June 14, 1966 G. L. CAPRIO 3,256,515

KEYED ALARM

Filed Aug. 6, 1962 2 Sheets-Sheet 1

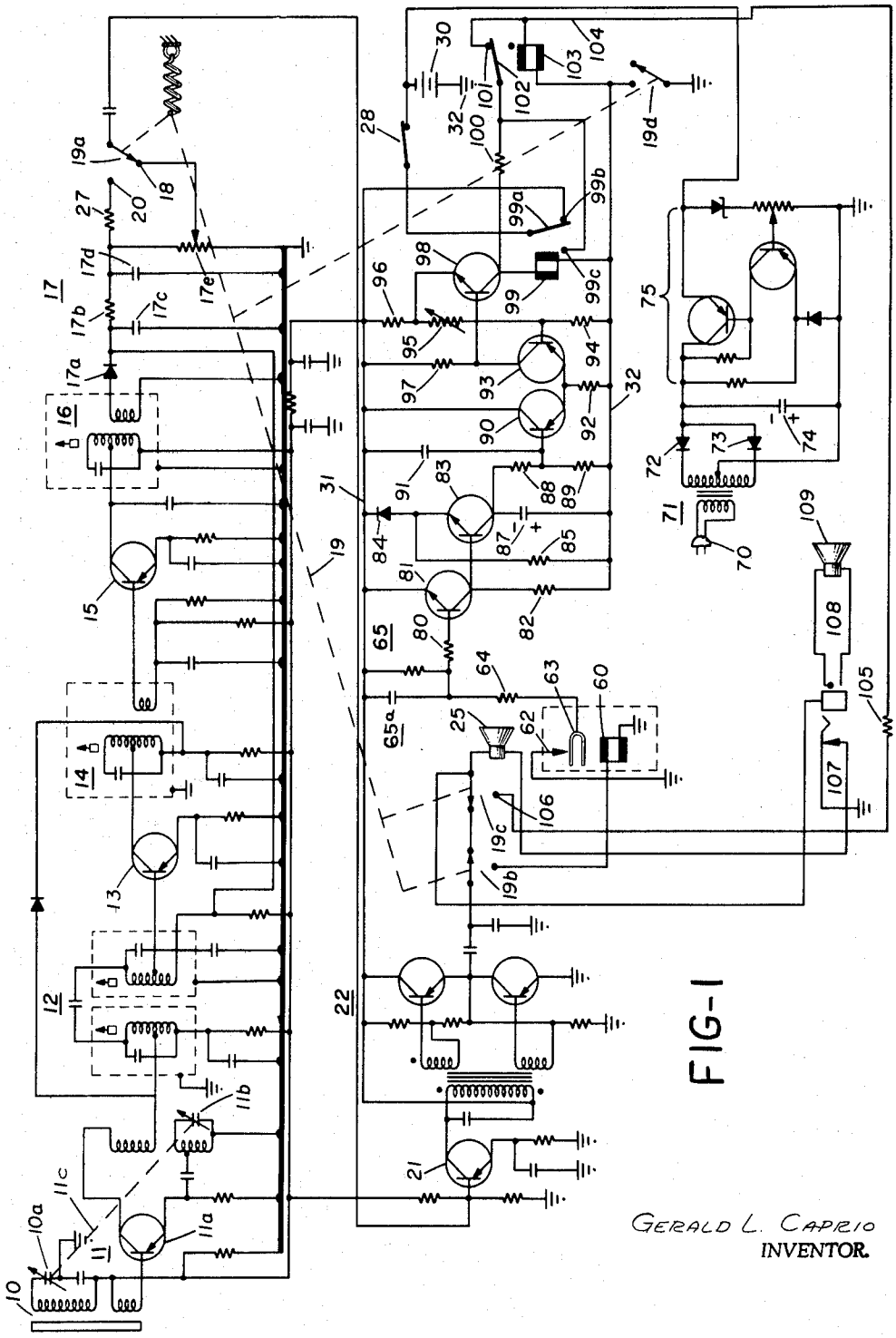


FIG-1

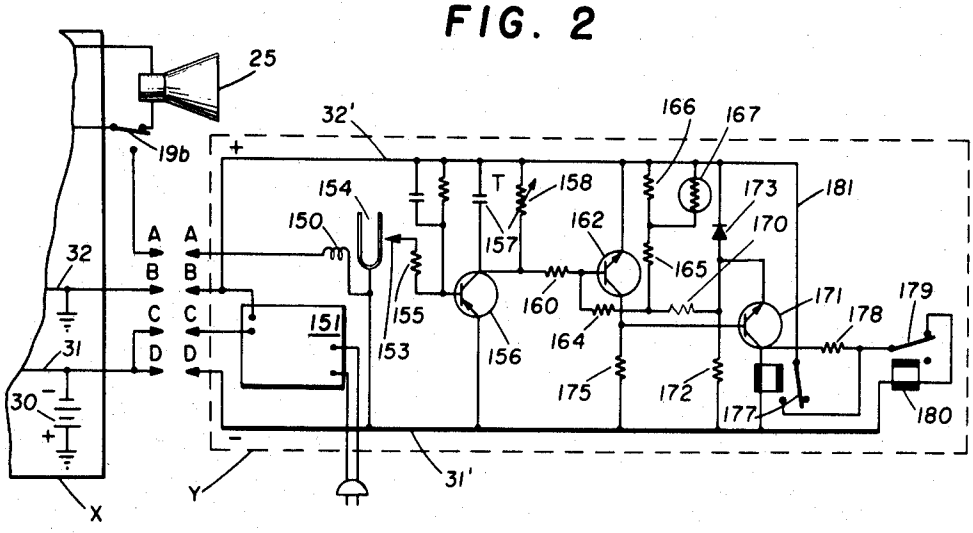
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Filed Aug. 6, 1962 2 Sheets-Sheet 2

FIG. 2



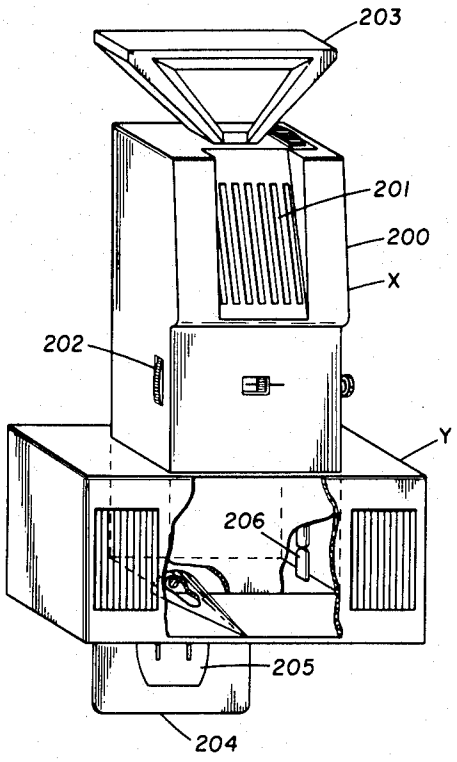


FIG. 3

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United States Patent Office 3,256,515 Patented June 14, 1966

3,256,515

KEYED ALARM

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5 Claims. (Cl. 340—171)

This invention relates to a keyed alarm system and more particularly to a system for providing a positive alarm in response to a monotonic signal after a time delay which may be selectively variable over a wide range.

This invention finds application in alarm systems such as those to be used for radio transmission for reception by the general populace. It may be included in a radio receiver which is to be maintained on an alarm stand-by basis pending the receipt of a particular signal and following which the receiver operates in conventional mode. It is necessary in order to make certain that only the intended signal will serve to actuate the system. Furthermore, it must be immune to noise signals and improvident occurrences which might otherwise trigger the same. In addition, it must be adapted to be maintained in a stand-by condition preferably in either a fixed or portable state. Thus the electronic circuitry meeting the foregoing demands embodies specific cooperation between various elements therein which lead to a new combination not heretofore known in the art.

In accordance with the present invention, a keyed alarm circuit is provided which is responsive to a component of a received signal of monofrequency character if and only if such component is sustained for a time interval of substantial duration. More specifically, there is provided a sensing circuit preferably including a tuned electromechanical element responsive only to a component of a received signal of said monotonic character. There further is provided a normal quiescent utilization circuit. A circuit is then connected between the sensing circuit and the utilization circuit which includes a switch means and a time delay circuit for applying to the switch means an actuating signal from the sensing circuit. Connected to said time delay circuit is a reset control. The period of time delay circuit is of substantial length, with the period of the reset control being operative substantially instantaneously.

