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ACOUSTICAL ALARM SYSTEM

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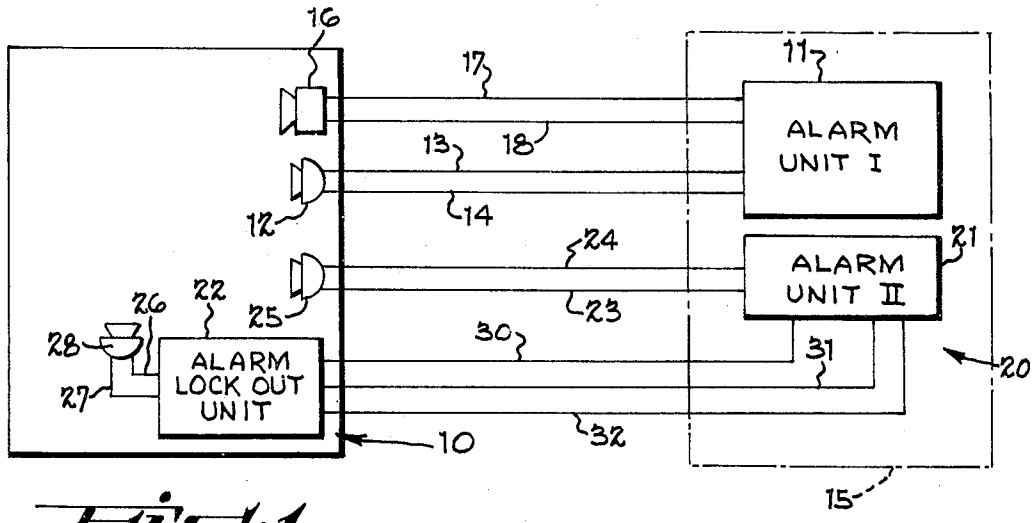

