Jan. 5, 1971 J. K. MERCHANT ET AL 3,553,669

GAIN INCREASING ALARM SYSTEM

Filed Nov. 16, 1967 3 Sheets-Sheet 1

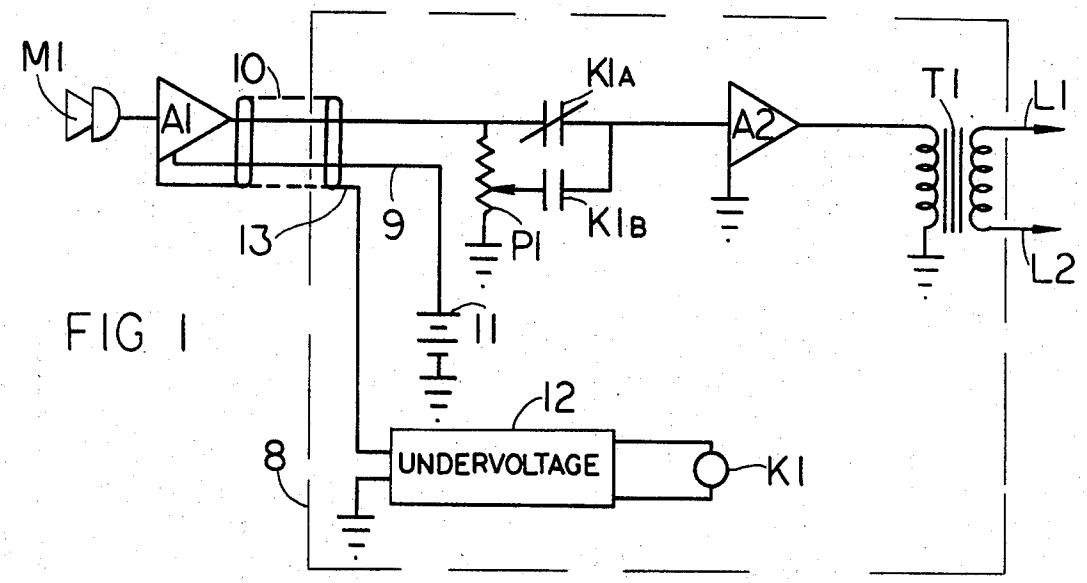

FIG 1

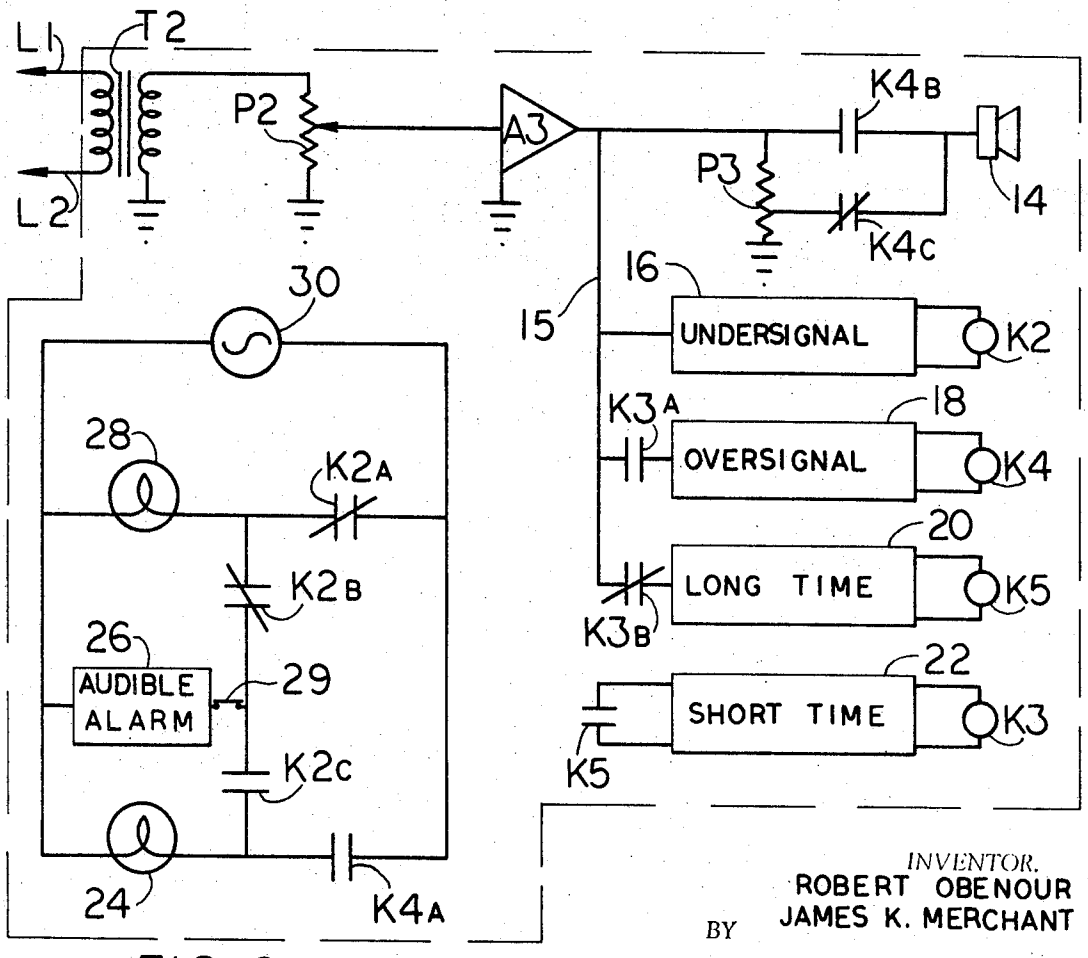