In a more specific aspect, a first circuit is provided for applying to the electromechanical element an actuating force which varies in accordance with variation with the multicomponent signal. A control circuit including a capacitor and a voltage source is provided for normally maintaining a charge on the capacitor. An actuating circuit is connected between the control circuit and the electromechanical element for initiating discharge of the capacitor and for continuing said discharge as long as the electromechanical element is actuated. An alarm is provided which is responsive to a change in the charge on the capacitor at a predetermined fraction of the initial charge. A charging circuit is provided for the capacitor which is completed upon cessation of actuation of the electromechanical element. The charging circuit has a time constant very small compared with the time constant of the control circuit.

For a more complete understanding of the present invention and for further objects and advantages thereof, reference may now be had to the following description taken in conjunction with the accompanying drawings in which:

FIGURE 1 is a schematic diagram of one embodiment of the invention;

FIGURE 2 illustrates a modification of the invention in which two units are employed; and

FIGURE 3 is an isometric view, partly in section, showing one embodiment of the invention.

Referring now to FIGURE 1, there is illustrated in schematic diagram form a radio receiver in which the alarm system of the present invention is included. The example of FIGURE 1 is a transistorized AM receiver, battery powered and operable either in a stand-by alarm condition or in a broadcast reception condition.

More particularly, a receiving antenna **10** is provided at the input of the signal channel in which a mixer-oscillator stage **11** includes a transistor **11***a*. Tuning capacitors **10***a* and **11***b* are mechanically coupled as by link **11***c* so that the local oscillator including transistor **11***a* may be made to track the signal to which the circuit including the antenna **10** is tuned.

An I.F. signal is then transmitted by way of the I.F. transformer **12** to the first I.F. amplifier **13**. The signal is then transmitted by way of I.F. transformer **14** to the second I.F. stage **15**.

A third I.F. transformer **16** is connected at its output to a demodulator **17**, including diode **17***a*, which provides an audio output signal which is developed across a capacitor **17***c*. A resistor **17***b* is connected between diode **17***a* and a volume control **17***e*. A capacitor **17***d* is connected across the control **17***e*.

The variable tap on the volume control **17***e* is connected to terminal **18** of a first section **19***a* of a multisection switch **19**. With the selector arm of switch **19***a* connected to terminal **18**, the signal detected in the demodulator **17** is applied to an audio-amplifying channel which includes a driver transistor **21** and an output amplifier **22**. The output of stage **22** is applied by way of switch sections **19***b* and **19***c* to a speaker **25**. The switch sections of **19***b* and **19***c* are the second and third section, respectively, of the multisection switch **19** and are coupled to section **19***a* by the linkage (shown dotted). Both the R.F. section and audio sections of the receiver are powered from a battery **30**, the negative terminal of which is connected to bus **31** by way of the on-off switch **28** and the relay **99**. The positive terminal of battery **30** is connected to a ground reference terminal or bus **32**.

For broadcast reception, the volume control **17***e* provides adjustment to the desired audio output level at speaker **25**. However, applicant has provided an alarm unit particularly suitable for use on a stand-by basis as to be continuously responsive to a signal of particular character appearing at the second terminal **20** of switch section **19***a* which is conected for maximum gain. Terminal **20** is connected through resistors **17***b* and **27** to the cathode of the detector **17***a*. By this means the maximum signal output is applied by way of switch section **19***a* to the audio amplifier. In the stand-by condition it will be noted that the switches **19***b* and **19***c* disconnect the amplifier **22** from the speaker **25** and connect it to a resonant reed relay coil **60** of the alarm unit. Reed contact **62** is connected to ground. The vibrating reed **63** actuated by and upon energization of coil **60** is connected by way of resistor **64** and the RC networwk **65** to the bus **31**.

The battery **30** is trickle-charged from a power supply circuit including a plug **70** which may be connected to a power line as by a convenience outlet to apply alternating current to the power supply transformer **71**. The secondary winding of the transformer **71** is connected at its central terminal to ground and at its extremities to rectifiers **72** and **73**. The anodes of the rectifiers **72** and **73** are connected together and to a capictor **74**. A voltage regulator **75** is connected at its output to the negative terminal of battery **30** to maintain a trickle charge on the battery **30**. It will be noted that battery power is applied to the bus **32** from battery **30** only when the switch **19***d* is closed.