Fig. 1

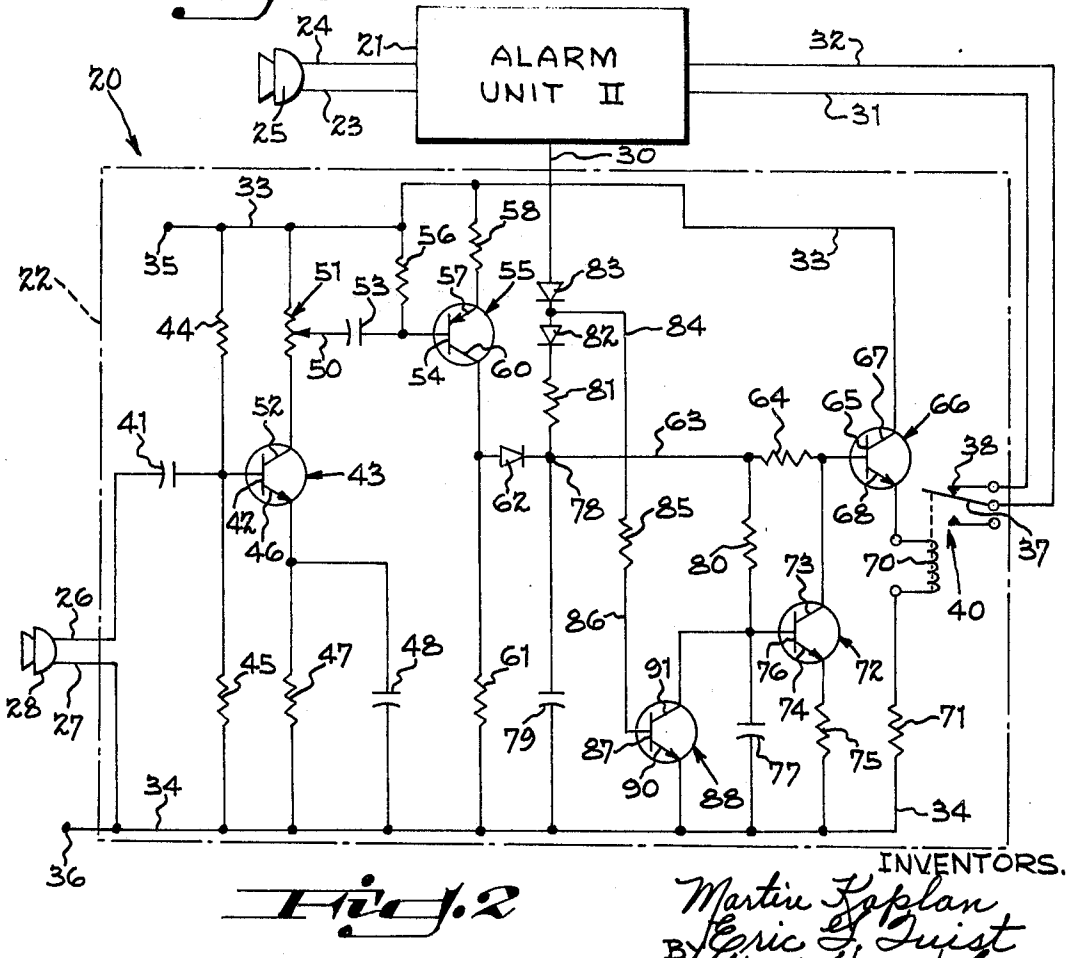

Fig. 2

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ACOUSTICAL ALARM SYSTEM

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ABSTRACT OF THE DISCLOSURE

An audio alarm unit for use in a common enclosure with a second audio alarm unit of the type having a sound pickup and a sound generator for use in checking the unit. The alarm unit includes a first pickup and a second pickup located in the common enclosure and responsive to the sound generator. False alarms during test periods when the sound generator is actuated are prevented by an alarm lockout unit. This unit is triggered by the second pickup at the start of the test and prevents the first pickup from actuating the alarm unit for a period of time longer than the normal period of operation of the sound generator.

This invention relates to alarm systems and is particularly directed to a novel audio alarm unit incorporating a lockout circuit for preventing actuation of the alarm as a result of a sound of predetermined duration, such as that resulting from a testing of a second, independent alarm system protecting the same premises.

As a result of increased skill and sophistication of techniques employed by criminals to burglarize vaults and other protected areas, it has been found desirable for maximum security in some installations to utilize two alarm systems to protect the same vault or other premises. These alarm systems are completely independent from one another so that even if a burglar should effectively compromise one system, his intrusion could still be detected by the other system and an appropriate alarm signal given. A very substantial problem arises, however, in the provision of a second, independent alarm system which is compatible with an existing system.

More particularly, many existing systems of the audio type utilize a microphone or other acoustical pickup placed in the vault or other premises being protected. When an intruder causes noises, this pickup causes a signal to be sent over interconnecting lines to a central station. This signal actuates a suitable alarm to call attention to the intrusion. These systems further includes means for periodically testing the integrity of the system to make certain that the lines or pickup device have not been compromised. Commonly, this test is obtained by sounding a horn, or other transducer, located near the acoustical pickup for a predetermined time, for example, 15 seconds. When this horn is sounded, if a proper alarm signal is received at the central station, the system has presumably not been compromised. On the other hand, if no alarm signal is received back at the central station, the monitor is able to determine that something is wrong and that the premises should be investigated.

The principal object of the present invention is to provide a completely independent audio alarm system which is compatible with an audio alarm system including a test horn of the type described above. More particularly, the present alarm system is effective to provide an alarm whenever there is an intrusion on the premises. However, the present alarm system does not proivde a false alarm when the test horn of the companion alarm system is sounded for its prescribed period.

It is another object of the present invention to provide an alarm system including a lockout unit for preventing actuation of the alarm when a test horn is operated for a prescribed period, but which in addition is effective to provide an alarm in the event that the horn or some other noise continues beyond the preselected period. In other words, the present alarm system cannot be compromised by continuing or simulating an alarm signal for an appreciable period.

A still further object of the present invention is to provide an alarm system which can be reset by means of a brief reset pulse. More particularly, this is accomplished by providing in the lockout unit a time delay which begins when the alarm is turned off and which prevents the alarm from being reactuated for a brief period sufficient to allow lingering noises due to reverberations from previously actuated alarm bells, buzzers or the like, to die down before the alarm unit can again be reactuated in response to a new or continuing noise.

Another object of the present invention is to provide an alarm lockout unit effective to perform all of the various functions described and which is nevertheless of simple construciton and reliable in operation.

The present alarm system comprises two units. One unit is a generally conventional acoustical alarm unit including a microphone located in the area to be protected and lines interconnecting the microphone and main alarm circuit in the central station. The system includes a second, major component, a lockout unit. This lockout unit is provided with its own microphone in the area being protected.

The lockout unit and alarm unit are provided with two interconnections. One interconnection is made from the alarm unit to a relay in the lockout unit. When the contacts of this relay are closed, the alarm unit is conditioned for actuation in response to a signal from its pickup. However, when the relay contacts are open the alarm is decommissioned and cannot be actuated by a signal from its pickup unit.