FIG 2

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GAIN INCREASING ALARM SYSTEM

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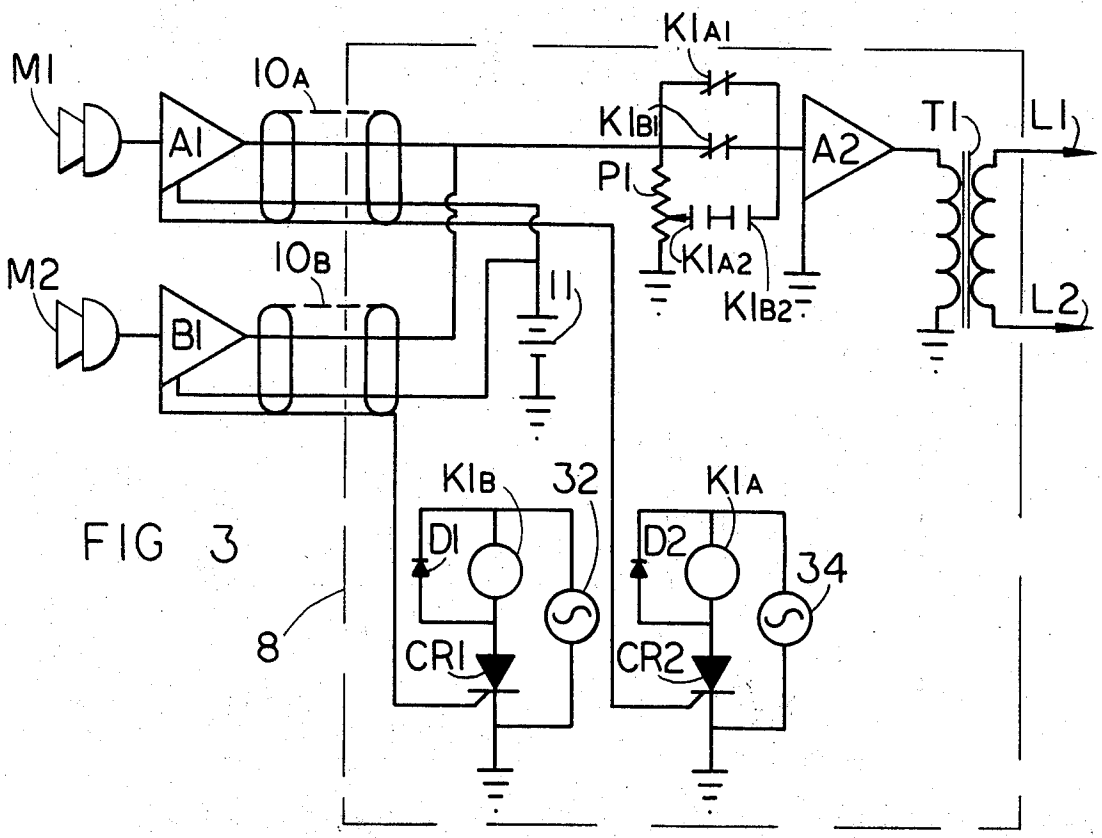