The RC circuit **65** is connected by way of resistor **80**

to the base of a transistor **81** whose emitter is connected to the bus **31**. The collector of transistor **81** and the base of transistor **83** are interconnected. The emitter of transistor **83** is connected by way of diode **84** to the bus **31** and, by way of resistance **85**, to the ground bus **32**.

Capacitor **87** connects the collector of transistor **83** to the ground bus **32**. Series resistances **88** and **89** parallel the capacitor **87** with the juncture between resistances **88** and **89** being connected to the base of transistor **90** and, by way of capacitor **91**, to the bus **31**. The collector of transistor **90** is connected to the bus **31**. The emitter is connected by way of resistance **92** to the bus **32** and to the emitter of a transistor **93**. The base of transistor **93** is connected by way of resistance **94** to the bus **32** and by way of variable resistance **95** and resistance **96** to the bus **31**. The collector of transistor **93** is connected by way of resistance **97** to the bus **31** and also to the base of transistor **98**.

The transistor **98** is connected in series with a relay coil **99**. More particularly, the emitter of transistor **98** is connected to the bus by way of resistor **96** and the collector is connected to one terminal of the coil **99**. The other terminal of the latter coil is connected to the bus **32**.

The relay coil **99** serves to actuate the relay armature **99***a* which is connected to the switch **28**. Terminal **99***b* is connected to bus **31** and the other terminal **99***c* is connected by way of resistance **100** to the collector of transistor **98** and to a buzzer alarm unit **101** which includes a vibrating contact **102** and an energizing coil **103**.

In order to provide desired operation, the resonant reed **63** is sharply tuned, vibrating only when an alternating current signal of sufficient amplitude and at the exact frequency to which the reed is tuned is applied across the terminals of coil **60**. When the reed **63** vibrates, it makes intermittent contact to close the circuit from ground terminal **62** to the RC circuit **65**. The intermittent contact thus made serves to apply intermittent pulses to the circuit **65** wherein they are integrated. The system response is keyed as to frequency and produces a D.C. voltage which is applied through resistance **80** to the base of transistor **81**. Resistance **80** serves to limit the base current of the transistor **81**. Transistor **81** is a switching transistor which is normally non-conducting, i.e., when no alarm signal is present in the output of the receiver. Resistance **82** is the collector load resistor for transistor **81**. However, when a signal is received having the precise frequency to which the reed **63** is tuned and is of sufficient amplitude to cause the reed to vibrate, a voltage is then applied to the base of the transistor **81**. This voltage is established almost instantaneously across the capacitor **65***a* in network **65** and when the signal is removed, the D.C. voltage on capacitor in circuit **65** collapses almost instantaneously. When a D.C. voltage is present across the capacitor **65***a*, the transistor **81** is switched from non-conducting to a conducting condition. Resistance **85** and the diode **84** serve to maintain a bias voltage for the transistor **83**. This causes the transistor **83** to be non-conducting when the transistor **81** is conducting. The series resistors **88** and **89** comprise the collector load resistance for transistor **83**.

When no signal of frequency to which the reed **63** is tuned is present, the transistor **81** is cut off, permitting current to flow through resistance **82** and the base-emitter junction of transistor **83**. This places transistor **83** in a highly conducting or saturated state. When transistor **83** is saturated, the low resistance represented thereby and by the diode **84** permits capacitor **87** to charge rapidly to the full voltage drop across the resistances **88** and **89**. However, when the tone to which the reed **63** is tuned is present, the transistor **81** becomes saturated. This immediately cuts off the transistor **83**. Upon cutoff in transistor **83**, the capacitor **87** is allowed to discharge at a relatively slow rate through resistances **88** and **89**. Any time that the alarm signal is removed or interrupted, capacitor **87** will be recharged almost instantaneously.

Transistors **90** and **93** along with resistances **92, 94, 95, 96** and **97** constitute a direct current differential amplifier which is responsive to the voltage across capacitor **87**. The setting of the resistance **95** determines the point along the RC discharge characteristic of the capacitor **87** at which the transistor **98** will be switched from a normally non-conducting state to a conducting state.

To illustrate alarm use of the system, note that conelrad transmission of a general alarm signal is at a broadcast frequency in the form of a 1000 cycle tone maintained for fifteen seconds. The resistance **95** is set such that the transistor **98** will begin to conduct after a preset delay, preferably of the order of about ten seconds. This time delay may be set from two seconds up to as much as thirty seconds by selection of the time constant of circuit **87, 88, 89**.

