possible to maintain a condition responsive to either a greater movement detection and little sound sensitivity or a condition which is responsive to a small amount of movement and a great amount of sound sensitivity.

The flexibility and sensitivity of the alarm system can be readily controlled by adjusting the volume controls (not shown) on the amplifiers 6 and 8 of the tone generator 1 and pickup unit 2, respectively. In order to increase sensitivity of the system to movement and fire, the volume of the tone generator amplifier 6 is increased, while a decrease of the volume of said amplifier will decrease the strength of the standing wave pattern created by the tone and therefore reduce the sensitivity to movement and fire. At the same time, the sound sensitivity of the system can be increased by increasing the volume of the pickup amplifier 8. By increasing the volume of both amplifiers 6 and 8 the sensitivity to movement, sound, and fire can be increased. However, where the protected area is normally affected by extraneous noises it is desirable to reduce the sensitivity of the system to sound by decreasing the volume of the pickup amplifier 8. Likewise, where the protected area includes a moving display, such as in a storeroom, the volume of the tone generating amplifier 6 can be reduced to decrease the sensitivity of the alarm system to the movements of such a display and thereby avoid the possibility of a false alarm.

The principle of establishing a standing wave pattern has been used in prior alarm devices. In detecting a difference in a standing wave pattern, this device responds only to an increase or decrease in sound level at the pickup amplifier 8. The device of this invention does not monitor the frequency of oscillations as in the Doppler effect, but instead monitors a change in the standing wave pattern as it is presented to the pickup unit 2 in the form of sound pressure.

The sounds of a forceful entry cause the pickup unit 2 to transmit a larger input voltage to the amplifier 8, resulting in an increased output potential to be rectified by the rectifier 42 and appear as an increased voltage across the filtering capacitor 43, the shunting resistance 44, the alarm meter relay 50, and the balancing capacitor 46. The increased voltage charging the capacitor 46 through the coil 49 of the meter relay causes the meter contact 56 or 57 to close with the indicator 55 and create an alarm. As the capacitor 46 assumes the applied equivalent potential, current ceases to flow through the meter relay 50 and a contact pointer 55 centers between the contacts 56 and 57.

The armature 35 which operates with the armature 31 is provided on the relay 30 to close the circuit through the coil 49 and the negative terminal of the capacitor 46. The armature 35 is necessary to prevent the constant drain of bias battery 47 through the diode 48, the resistance 44, and the meter relay coil 49 during the period the alarm system is inoperative. When turning off the alarm system a delay period is provided by the relay 30 to maintain a constant output of oscillator 5, the amplifier 6 the tone output 1, and the amplifier 8, thereby preventing on interruption of the alarm circuit and preventing the capacitor 46 from tripping prior to the power being disconnected to the alarm relay 50.

The device of the present invention thus avoids prior art difficulties. By creating a standing wave pattern of ambient sound within the protected area, an alarm is created if the pattern is disturbed by movement of a thing or person within the area. In addition, any sound of breaking or entering will trigger an alarm and thereby deter a would-be entrant from even damaging the exterior surface of the wall, door or window of the protected area. Inasmuch as the system creates a sound rather than using high or ultrahigh frequency, the sound is normally heard

outside of a door or window and thereby gives an early warning to a would-be entrant.

Unlike most prior devices, the device of the present invention is tamperproof. All components of the device are located within the protected area so that they are not susceptible to defeat by manipulation. Moreover, the device is dependent upon a battery for its source of power rather than an outside supply of electricity, whereby the system is further removed from being turned off by an unauthorized person.

Finally, the device of the present invention includes components which prevent the system from setting off a false alarm and thereby incurring a series of undesirable events such as police rushing to the area.

The device, being completely transistorized, has a long life expectancy and in addition each component monitors itself and causes an alarm if an improper function or failure occurs. Notwithstanding the foregoing advantages, the device is inexpensive and simple to maintain.

In the foregoing description certain terms have been used for brevity, clearness and understanding, but no unnecessary limitations are to implied therefrom beyond the requirements of the prior art, because such words are used for descriptive purposes herein and are intended to be broadly construed.

Moreover, the embodiments of the improved construction illustrated and described herein are by way of example, and the scope of the present invention is not limited to the exact details of construction shown.

Having now described the features, constructions and principles of the invention, the characteristics of the sonic alarm system and the advantageous, new and useful results provided; the new and useful discoveries, principles, parts, elements, combinations, subcombinations, structures and arrangements, and mechanical equivalents obvious to those skilled in the art are set forth in the appended claims.

I claim:

1. A sonic alarm system for creating a standing wave pattern of ambient audible sound within a protected area and for actuating an alarm in response to changes in at least one of the standing wave patterns and of the sound intensity including

(a) a first circuit including tone generator means for generating said standing wave pattern;

(b) a second circuit including sound receiver means for receiving said standing wave pattern and variations thereof;

(c) a signal circuit including the sound receiver means, means for monitoring voltage changes from said sound receiver means, and an alarm device including an alarm meter relay coil with contacts;

(d) the means for monitoring voltage changes from said sound receiver means including a balancing capacitor for determining the time rate of change of voltage sufficient for actuating said alarm meter relay coil, and also including time delay means including a relay for opening and closing a circuit to the alarm meter relay coil in said signal circuit, which coil is responsive to a predetermined change of voltage of the signal circuit;

(e) the relay coil being connected between said alarm device and the sound receiver means for detecting variations in voltage caused by changes in at least one of the standing wave pattern and of the sound intensity picked up by the sound receiver means;

(f) the signal circuit also including a combination of a bias battery and a diode series connected and the combination connected in parallel with the balancing capacitor and said bias battery and diode with the balancing capacitor being connected as a combination between the opposite ends of the alarm meter relay coil;

(g) whereby a change below a predetermined limit in

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at least one of the pattern and intensity of the sound received is absorbed by the balancing capacitor and causes no significant operation of the relay coil and thereby avoids operation of the relay contacts, and whereby a change above a predetermined limit in at least one of the pattern and intensity of the sound received is unabsorbed by the balancing capacitor and causes the relay coil to operate the relay contacts and thereby actuates the alarm device.

2. The alarm system of claim 1 having variable resistance means for adjusting flexibility of the system to respond to at least sound, motion, and fire.

3. The alarm system of claim 1 having limiting resistance means for adjusting sensitivity of the system for detection of fire in response to at least the crackling noise of fire and the change in the standing wave pattern due to flame and hot gaseous formation in a protected area.

4. The alarm system of claim 1 in which the balancing capacitor is connected in the circuit between the sound receiver means and the alarm meter relay coil, whereby

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the time delay means preliminarily charges the capacitor prior to closing the circuit to the alarm meter relay coil.

5. The alarm system of claim 4 in which the time delay means also includes a second capacitor and variable resistance for sequentially opening the circuit to the alarm meter relay coil and then closing the circuit to the balancing capacitor and then closing the circuit to the sound receiver means and then closing the circuit to the alarm meter relay coil.

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