FIG 3

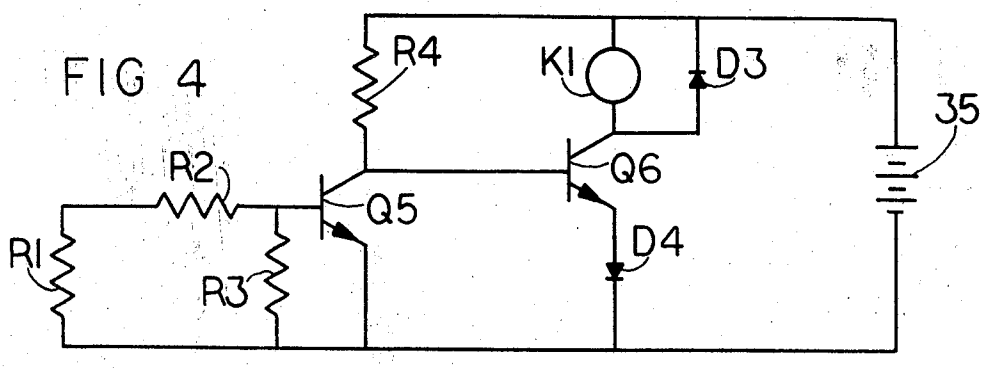

FIG 4

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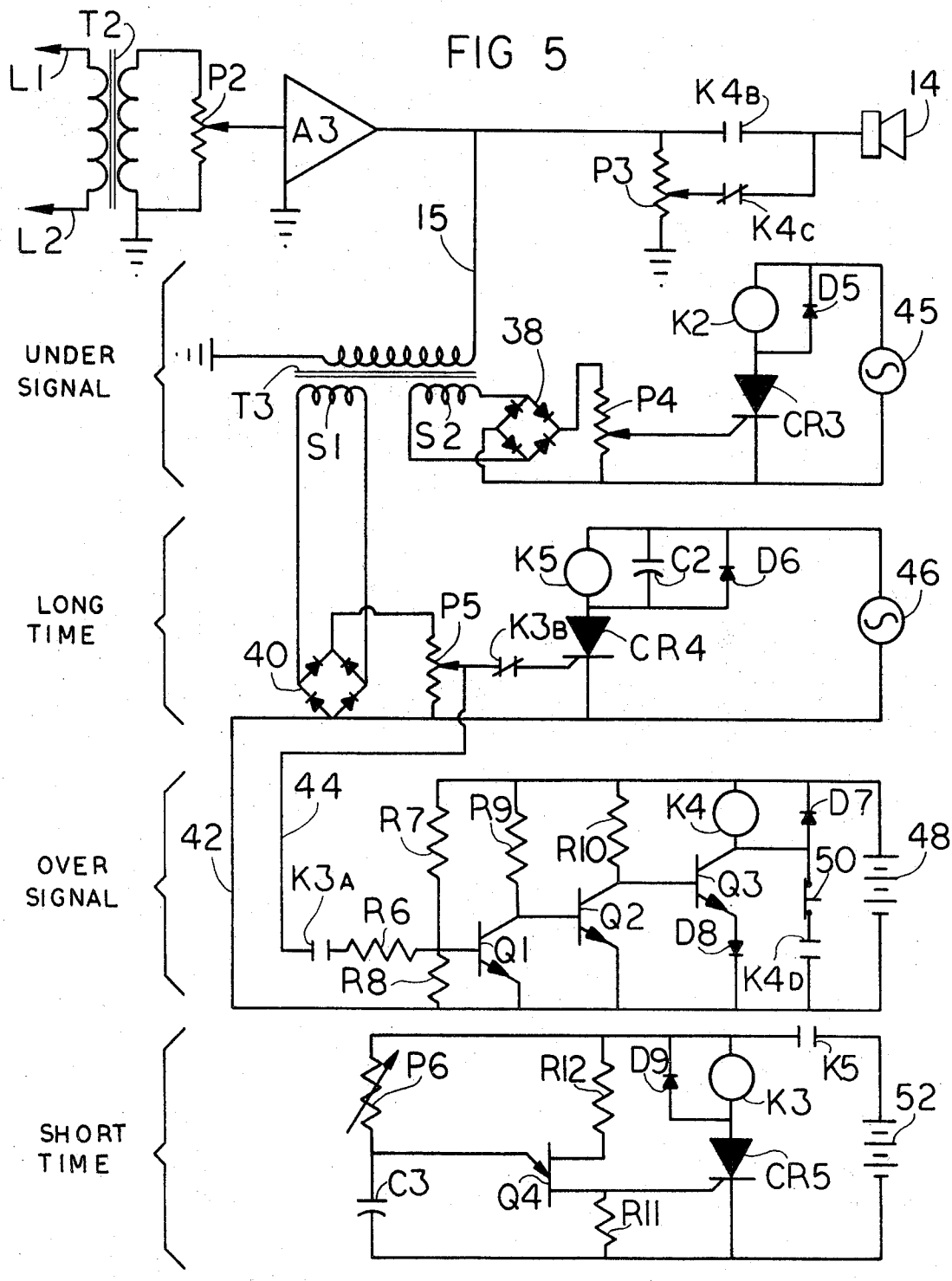
FIG 5



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United States Patent Office 3,553,669 Patented Jan. 5, 1971

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GAIN INCREASING ALARM SYSTEM

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Filed Nov. 16, 1967, Ser. No. 683,695
Int. Cl. G08b 13/00
U.S. Cl. 340—261 4 Claims

ABSTRACT OF THE DISCLOSURE

An audio sensitive alarm is disclosed by which an alarm is activated if the audio level in a room being monitored either falls below a selected level or rises above another selected level, and subsequently continues for more than two seconds or again rises above the selected level more than two seconds after the first rise and less than thirty seconds after the first rise.