In essence, the circuitry of the lockout unit is effective to open the relay contacts to decommission the main alarm unit at the beginning of a noise signal such as that produced by the testing horn. If the test horn or other noise stops within a set period, no false alarm signal is given. However, after a period of time corresponding to the established duration of the test horn signal, if the noise continues the lockout circuit closes the relay contacts, conditioning the main alarm unit for actuation. Since the acoustical pickup of this main alarm unit also senses the continuing noise, an alarm is given. As a result, the present alarm system is effective to independently detect any intrusion (which would necessarily involve a noise lasting longer than the test horn signal) and yet cannot be compromised by merely continuing the test signal noise to cover up an intrusion.

The lockout unit and alarm unit are provided with a second interconnection which facilitates resetting the alarm unit. More particularly, the main alarm unit once actuated is latched in in a conventional manner. When this occurs, the second interconnection between the alarm unit and lockout unit provides a potential to the lockout unit which is effective to cause the above mentioned relay to open. While the relay when open does not cause the alarm unit to drop out, it does open a circuit in the alarm unit which prevents the re-actuation of the alarm unit in response to a noise signal pickup by the microphone associated with the alarm unit. This potential is removed when the alarm unit drops out momentarily in response to the actuation of a reset pulse. However, the circuit in the lockout unit which energizes the relay includes a time delay of sufficient duration to allow the reverberations or other lingering noises to die down

before the relay contacts close to condition the alarm unit for further actuation.

These and other objects and advantages of the present invention will be more readily apparent from a consideration of the following detailed description of the drawings illustrating a preferred embodiment of the invention.

In the drawings:

FIGURE 1 is a diagrammatic view of a typical security installation incorporating the present alarm system.

FIGURE 2 is a schematic circuit diagram of the present alarm system.

As is shown in FIGURE 1, the present alarm system can be utilized to provide protection against intrusion upon any enclosure; for example, a bank vault **10**. The present alarm is compatible for use with a second alarm system **11** identified in the drawings as "Alarm Unit I." This alarm unit I includes an acoustical pickup **12** disposed within the vault or other area being protected. The acoustical pickup, or microphone, **12** is connected through lines **13** and **14** to the main portion of alarm unit I located in a central area designated by dotted lines **15**. Alarm unit I further includes a horn **16** located within the protected area and interconnected through alarm unit I to lines **17** and **18**.

The exact details of construction of alarm unit I constitute no part of the present invention. In essence, this unit is effective to cause an alarm whenever pickup **12** senses an excessive amount of noise, such as that caused by someone breaking into the enclosure. In order to prevent the defeat of alarm unit I in various ways, such as by tampering with lines **13** and **14**, alarm unit I contains suitable circuitry for periodically energizing horn **16**. Thus, horn **16** may, for example, be energized every 15 minutes for a period of 15 seconds. If when this horn is energized a suitable response is not obtained from microphone **12** at alarm unit I, a line alarm condition is established and suitable alarm signals are actuated. If, however, the alarm unit is operating in proper order, at the end of a predetermined period of horn operation, e.g. 15 seconds, the horn is deenergized and alarm unit I is returned to its normal mode of operation.

The present alarm system is effective for use as an independent alarm system to provide additional protection for the same enclosure. Thus, if alarm unit I is defeated in some manner, alarm unit II will still give an alarm signal in the event of intrusion. More particularly, the present alarm system **20** comprises two principal units. One unit **21** is identified as "Alarm Unit II." The second unit **22** is identified in the drawings as "Alarm Lockout Unit." Alarm unit II is a conventional acoustical alarm and the details of its construction constitute no part of the present invention. This alarm unit II is interconnected through lines **23** and **24** to an acoustical pickup, or microphone, **25** located in the protected enclosure **10**. Lockout unit **22** is preferably located in the protected enclosure and is connected through leads **26** and **27** to an acoustical pickup, or microphone, **28** which is also located in vault **10** or other protected area. The alarm unit II is located in the central area and is interconnected to the lockout unit **22** through lines **30**, **31** and **32**.

Essentially, in the present alarm system, alarm unit II is effective to cause an alarm signal whenever microphone **25** senses an excessive amount of noise which would indicate an intrusion or the like. However, lockout unit **22** prevents alarm unit II from going into an alarm condition when horn **16** of alarm unit I is sounded for a predetermined period incident to the testing of alarm unit I. However, the lockout unit and alarm unit II function in combination to provide an alarm signal in the event that a noise, such as that caused by horn **16** in combination with another noise source, continues beyond a predetermined period. As a result, the present alarm system is completely compatible with alarm system I, i.e. will not cause a false alarm while that system is being tested; and yet the present alarm system cannot be defeated by causing a noise like horn **16** and continuing the noise for a protracted period.