Transistor **98** serves to operate the relay coil **99**. The relay coil **99**, when energized, moves armature **99***a* from contact **99***b* to contact **99***c*, completing a circuit to a buzzer **101** from battery **30**. The relay coil **99**, or "locking means," is thereafter maintained energized by flow of current through resistance **100**, holding the relay closed so that the buzzer **101** will continue to operate after the trigger signal is removed. Once the contacts of relay **99** have been actuated, the buzzer **101** will continue to operate until a power connection is interrupted. Thus, with the receiver in an alarm stand-by condition, the reception of a 1000 cycle tone signal will energize the buzzer **101** only if the 1000 cycle signal is maintained for the preset period of the circuit **87, 88, 89**, and **95**. Once the buzzer is energized, a listener will be immediately warned that an alert is in effect. Momentary opening of switch **28** will remove the power from the alarm circuit, stopping the buzzer. Switch **19** may then be actuated to change the receiver circuit from its alarm-stand-by to its normal reception state wherein the audio circuit of the receiver is connected by way of the volume control **17***e* to the detector circuit, and the speaker **25** is connected to the output of the amplifier **22**.

It will be noted that terminal **104** of the buzzer **101** is connected by way of resistance **105** to the alarm terminal **106** of the switch section **19***c*. When the switch **19** is in the alarm position, the energizing signal applied to the buzzer coil **103** is also applied to the speaker **25** so that a distinctive audible signal will be produced by the speaker **25**. It will be noted that the speaker **25** is connected to ground by way of a phone jack **107**. This jack permits the connection to a circuit, such as circuit **108**, leading to a second speaker **109** so that the system may operate a local speaker and one or more remote speakers.

From the foregoing it will be seen that the R.F. as well as the audio section of the receiver together with the alarm circuit are powered from battery **30**. Battery **30** is maintained in a charged condition by use of the rectifier circuit leading from the power plug **70**. The system, by this means, is assured of proper operating voltage and may be maintained on a stand-by basis for long periods ready to receive an alarm should any signal corresponding to the frequency of the reed **63** be received. Upon receipt of the signal, the alarm is energized. The receiver may then be switched to a broadcast-receiving condition. It may be maintained in the same physical location with the plug **70** maintaining connection to a power circuit. Alternatively, if the power circuit should be dead or should fail or if it is desired to move the receiver to a different location following reception of an initial alarm, the battery is in a fully charged condition for assuring maximum service as a portable unit at a time of greatest need. Note that triggering of the alarm disconnects the system from the battery **30** except the alarm **101**. Battery power thus is required only to power the alarm **101** and the speaker **25** after reception of a keyed signal.

Thus, there is provided a combination which includes a receiver system having a tuned element responsive only

to a keyed signal for establishing an alarm. The system may then be switched manually or automatically, as the case may be, to a broadcast-receiving condition. In a preferred embodiment of the invention the switch **19** including sections **19***a*–**19***d* is manually operable.

A modification of the invention is shown in FIGURE 2. The receiver and audio section of the system are mounted in one chassis whereas the alarm and the power supply circuit are mounted in a second chassis which is adapted to be wall mounted in contact with a convenience outlet or otherwise supplied with power for maintaining the battery and the receiver in a charged state. In this embodiment of the invention shown in FIGURE 1, the switch **19** is automatically actuated by insertion of the chassis into the holder and by removal therefrom. Upon insertion, the circuit from the power supply to the battery is completed as in the circuit from the battery to the alarm circuitry.

More particularly, in FIGURE 2 the receiver portion of the system is housed in a first unit X with the alarm and the power supply system housed in a unit Y (shown dotted). It will be noted that the battery **30** is housed in the unit X but it is so connected that it must be charged from unit Y. A multi-terminal plug including contacts A–D is provided for connecting the unit X to the unit Y. More particularly, the contacts A—A serve to connect the alarm terminal on the switch section **19***b* from speaker **25** to the driving coil **150** of a tuned reed device. Terminals B—B connect the bus **32** in unit X to the bus **32′** in unit Y. The terminals C—C connect the power supply **151** to the negative terminal of battery **30**. The terminals D—D connect the bus **31** and the negative terminals of battery **30** to the bus **31′** in unit Y.

It will be noted that the terminals C and D in unit X are shorted together so that the alarm unit Y will be energized only when connected to the unit X.