Controlled rectifier and triode transistor circuits are provided to detect the selected rise or fall of audio level and to control several relays. Time delays are provided by capacitor discharge circuits.

BACKGROUND OF THE INVENTION

Our invention relates to alarms, and more particularly to alarms for signalling, at a remote monitoring station, the presence of a burglar or other dangerous condition at a warehouse or other building being protected and monitored.

The need for such alarms has long been recognized and is well known. Other inventors have provided alarms which have a microphone at the place being protected and audio amplifiers and a speaker for reproduction of noises at a monitoring station. Still other inventors have provided alarms which respond to any noise which reaches a selected level above the usual noises which are present in a building under normal conditions (e.g. not under threat of burglary). Such usual noises may, for example, be caused by wind, traffic flow, or machines.

There is, however, a need for an alarm system which can distinguish between certain likely non-dangerous noises and the danger indicating noises. For example, the screech of brakes outside a store being protected, or the sound of a nearby factory whistle, do not indicate the presence of danger but will cause many alarms to give a warning.

Further, it is possible for a knowing burglar to mask the microphones of other alarms in order to prevent the alarm system from detecting dangerous sounds such as an explosion caused by a safecracker. Moreover, while the severing of the microphone cables would cause the alarm of some other systems to be sounded, such severing would prevent audio monitoring of the protected area by someone at the monitoring station.

It is an object of our invention to provide an improved alarm.

Another object of our invention is to provide an alarm system which will cause activation of its alarm whenever the audio signal received at the monitoring station either falls below the level of the usual room noises or ceases entirely because of an attempt, for example, to mask a microphone or sever a microphone cable.

A further object of our invention is to provide an alarm which will cause a warning in response to certain noises above a selected level but not to other noises.

A further object of our invention is to provide an alarm which will not cause a warning in response to a single noise lasting less than a selected short period of time.

A further object of our invention is to provide an alarm which will not respond to ordinary non-dangerous noises which may be recurrent with a period greater than a selected long time interval.

A still further object of our invention is to provide an alarm which will issue a warning if a first noise is subsequently followed by a second one which occurs after a selected short time interval but prior to expiration of a selected long time interval.

Further objects and features of our invention will be apparent from the following specification and claims when considered in connection with the accompanying drawings illustrating several embodiments of our invention.

SUMMARY OF THE INVENTION

We have found that the foregoing and other objects may be attained in an alarm system for actuating an alarm in response to at least one undesirable condition, the system having an audio transducer input, audio amplification means including at least one audio amplifier for amplifying an audio signal, and audio reproduction means, the system comprising: (a) undersignal means connected to said system for actuating an alarm in response to a selected decrease in audio signal level; (b) an enabling switch having a plurality of contacts; (c) oversignal means connected to said system through the enabling switch, when the enabling switch is actuated, for actuating an alarm in response to a selected increase in the level of an audio signal transmitted through the enabling switch; (d) means, connected to said system through the enabling switch, when the enabling switch is not actuated, for producing a trigger signal in response to a selected increase in the level of an audio signal transmitted through the enabling switch, the trigger signal being extinguished within a selected long time interval; and (e) means co-operating with said trigger means for actuating the enabling switch a selected short time period after said trigger signal is produced; wherein the occurrence of a selected increase in audio level produces a trigger signal, the enabling switch is actuated a selected short time period after production of the trigger signal, the enabling switch is maintained actuated for the selected long time interval after production of the trigger signal, and the alarm may be energized in response to a later occurrence of a selected increase in audio level which occurs after the short time period and before the termination of the long time interval.

DESCRIPTION OF THE VIEWS

FIG. 1 is a diagrammatic view of the transmitter of an embodiment of our invention;

FIG. 2 is a diagrammatic view of the receiver of an embodiment of our invention;

FIG. 3 is a schematic view of the transmitter of the preferred embodiment of our invention;

FIG. 4 is a schematic view of an alternative circuit for use in a transmitter constructed according to our invention; and

FIG. 5 is a schematic view of the receiver of the preferred embodiment of our invention.

