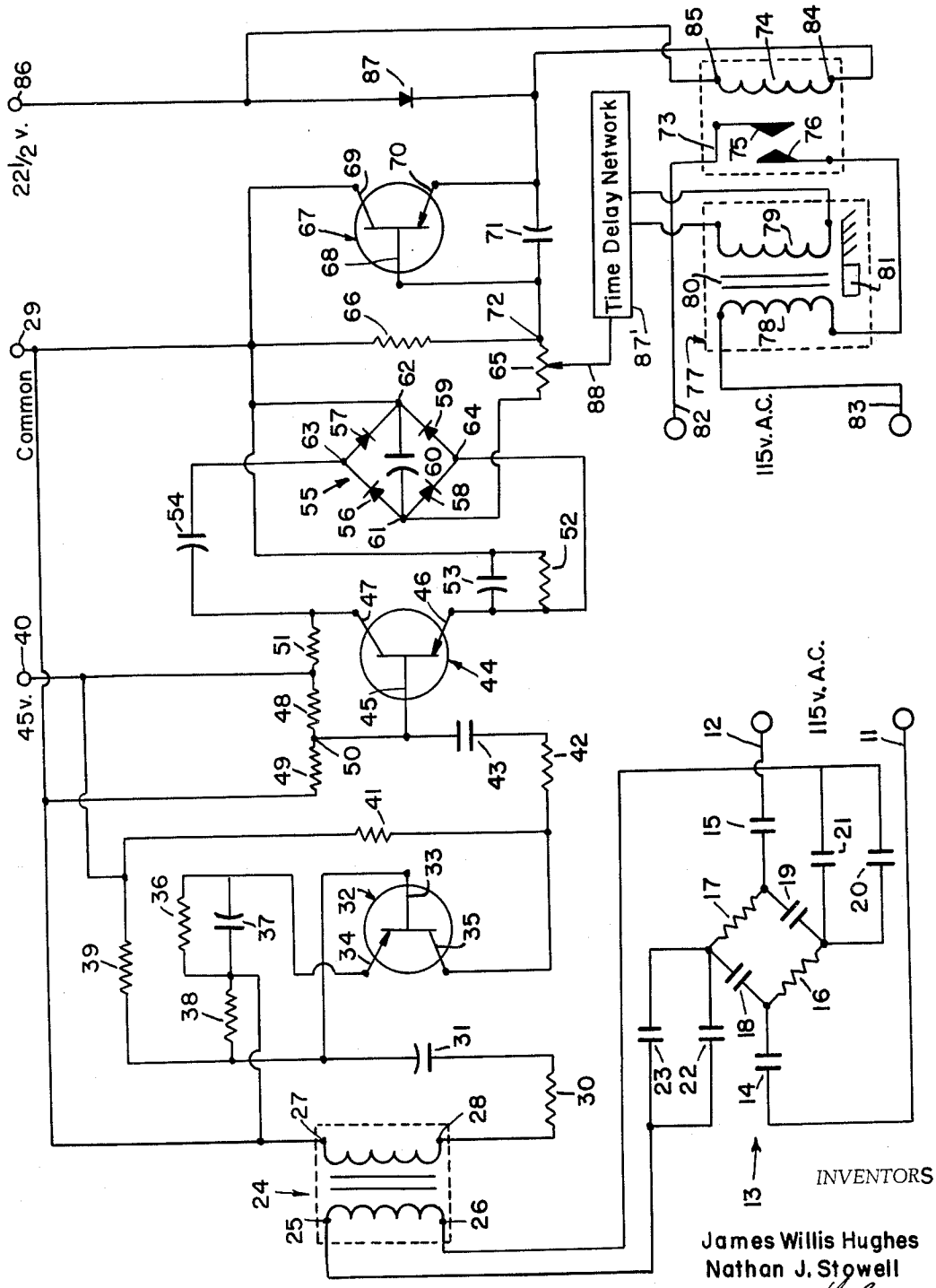
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POWER LINE EMERGENCY ALARM SIGNAL RECEIVER
HAVING TIME DELAY MEANS
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POWER LINE EMERGENCY ALARM SIGNAL RECEIVER HAVING TIME DELAY MEANS

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This invention relates to an electrical alarm device, and more particularly to an electrical alarm device operating in conjunction with an alternating current power distribution system over which alarm signals of selected frequencies are transmitted.