The circuit details of construction of the present alarm system **20** are shown in FIGURE 2. As there shown, alarm unit **22** is interconnected to microphone **28** through lines **26** and **27**. A suitable DC operating potential is applied to positive line **33** and ground line **34** at terminals **35** and **36** respectively. The lockout unit **22** is interconnected to alarm unit II through lines **30**, **31** and **32**. Lines **31** and **32** are connected respectively to the movable contact arm **37** and stationary contact **38** of a relay **40** in the lockout unit.

As explained in detail later, when this relay is energized and contact arm **37** pulls in, a circuit is opened in the relay from line **32** to line **31**. This disconnects a power circuit in alarm unit II and that unit cannot go into an alarm condition. When, however, relay **40** is deenergized, and contact arm **37** is dropped out, the power circuit to alarm unit II is completed and the alarm unit is conditioned for operation in response to a signal from microphone **25**. Line **30** is connected to a suitable source of DC potential within alarm unit I preferably through a contact of the latching relay of that alarm unit in such a manner that whenever alarm unit II has been latched in the alarm condition, a positive potential is supplied to line **30**.

One lead **27** from microphone **28** is connected to ground line **34**. The second lead **26** is coupled through capacitor **41** to the base **42** of transistor **43**. This transistor functions as a common emitter amplifier. The transistor is normally biased through resistors **44** and **45** which respectively interconnect base **42** with line **33** and ground line **34**. The emitter **46** of transistor **43** is connected to ground line **34** through the parallel combination of resistor **47** and capacitor **48**.

The output signal from transistor **43** is taken from the tap **50** of potentiometer **51**. Potentiometer **51** interconnects collector **52** of transistor **43** and line **33**. Tap **50** is capacitively coupled through capacitor **53** to base **54** of second stage transistor **55**. Transistor **55** is normally biased through resistor **56** which interconnects base **54** and line **33**. The emitter **57** of this second stage transistor is connected to line **33** through resistor **58**. The collector **60** is connected to ground line **34** through resistor **61**. The output signal from the second stage is applied through diode rectifier **62**, lead **63** and resistor **64** to the base **65** of the third stage transistor **66** which is connected as a common collector amplifier. The collector **67** of this transistor is connected to lead **33** while emitter **68** is is joined to one terminal of coil **70** of relay **40**. The other terminal of this coil is connected to ground line **34** through resistor **71**.

A fourth stage transistor **72** is provided. This transistor includes a collector **73** connected to base **65** of transistor **66**. Emitter **74** of transistor **72** is connected to ground line **34** through resistor **75**. The base **76** of transistor **72** is connected to ground line **34** through capacitor **77** and is connected to junction **78** through resistor **80** and lead **63**. Junction **78** is tied to line **30** through resistor **81** and series connected diode rectifiers **82** and **83**. Capacitor **79** is interconnected between junction **78** and line **34**. A lead **84** interconnects the junction of rectifiers **82** and **83** with a resistor **85**. This resistor is in turn connected through lead **86** to the base **87** of the fifth stage transistor **88**. The emitter **90** of this transistor is connected to ground line **34**. The collector **91** of transistor **88** is connected to base **76** of transistor **72**.

In use, the alarm unit I and the present alarm system including alarm unit II and the alarm lockout unit are installed completely independently of one another. There are no common lines utilized by the units and no interconnection between them. As explained previously, alarm unit I includes a pickup microphone **12** and a testing horn **16** mounted within enclosure **10** and a main alarm circuit indicated at a remote station **15**. The present alarm syste mincludes a pickup microphone **25** con-

nected directly to alarm unit II and a microphone 28 connected to the alarm lockout unit 22. In thet event that there is an attempted intrusion upon the vault or other protected enclosure, the pickup 12 of alarm unit I will sense the noise and will cause that unit to go into alarm.

Periodically, alarm unit I is tested by sounding horn 16 for a predetermined period; for example, 15 seconds. When this occurs, lockout unit 22 prevents alarms unit II from going into an alarm condition. Specifically, when pickup 28 senses the output of horn 16, it produces an AC signal which is applied to base 42 of common emitter amplifier 43. This signal is amplified and is applied to the base 54 of the second stage transistor 55 which is normally off. This transistor is switched on and off in accordance with the AC input signal.