In describing the embodiments of the invention illustrated in the drawings, specific terminolongy will be resorted to for the sake of clarity. However, it is not intended to be limited to the specific terms so selected, and it is to be understood that each specific term includes all technical equivalents which operate in a similar manner to accomplish a similar purpose.

DETAILED DESCRIPTION

In general

A general diagram of an embodiment of our invention is shown in FIGS. 1 and 2. The transmitter, shown in FIG. 1, is normally located at a building being protected. The receiver, shown in FIG. 2, is located at a monitoring

station, such as police headquaters. The transmitter (FIG. 1) is connected to the receiver (FIG. 2) by means of transmission lines L1 and L2 which usually are telephone lines.

The transmitter generally comprises one or more audio transnducers such as the audio transducer M1, which may be an ordinary microphone, feeding an audio signal in series through an audio amplifier A1, a cable **10**, the normally closed contacts K1A of a switch K1, and a second audio amplifier A2. The audio output from the second amplifier A2 is fed through an impedance matching transformer T1 to transmission lines L1 and L2.

It should be made clear that throughout our description we refer to several switches. While we prefer to use electromagnetic relays as switches, we intend this term to include all the well-known electronic switches. Furthermore, a switch referred to in the description may have multiple poles and multiple throws and still be considered a single switch.

The main circuitry of the transmitter is contained within a chassis **8** which is located at a central point in the building being protected. The microphone M1 and the first amplifier A1 are located at a remote position within the building, wherever desirable for maximum protection. These remote components are connected to components within the central chassis **8** by the cable **10**.

The cable **10** contains not only a conductor for the audio signal but also contains a conductor **9** connected to a power supply **11** for providing power to the first amplifier A1.

An undervoltage detecting circuit **12** is interposed between ground in the central chassis **8** and the cable ground conductor **13**, which is connected to the ground of the remote first amplifier A1. The undervoltage detecting circit **12** is provided to produce a response if current flow through line **13** is interrupted such as by cutting the cable **10**. The response produced by the preferred undervoltage detecting circuit is operation of a switch actuation means such as relay coil K1. A potentiometer P1 is provided to permit adjustment of the audio input signal to the second amplifier A2 when the normally open contacts K1B of switch K1 are closed (e.g. when the relay K1 is actuated). When the normally closed contacts K1A of K1 are closed, the maximum audio signal is applied to the input of the second amplifier A2. Thus, when the relay is deactuated, as for example because of the cutting of the cable **10**, normally closed contacts K1 are allowed to close, thus increasing the audio input signal to amplifier A2.

The receiver of our alarm, shown in FIG. 2, receives the audio signal from M1 through transmission lines L1 and L2. The audio signal is applied to a third amplifier A3 through a potentiometer P2 which permits adjustment of the input to the third amplifier A3. The output from the third amplifier A3 is applied to an audio reproduction means, such as speaker **14**, either directly through the normally open contacts of a switch K4B or through a potentiometer P3 and the normally closed contacts of the switch K4C. The output from the third amplifier A3 is also applied through a conductor **15** to several sensing circuits, **16**, **18**, and **20**.

An undersignal sensing means **16** is provided to maintain the switch K2 actuated until the audio signal level falls below a selected level. When the audio signal drops, actuation of switch K2 ceases, ultimately causing a visual and audible signal indicating possible intrusion in the guarded area.

An oversignal sensing means **18** is provided to actuate switch K4 whenever an enabling switch K3 is actuated, and subsequent thereto the auido signal level at the conductor **15** is maintained above or increases above a selected level.

A trigger means **20** is provided to actuate a switch K5 if the audio signal level increases above a selected level and to maintain the switch K5 actuated for a selected long time, such as **30** seconds. An enabling switch actuating means **22** is provided to actuate the enabling switch K3 a selected short time period after actuation of switch K5.

A power source **30** is connected to indicating lights **24** and **28** and to an audible alarm **26** by means of contacts K2A, K2B, K2C and K4A of switches K2 and K4 to alert a person at the monitoring station that certain alarm conditions exist.

DESCRIPTION OF RESPONSES TO ALARM CONDITIONS

Such alarm conditions may be understood by the following description of the responses of our alarm system to some possible occurrences.

If a burglar enters a store in which the transmitter shown in FIG. 1 is located and either cuts the cable **10** or masks the microphone M1, the undersignal sensing means **16**, located in the receiver, will release the switch K2 from actuation. This permits the closing of the normally closed contacts K2B to apply power from the power source **30** to the bulb **28** and the audible alarm **26**. An alarm will be sounded and the cause of the alarm will be indicated by illumination of the bulb **28** which may be located on a panel and labelled "undersignal."