It is an object of this invention to provide a novel and improved electrical alarm which is responsive to alarm signals transmitted over an alternating current power distribution system.

A further object of this invention is to provide an electrical alarm which will operate only after an emergency signal is applied to the alternating current line for a predetermined period, will operate by its own accord for a second predetermined period, and will again sample the A.C. line for an emergency signal after the expiration of said second predetermined period to repeat the cycle continuously until the emergency signal is removed from the A.C. line.

A further object of this invention is to provide an improved electrical alarm having solid state transistor amplifiers.

A further object of this invention is to provide an improved electrical alarm which includes a novel solid state transistor timing switch.

The electrical alarm constructed in accordance with this invention is adapted to be used in conjunction with the Automatic Civil Emergency Warning System described and shown in the application of James Willis Hughes and Nathan J. Stowell, Serial No. 136,294, filed September 6, 1961, now U.S. Patent 3,130,396.

Further objects and advantages of the invention will become apparent from the following description and claims, and from the accompanying drawing wherein the single figure is a schematic wiring diagram of the improved electrical alarm constructed in accordance with the present invention.

Referring to the drawing, numerals **11** and **12**, respectively, designate a pair of electric power supply lines which may be connected in any suitable manner to the household power supply line, as by a conventional plug engaged in a receptacle of the household supply system.

Designated at **13** is an RC filter network tuned for maximum amplitude to pass the emergency alarm signal frequency and a maximum rejection of 60 cycles and any other even and odd harmonics of 60 cycles not designated for the alarm signal. A satisfactory alarm signal frequency for transmission over power lines is 240 cycles per second, but may be any other frequency designated by the Department of Defense Communications and Warning Director or other administrative body.

Capacitors **14** and **15** are isolation capacitors, namely to remove a direct connection to the 115 volt lines **11** and **12**. Resistors **16** and **17** and capacitors **18** and **19** comprise an input Wien-bridge for the purpose of rejecting 60 cycles A.C. and admitting 240 cycles or any other frequency chosen by the emergency administrative organization. (For purpose of illustration only the designated alarm frequency will hereafter be referred to as a 240 cycle per second frequency or 240 c.p.s.) Capacitors **20**, **21**, **22** and **23** are tuning capacitors to tune the primary side of transformer **24** to the 240 c.p.s alarm signal frequency. Designated at **25** and **26** are the primary terminals of transformer **24**. Designated at **27** and **28** are the secondary terminals of transformer **24**.

Terminal **27** of transformer **24** is connected to a common terminal **29**. Terminal **28** is the voltage input terminal serially connected through buffer resistor **30** and capacitor **31** to the base **33** of transistor **32**.

Transistor **32** is connected as a first stage amplifier for the alarm signal. Transistor **32** is biased by resistor **36** and capacitor **37** connected in parallel between the emitter **34** and common terminal **29**. The base **33** of transistor **32** is connected to the junction of resistors **38** and **39** serially connected between a source of negative voltage **40** and common ground **29**. Resistor **41** is a load resistor connected to collector **35** of transistor **32**.

A second stage transistor amplifier **44** includes a base **45**, an emitter **46** and a collector **47**. Collector **35** of the first stage amplifier is connected through buffer resistor **42** and coupling capacitor **43** to the base **45** of transistor **44**. Base **45** is also connected to junction **50** of a voltage divider network comprising resistors **48** and **49** serially connected between negative voltage source **40** and common terminal **29**. Designated at **51** is a load resistor connecting collector **47** to the negative voltage source **40**. The emitter **46** is biased by resistor **52** and capacitor **53** connected in parallel between emitter **46** and common terminal **29**.

Capacitor **54** is a coupling capacitor connecting collector **47** and a bridge rectifier **55**.

The bridge rectifier **55** includes diodes **56**, **57**, **58**, **59** and capacitor **60**. Diodes **56** and **57** in series, diodes **58** and **59** in series, and capacitor **60** are connected in parallel branches respectively between terminals **61** and **62** of the bridge rectifier. Terminals **63** and **64** are the junctions between diodes **56** and **57** and diodes **58** and **59**, respectively. Bridge rectifier **55** receives input voltage at terminal **63** through coupling capacitor **54**. The positive terminal **62** of the rectifier **55** is connected to common terminal **29**. The negative terminal **61** is connected through resistor **65** to the base **68** of transistor **67**. The negative voltage developed at terminal **61** operates transistor **67**.