The alarm circuit of FIGURE 2 connected to the reed relay **150** may be employed as a separate unit such as illustrated by the unit Y of FIGURE 2 or it may be employed in substitution for the more complex alarm circuit of FIGURE 1. The alarm circuit of FIGURE 2 is preferred in that it is less complex and provides stability that is not present in the alarm circuit of FIGURE 1. More particularly, in accordance with FIGURE 2, the contact **153** associated with the tuning fork **154** is connected by way of a resistor **155** to the base of a transistor **156**. The base is also connected by way of an RC network **157** to the bus **32′**. The emitter electrode of transistor **156** is connected to bus **31′**. The collector of transistor **156** is connected to the bus **32′** by way of the capacitor **157** and variable resistor **158**. Elements **157** and **158** form a pararallel circuit, the time constant of which determines the switching characteristics of the sensing system. The collector of transistor **156** is connected by way of resistor **160** to the base of a transistor **162**. The base of transistor **162** is also connected by way of resistor **164** and **165** to a parallel circuit including resistor **166** and a thermistor **167** which are connected to the bus **32′**. The juncture between resistors **164** and **165** is connected by way of resistor **170** to the emitter electrode of transistor **171**, by way of resistor **172** to the bus **31′** and by way of diode **173** to bus **32′**. The emitter electrode of transistor **162** is connected to the bus **32′**. The collector electrode of transistor **162** is connected to the bus **31′** by way of a resistor **175** and to the base of transistor **171**. The collector of transistor **171** is connected by way of a relay coil **177** to the bus **31′**. It is also connected by way of resistor **178** to the normally open contact associated with relay **177** and to the arm **179** of a buzzer **180**. The normally closed terminal associated with relay **180** is connected in series with the relay coil and thence to the bus **31′**. The armature of relay **177** is connected by way of conductor **181** to the bus **31′**.

In operation when a signal to which the reed **154** is tuned is applied to the terminals A—A and with the buses **31′** and **32′** energized, the transistor **156** will promptly be rendered non-conductive whereupon the charge on capacitor **157** will begin to leak off. The time required for the voltage on the base of transistor **162** to become sufficiently low to permit conduction will be controlled by the setting of the variable resistor **158**. The time constant is somewhat controlled by the parallel circuit including resistors **160, 164, 165, 166** and **167**. The thermistor **167** serves to compensate for variations with temperature of the base-emitter forward conduction knee of the transistor **162**. As well-known, the barrier potential of a transistor varies inversely with temperature so that in order to incorporate the desired stability as to the time at which the circuit of FIGURE 2 will actuate the alarm following the onset of the monotonic signal, it was found desirable to provide such compensation.

As transistor **162** begins conduction, transistor **171** also begins to conduct, thereby closing the relay **177**. This applies power from bus **32′** through the buzzer coil **180**. The latter circuit is repeatedly broken by actuation of the armature **179**. At the same time the circuit by way of resistor **178** maintains the relay coil **177** energized so that the remainder of the circuit may be restored to its stand-by condition upon termination of the signal on coil **150**. The buzzer **180** will then remain energized until manually stopped or otherwise rendered inoperative.

It will be noted that in the foregoing system the systems X and Y are to be mated for stand-by operation. The receiver X may, upon sounding of an alarm, be removed from system Y and then be employed as a conventionally designed portable radio receiver but with the assurance that at the outset the battery **30** is in a fully charged condition. Thus, not only is there provided a reliable stand-by unit, but upon the occurrence of an alarm signaled by the stand-by unit, the receiver unit will then be fully operative for receipt of voice information as may be desired. The system, therefore, is dependent upon power for charging as by way of the power supply **151** only until the time that a major requirement for the use of the alarm-signaling system may come into being.

In FIGURE 3 there is illustrated one embodiment in which the receiver unit X and the alarm system Y are physically encased so that the unit Y will receive the unit X in a manner conveniently adapted for use in its stand-by state. More particularly, a housing **200** is provided with a speaker enclosure **201**, a volume control **202** and with an antenna-handle element **203**. The unit X may be of a form of a small transistorized radio frequency receiver. In the lower end of the receiver X there is a four terminal plug having terminals corresponding with terminals A–D of unit X, FIGURE 2. A mating plug is provided in unit Y so that the connections AA–DD can be completed by insertion of the unit X into the nest in the unit Y.