The position of the microphone M1 may be such that it will receive noises from non-dangerous sources such as truck brakes from a nearby street or a time clock which periodically emits a noise. A satisfactory alarm system should be capable of responding to noises proudced by dangerous conditions while not responding to noises produced by such common non-dangerous conditions. Our alarm system can make such a discrimination. With our alarm system the occurrence of a single noise, causing the audio signal level at the output of the third amplifier A3 to rise above a selected level, will not cause an alarm. In our system, an alarm will be caused only if a second rise in the audio signal level occurs more than a selected short time interval after the first rise, for example more than 2 seconds, and less than a selected long time period after the first rise, as for example 30 seconds, or if the first rise continues for more than the selected short time interval. Thus, a single noise such as a truck stopping will not cause an alarm. Furthermore, a recurring noise with a period of more than 30 seconds will not cause an alarm.

Referring to the receiver circuit of FIG. 2, a first increase of audio signal level will be applied, first through the normally closed contacts K3A of the enabling switch K3, to the long time trigger means **20**. If the increase is at least a selected amount, the switch K5 will be actuated to initiate operation of the short time enabling switch actuating means **22**. The trigger means **20** will maintain switch K5 actuated for a selected long time interval, such as 30 seconds. The enabling switch actuating means **22** will actuate the enabling switch K3 only after a selected short time interval, such as 2 seconds, after the switch K5 has been closed (i.e. after the first rise in audio signal). If the increase in audio signal continues after the 2 second interval, the oversignal sensing means **18** will actuate switch K4. If no other rise in the audio signal occurs, the switch K5 will de-actuate causing deactuation of the enabling switch K3. The circuit returns to normal with no alarm having sounded. If a second rise, or continuation of the first rise, in audio signal level occurs after the first signal rise, but ends before the enabling switch K3 is actuated, no alarm can be sounded. Thus, a screech of brakes lasting the short time interval of two seconds will not cause an alarm. However, if a second audio rise occurs or the initial noise continues after the enabling switch K3 is actuated, the audio signal rise will be applied through the normally open contacts K3A of the enabling switch K3 to the oversignal sensing means **18**. If this second rise is at least the selected amount, switch K4 will be actuated. Actuation of switch K4 connects the bulb **24**

to the power source 30 through the normally open contacts K4A of switch K4. The audible alarm 26 will also be connected to the power source 30 when switch K4 is actuated because the normally open contacts K2C are usually maintained closed by the undersignal sensing means 16.

Furthermore, actuation of the switch K4 provides the speaker 14 with full power by closing of the normally open contacts K4B connected between speaker 14 and the third amplifier A3.

PREFERRED EMBODIMENT

A preferred embodiment of the transmitter is shown in more detail in FIG. 3. It is provided with a plurality of remote microphones such as M1 and M2 and remote amplifiers A1 and B1. These are connected to the central chassis 8 through cables 10A and 10B. The audio output of each amplifier is connected to the second audio amplifier A2 by means of an input adjusting potentiometer P1 and the contacts of switches K1A and K1B.

The power supply connections of both remote amplifiers A1 and B1 are connected to the power supply 11. The ground connection of amplifier A1 is connected to the gate of a controlled rectifier CR2 while the ground connection of amplifier B1 is connected to the gate of another controlled rectifier CR1. The cathodes of both controlled rectifiers CR1 and CR2 are connected to the chassis 8 ground.

Controlled rectifier CR1 is serially connected to a power source 32, such as the secondary of a power transformer, and the coil of relay K1B. A diode D1 is shunted across the coil of relay K1B to provide a current path for the de-energization of the coil when CR1 becomes non-conductive. Controlled rectifier CR2 is similarly connected to power source 34 and the coil of relay K1A across which a discharge diode D2 is provided.

The normally closed contacts K1A1 and K1B1, when closed, serve to couple the output of the remote amplifiers A1 and B1 directly to amplifier A2. The normally open contacts K1A2 and K1B2, when both are closed, connect the input adjusting potentiometer P1 to the input of amplifier A2.

In operation, the supply currents to the remote amplifiers A1 and B1 are supplied from power supply 11 and flow through the gates of controlled rectifiers CR1 and CR2 to ground. With no alarm conditions present, the controlled rectifiers are in conduction and relays K1A and K1B are actuated. Thus the normally open contacts K1A2 and K1B2 are closed to permit adjustment of the input to A2 to provide a desirable signal level on lines L1 and L2 corresponding to ambient room noise. At the same time, the normally closed contacts K1A1 and K1B1 are open.