When transistor 55 becomes conductive, a rectified DC signal approximately full supply voltage is obtained at junction 78. This is applied to the base 65 of third stage transistor 66. Transistor 66 is a common collector amplifier with relay coil 70 as a load. When relay coil 70 is energized, relay 40 is pulled in to disconnect leads 31 and 32 and, hence open a circuit in alarm unit II. Thus, this alarm unit cannot be actuated even though microphone 25 produces a signal in response to the sounding of horn 16. It will be understood, however, that once alarm unit II has been actuated, it is latched in through a conventional latching relay, or the like, and is not reset or otherwise affected by opening of relay contacts 37 and 38 of relay 40.

In the event, however, that there is a continuing noise sensed by microphone 28 beyond the normal period of operation of horn 16, for example, for a period of two minutes, the voltage at junction 78 remains elevated for a sufficiently long time to charge capacitor 77 to a point where the potential of base 76 of the fourth stage transistor 88 is elevated, making that transistor conductive. This in turn shunts the base 65 of transistor 66 to ground, rendering that transistor non-conductive and deenergizing relay 40. As a result, movable contact 37 moves back into engagement with contact 38 and a circuit is completed in alarm unit II, conditioning that unit for actuation in response to signals from microphone 25. Since the microphone 25 of alarm unit II senses the same noise sensed by microphone 28, the alarm unit goes into an alarm condition. Once the alarm unit II goes into an alarm condition, it is automatically latched in that condition until reset.

The present lockout unit provides a means for facilitating resetting of the alarm by means of a pulse of short duration. Specifically, when alarm unit II is latched in, a potential is applied through the latching relay of alarm unit II to line 30. This potential is applied to the base of fifth stage transistor 88 causing transistor 88 to become conductive. As a result, base 76 of fourth stage transistor 72 is shunted to ground and this transistor is rendered non-conductive despite the presence of a continued potential at junction 78.

When transistor 72 is turned off, the shunt to ground is removed from base 65 of transistor 66. That transistor again becomes conductive, energizing relay 40 and opening a circuit in alarm unit II. Alarm unit II remains energized, but once reset cannot be reactuated until contacts 37 and 38 are again closed and a noise signal is sensed by microphone 25.

When alarm unit II goes into alarm, in many installations bells, buzzers or the like, are placed in operation near the protected vault or the like. In many systems, it is desirable to reset the alarm unit after the alarm situation has been corrected by means of a very brief signal, e.g. a pulse from the central station 15. The resetting circuits of the alarm unit II are conventional and there is no need to describe them in detail here. It will be appreciated, however, that when the alarm unit is reset, there will remain for a short time a high noise level due to the time required to stop operation of the bells, buzzers or the like, and their reverberations. Accordingly, if contacts 37 and 38 happened to be closed when the short duration reset pulses were applied to alarm unit II, the alarm unit would be momentarily turned off by the reset pulse, but then would automatically be brought back into an alarm state because of the signals picked up by microphone 25. The present lockout unit prevents this.

Specifically, as was mentioned previously, the potential applied to the fifth stage transistor 88 through line 30 maintains third stage transistor 66 energized and relay 40 pulled in so long as the alarm unit II is latched in. Relay 40 thus holds open a circuit in alarm unit II so the alarm unit is not responsive to signals picked up by microphone 25. When alarm unit II drops out momentarily because of the reset pulse applied to it, the potential is removed from line 30. This renders fifth stage transistor 88 non-conductive. However, fourth stage transistor 75 cannot be turned on until capacitor 77 charges up. Transistor 66 is maintained conductive and relay 40 energized for a predetermined period by the discharge of capacitor 79 through transistor 66 and the relay coil.

During the time delay thus provided, alarm unit II cannot be actuated because of the open contacts of relay 40. Before these contacts close, the sound stops so that no signal is received by microphone 25. In the absence of such an input signal, alarm unit II does not go into alarm when relay contacts 37 and 38 are reclosed. At the end of a suitable time delay to allow for the bell or buzzer noise to die down, alarm unit II is automatically reconditioned for actuation in the event that a new noise is picked up by microphone 25. Specifically, if all noise stops before capacitor 77 recharges, transistor 55 is turned off removing the potential from the base of transistor 66. This turns off this transistor and drops out relay 40. As a result, the contacts 37, 38 are closed and alarm unit II is conditioned for actuation. However, if a noise persists beyond the time delay provided by the charge time of capacitor 77, transistor 72 is turned on and the base of transistor 66 is again shunted to ground. Transistor 66 thus becomes non-conductive dropping out relay 40 and reconditioning alarm unit II for actuation in response to any new sounds sensed by microphone 25.