Unit Y is provided with male electrical terminals on the rear face thereof for insertion into a convenience outlet such as on the unit **204**. The unit Y would be connected with the upper of the two outlet receptacles on the convenience outlet **204** leaving the lower one, the outlet **205**, available for normal use. The switches **19***a*–**19***d* of FIGURE 1 are actuated by a push bar **206** mounted in the bottom of the nest in the holder Y and adapted to be inserted into a slot in the bottom of the unit X to engage the structure represented by linkage **19** of FIGURE 1. Upon energizing the alarm, signaling the receipt of a keyed tone by the unit Y, the unit X will be lifted from its nest. A spring **19***e* incorporated in unit X and linked as shown in FIGURE 1 will automatically switch the receiver to the broadcast-receiving condition.

The relationship between the alarm unit of FIGURE 1 and the receiver system and control circuits for modifying one with respect to the other are described and claimed in an application of Roger L. Weber, filed con-

currently herewith, entitled Alarm Radio System, Serial No. 215,111, filed August 6, 1962.

Having described the invention in connection with certain specific embodiments thereof, it is to be understood that further modifications may now suggest themselves to those skilled in the art and it is intended to cover such modifications as fall within the scope of the appended claims.

What is claimed is:

1. The combination which comprises:

(a) a sharply tuned electromechanical filter being tuned to a monotonic signal component which ceases to be produced after a predetermined time interval,

(b) a control circuit including a capacitor, a transistor and a voltage source connected in series,

(c) means for maintaining said transistor in a normally conducting state for charging said capacitor to the voltage of said source,

(d) a discharge path connected across said capacitor having a relatively long time constant,

(e) a voltage sensing circuit connected across said capacitor, for sensing the voltage across said capacitor,

(f) an alarm circuit including normally open switch means and an alarm element connected across said source,

(g) a circuit connected between said voltage sensing circuit and said normally open switch means for closing said normally open switch means when the voltage across said capacitor reaches a predetermined discharge level, and

(h) a circuit forming a part of the control circuit having a time constant very short compared with the time constant of said discharge path for terminating and re-establishing conduction in said transistor instantaneously with the onset and termination, respectively, of the application to said filter of a signal component to which said filter is tuned.

2. The combination set forth in claim **1** in which locking means is provided for maintaining said alarm element energized following each actuation thereof.

3. An alarm circuit which comprises:

(a) a sharply tuned electromechanical filter,

(b) means for applying to said filter an actuating force which varies in dependence upon variations in amplitude and frequency of the components of an input signal,

(c) a control circuit including a voltage source, a capacitor and the collector emitter path of a first transistor connected in series with said voltage source,

(d) a long time constant discharge path for said capacitor, said path having elements providing a predetermined time constant and said elements being connected across said capacitor,

(e) a bias circuit connected to the base of said transistor and to said filter having a very short time constant for normally maintaining said transistor conductive and for rendering said transistor non-conductive upon actuation of said filter,

(f) a voltage sensing circuit including a second transistor connected in its collector emitter path across said source and connected at its base to said first transistor for sensing the voltage across said capacitor, and

(g) a third transistor normally non-conductive and connected at its base to said first transistor and having its collector emitter path connected in series with an alarm element and to said source for energizing said alarm element when said third transistor is rendered conductive.

4. The combination set forth in claim **3** in which locking means is provided for maintaining said alarm element energized following each actuation thereof.

5. An alarm circuit which comprises:

(a) a sharply tuned electromechanical filter,

(b) means for applying to said filter an actuating force which varies in dependence upon variations in amplitude and frequency of the components of an input signal,

(c) a control circuit including a voltage source, a capacitor and the collector emitter path of a first transistor connected in series with said voltage source,

(d) a long period discharge path for said capacitor, said path having elements providing a predetermined time constant and said elements being connected across said capacitor,

(e) a bias circuit connected to the base of said transistor and to said filter having a very short time constant for normally maintaining said transistor conductive and for rendering said transistor non-conductive upon actuation of said filter,

(f) a voltage sensing circuit including a second transistor connected in its collector emitter path across said source and connected at its base to said first transistor for sensing the voltage across said capacitor,

(g) a third transistor normally non-conductive and connected at its base to said first transistor and having its collector emitter path connected in series with an alarm element and to said source for energizing said alarm element when said third transistor is rendered conductive, and

(h) a compensating network connected to one terminal of said source, to the base of said second transistor and to one of the collector and emitter terminals of said third transistor for compensating variations in temperature in said alarm circuit.

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