If a burglar cuts the cable 10A leading to the remote amplifier A1, CR1 will cease conducting which will deactuate relay K1A. The normally open contacts K1A2 will open, disconnecting the potentiometer P1 from the input to A2. The normally closed contacts K1A1 will be allowed to close to provide increased input to the amplifier A2.

Severing of one cable will therefore increase the gain of the transmitter to compensate for loss of one microphone and permit improved monitoring at the receiver. Furthermore, it will increase the audio signal level in lines L1 and L2 so that the ambient noises picked up by the microphone M2 will cause actuation of the oversignal circuit 18 in the receiver and produce an alarm.

An alternative undervoltage sensing circuit for use in the transmitter is shown in FIG. 4. It comprises two transistors, Q5 and Q6, arranged in two stages with the coil of relay K1 as the load of the second stage. A discharge diode D3 is provided and power is supplied from a power supply 35. Resistors R2, R3, and R4 are conventional biasing and load resistors having particular values for operation as stated below.

With this alternative, the ground connections from the remote amplifiers A1 and B1 are connected to the chassis 8 ground through resistor R1 rather than through the gates of the controlled rectifiers CR1 and CR2.

Transistor Q5 is biased so that the presence of remote amplifier supply current from supply 11 flowing primarily through resistor R1 will saturate transistor Q5, thus cutting off transistor Q6 and preventing actuation of the coil of relay K1.

Transistor Q5 is also biased so that absence of current flow through R1, resulting from severance of a cable 10, permits transistor Q5 to cease conducting and permits transistor Q6 to conduct, actuating the coil of relay K1. If this embodiment is used, the relay contacts, shown in FIG. 3 as normally open, must obviously be normally closed and likewise the contacts shown normally closed must be normally open. Diode D4 is provided in series with the emitter of transistor Q5 to provide bias stability and temperature compensation.

In FIG. 5 we show details of the preferred receiver circuit. The audio signal coming in on the transmission lines L1 and L2 is applied to the speaker 14 through the same components illustrated in FIG. 2. The conductor 15 feeds the audio signal from the output of the third amplifier A3 to the primary of an impedance matching means such as a transformer T3.

The audio signal present at the secondary S2 of the transformer T3 is rectified by a bridge rectifier 38 and applied to the gate of a controlled rectifier CR3 through an adjusting potentiometer P4. The controlled rectifier CR3 is serially connected to a power source 45 and means for actuating the alarm such as the coil of relay K2. The coil of the relay K2 is provided with a discharge diode D5.

The other secondary winding S1 of the transformer T3 is connected to another bridge rectifier 40 so that a rectified audio signal appears on the wiper of the adjusting potentiometer P5. This wiper is connected to the gate of a controlled rectifier CR4 through an enabling switch such as the normally closed contacts of relay K3. A switch actuating means, such as the coil of relay K5, is serially connected to the controlled rectifier CR4. A discharge diode D6 and a holding capacitor C2 are shunted across the coil of relay K5. Bridge rectifier 40 is of such a polarity that the voltage at the gate of the controlled rectifier CR4 tends to cause CR4 to conduct. However, the potentiometer P5 is adjusted so that magnitude of the gate voltage is below the gate firing voltage when normal ambient noise is present at the transmitter.

An increase in gate voltage up to the gate firing point will cause actuation of relay K5. The capacitor C2 will charge and maintain the actuation of relay K5 for a selected long time. The adjustment of P5 determines the amount of rise in audio signal level necessary to fire CR4 causing it to conduct.

The output from potentiometer P5 is also applied to the oversignal sensing means by conductors 42 and 44. The enabling switch, such as the normally open contacts K3A of relay K3 must be closed to permit the rectified audio signal to be applied, through resistor R6 to the base of transistor Q1. Resistors R7, R8, and R9 bias transistor Q1 so that with the normally open contacts of relay K3 open, transistor Q1 will be in a non-conductive state. Transistor Q2 coupled to transistor Q1 will be conductive when transistor Q1 is non-conductive. Transistor Q3 is non-conductive when transistor Q2 is conducting. Therefore little current will flow through the serially connected means for actuating a trigger switch, such as the coil of relay K4, which is connected as the load of transistor Q3. R10 is a bias resistor for Q2.

The coil of relay K4 is provided with a shunt discharge diode D7. A power supply 48 supplies power to the oversignal sensing means circuit. A current path parallel to the transistor Q3 is provided through a normally closed manual switch 50 and a normally open pair of contacts K4D of relay K4.

If the enabling switch K3 is closed, a rise in audio level

to a selected level will saturate transistor Q1 which cuts off Q2 thus putting transistor Q3 into conduction. The conduction of transistor Q3 actuates the coil of relay K4, closing the normally open contacts K4D of relay K4. The current through switch **50** will hold the relay K4 actuated until the switch **50** is depressed.