From the above disclosure of the general principles of the present invention and the preceding detailed description of a preferred embodiment, those skilled in the art will readily comprehend various modifications to which the invention is susceptible.

Having described our invention, we claim:

1. In an audio alarm system for use in conjunction with a second independent audio alarm system of the type including a primary transducer and a noise producing device located in the area being protected, said noise producing device being operated periodically for a predetermined time to actuate said transducer and test said second alarm system, the novel combination which comprises; an audio alarm unit, a first transducer located in the area being protected and being responsive to the same noise as said primary transducer, said first transducer being interconnected to the audio alarm unit, a lockout unit, a second transducer located in the area being protected and being responsive to the same noises as the primary transducer and first transducer and providing an input to said lockout unit, a switch in said lockout unit, said switch being interconnected with said alarm unit to condition said alarm unit for actuation when said switch is closed and said first transducer senses a noise, said lockout unit comprising first amplifying means for producing a signal in response to an input from said second transducer, second means responsive to said signal for opening said switch in said lockout unit and decommissioning said alarm unit, third time delay means responsive to a continuing input from said second transducer for causing said switch to be closed after a pre-

determined period longer than the predetermined time of operation of said noise producing device, whereby said alarm unit is again conditioned for actuation in response to an input from said first transducer.

2. The audio alarm system of claim 1 further comprising fourth means responsive to a potential applied when said alarm unit is actuated, said fourth means being effective to hold said switch open for a predetermined time following the removal of said potential during resetting of said alarm unit.

3. The audio alarm system of claim 1 in which said first means comprises a first stage transistor amplifier having said second transducer as an input and a normally off second stage common emitter transistor amplifier coupled to said first stage transistor, said second stage transistor being rendered conductive by the output of said first stage when said second transducer senses a noise, a rectifier connected in the collector circuit of said second stage transistor amplifier to provide a DC potential.

4. The audio alarm system of claim 1 in which said second means comprises a transducer having a base adapted to receive said signal, a relay including a coil in the load circuit of said transistor and including normally closed contacts constituting said switch.

5. The audio alarm system of claim 4 in which said third means comprises a second transistor effective when conductive to shunt the base of said first transistor to ground, and an RC circuit connected to said signal to cause second transistor to become conductive after a predetermined period, whereby said first transistor is de-energized and said relay contacts are enclosed.

6. The audio alarm system of claim 5 further comprising a third transistor effective when conductive to shunt the base of said second transistor to ground, means applying a DC potential to the base of said third transistor from said alarm unit during the time when said alarm unit is actuated.

7. In an audio alarm system for use in conjunction with a second independent audio alarm system of the type including a primary transducer and a noise producing device located in the area being protected, said noise producing device being operated periodically for a predetermined time to actuate said transducer and test said second alarm system, the novel combination which comprises; an audio alarm unit, a first transducer located in the area being protected and being responsive to the same noises as said primary transducer, said first transducer being interconnected to the audio alarm unit, a

lockout unit, a second transducer located in the area being protected and being responsive to the same noises as the primary transducer and first transducer and providing an input to said lockout unit, a relay in said lockout unit, said relay including normally closed contacts interconnected with said alarm unit and being effective when closed to condition said alarm unit for actuation by said first transducer means, said lockout unit comprising a first amplifier stage coupled to said second transducer, a normally off second stage common emitter transistor amplifier coupled to said first stage transistor, a rectifier in the collector circuit of said second stage transistor amplifier, a third stage transistor amplifier having a base interconnected to said rectifier, said relay having a coil in the load circuit of said third stage transistor, a fourth stage transistor interconnecting the base of said third stage transistor to ground and being effective when conductive to cause the third stage transistor to become non-conductive, said fourth stage transistor including a base, an RC circuit interconnecting said base with said rectifier, whereby said fourth stage transistor is normally rendered conductive after a predetermined period following energization of said third stage transistor, said predetermined period being longer than the predetermined operation of said noise producing device.

8. The audio alarm system of claim 7 further comprising a fifth stage transistor interconnected between the base of said fourth stage transistor and ground, said fifth stage transistor being effective when conductive to render said fourth stage transistor nonconductive, said fifth stage transistor having a base, means interconnecting the alarm unit and said base for applying a potential thereto so long as said alarm unit is actuated.

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