The means for actuating the enabling switch comprises a power supply **52** in series with a trigger switch such as the normally open contacts of the relay K5. A means for actuating the enabling switch, such as the coil of relay K3, is serially connected to a controlled rectifier CR5 for control thereby. The coil of relay K3 is provided with a discharge diode D9.

The gate of the controlled rectifier CR5 is connected to a relaxation oscillator comprising the base resistors R11 and R12, variable timing resistor P6, charging capacitor C3, and a unijunction transistor Q4. Closing of the contacts of the relay K5 permits flow of current from power supply **52** to begin charging capacitor C3. Resistor P6 is adjusted so that a selected short time interval, such as two seconds, will elapse before the unijunction transistor Q4 goes into conduction and actuates the enabling switch, relay K3.

In operation, the preferred circuit shown in FIG. 5 acts generally the same as the circuit in FIG. 2. If the audio signal at the conductor **15** decreases to a selected level, controlled rectifier CR3 ceases to conduct and relay K2 is de-actuated. This causes one bulb **28**, shown in FIG. 2, and the audible alarm **26** to be energized. A switch **29** is provided to permit manual silencing of the alarm.

If the audio signal rises to a selected level for a brief interval, the controlled rectifier CR4 will begin to conduct, relay K5 will be actuated, and will be maintained actuated for a selected long time interval by the discharge of capacitor C2. This actuation of relay K5 simultaneously initiates the charging of capacitor C3. After a selected short time interval, controlled rectifier CR5 conducts and activates relay K3.

If no further rises in the audio signal occurs before capacitor C2 discharges and relay K5 drops out, then the circuit will return to normal.

If, however, a second rise in audio level occurs before relay K5 drops out, then this second rise, if to a selected level, will saturate transistor Q1 turning off transistor Q2 which sends Q3 into conduction and actuates relay K4. Actuation of relay K4 will light bulb **24** and sound alarm **26**, and furthermore will permit maximum power to flow to the speaker **14**. Thus when the signal is sounded, the volume of speaker **14** automatically increases to permit better audio monitoring of the building being protected.

It is to be understood that while the detailed drawings and specific examples given describe preferred embodiments of our invention, they are for the purposes of illustration only, that the apparatus of the invention is not limited to the precise details and conditions disclosed, and that various changes may be made therein without departing from the spirit of the invention which is defined by the following claims. For example, various other thyristors could be substituted for the controlled rectifier which we show.

We claim:

1. An alarm system for actuating an alarm in response to at least one undesirable condition, the system having an audio transducer, an audio transducer input, audio amplification means including at least one audio amplifier for amplifying an audio signal, and audio reproduction means, the system comprising:

(a) undersignal means connected to said system for actuating an alarm in response to a selected reduction of audio input to said transducer and thus to a decrease in audio signal level;

(b) an enabling switch having a plurality of contacts;

(c) oversignal means connected to said system through the enabling switch, when the enabling switch is actuated, for actuating an alarm in response to a selected increase in the level of an audio signal transmitted through the enabling switch;

(d) means, connected to said system through the enabling switch, when the enabling switch is not actuated, for producing a trigger signal in response to a selected increase in the level of an audio signal transmitted through the enabling switch, the trigger signal being extinguished within a selected long time interval;

(e) means, co-operating with said trigger means, for actuating the enabling switch a selected short time period after said trigger signal is produced;

(f) a cable extending from a central location to a remote location of the audio transducer, the cable having a conductor therein; and

(g) means connected to said conductor for increasing the gain of said audio amplification means in response to a decrease in a current through said conductor;

wherein the occurrence of a selected increase in audio level produces a trigger signal, the enabling switch is actuated a selected short time period after production of the trigger signal, the enabling switch is maintained actuated for the selected long time interval after production of the trigger signal, and the alarm may be energized in response to a later occurrence of a selected increase in audio level which occurs after the short time period and before the termination of the long interval.

2. A system according to claim **1**.

wherein the conductor in the cable supplies DC power to an audio amplifier located at the remote position of the audio transducer.

3. A system according to claim **1**.

wherein the conductor in the cable supplies power to a resistance at a remote location of the audio transducer means.

4. A system according to claim **1** wherein the gain increasing means comprises:

(a) a potentiometer connected to the audio amplifying means for controlling the input to an audio amplifier;

(b) a first switch which, when actuated, permits a potentiometer controlled input to the audio amplifier and which when not actuated, permits a maximum input to the audio amplifier;

(c) means for actuating said switch; and

(d) a controlled rectifier in series connection with the actuating means and a power source, and having its gate and its cathode connected between said cable conductor and source of current through said conductor.

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U.S. Cl. X.R.

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