Transistor **67** operates as a switch and includes a base **68**, a collector **69** and an emitter **70**. The collector **69** is connected to the common terminal **29**. A capacitor **71** connected across the base **68** and the emitter **70** is part of a time integrating circuit.

Resistor **66** is an amplitude limiting resistor which is connected across the base **68** and collector **69** of transistor **67**. Resistor **66** serves two purposes: (1) it provides stability, and (2) it limits spurious A.C. spikes.

A time integrating circuit used to operate the transistor switch **67** includes resistor **65**, capacitor **71** and resistor **66**. The resistance and capacitance values of resistors **65**, **66** and capacitor **71** are chosen in order to delay the actuation time of transistor switch **67** for a predetermined period irrespective of the voltage developed across rectifier **55**. A preferred time delay is from ten to nineteen seconds. The time integrating circuit including resistors **65**, **66** and capacitor **71** will hereafter be referred to as a turn-on time delay network which effects a turn-on time delay for transistor switch **67**.

The D.C. voltage developed across rectifier **55** builds up slowly in capacitor **60**. This in turn leaks off slowly through resistor **65** and control bleed-off resistor **66** to common terminal **29**. The voltage developed at the junction **72** between resistors **65** and **66** is applied to the base **68** of the transistor switch **67**. Transistor **67** is operated in such a manner as to become a switch having virtually infinite resistance when negative voltage is not applied to the base **68**. When a small negative voltage is applied to the base **68** transistor **67** becomes

a closed switch and permits current to flow, actuating a second switch 73. Capacitor 71 regulates time base control.

Switch 73 is a hermetically sealed magnetic switch surrounded by an actuating coil 74. Switch contacts 75 and 76 are normally open when no current is applied to the actuating coil 74, but are closed by the magnetic attraction of the field surrounding the coil 74 when current flows through the coil 74.

One side 84 of the coil 74 is connected to the emitter 70 of transistor 67. The other side 85 of the coil 74 is connected to a source of negative voltage 86. A negative voltage of −22½ volts is found to be satisfactory, but this invention is not limited by the particular voltage selected. A diode 87 is connected across the coil 74 with its positive side connected to the coil side 84.

Designated at 77 is a combination buzzer-transformer for sounding an alarm. The transformer comprises a primary winding 78, a secondary winding 79, a magnetic core 80 and a buzzer vibrator element 81.

Designated at 82 and 83 are power lines connected by any suitable means to an alternating current household power supply.

Primary winding 78 of transformer 77 is connected in series with switch 73 and the power lines 82 and 83.

The secondary winding 79 of transformer 77 is connected to a cut-off time delay network 87'. When switch 73 is actuated to close the circuit including the primary winding of transformer 77, the voltage induced in the secondary winding 79 is applied to the cut-off time delay network 87'. After a predetermined cut-off time delay the voltage from the cut-off time delay network is fed to a contact arm 88 on resistor 65 and is sufficient to cause transistor switch 67 to cease conducting and to act as an open switch. The cut-off time delay network 87' is shown in block form and may be of a type known in the art. It is only necessary that the cut-off time delay network 87' produce a negative holding voltage for holding the transistor switch 67 conducting for a predetermined period followed by a positive peak sufficient to cause the transistor switch to cease conducting. The negative holding voltage produced by the rectifier 55 and fed through the turn-on time delay network to the base 68 of the transistor switch 67 overcomes other spurious signal voltages applied to the base of the transistor switch 67 until such time as the cut-off time delay network produces a positive peak to cause the switch 67 to cease conducting.

While PNP transistors have been shown throughout the apparatus it is anticipated that NPN transistors may be substituted for the PNP transistors according to practices known in the art involving a reversal of the polarity of the power supply in the circuit.

The emergency alarm as heretofore described is adapted to be kept in constant readiness to sound a warning alarm merely by plugging the set into a household 115 volt A.C. power receptacle. The only moving parts in the set are the switch contacts 75 and 76 and the buzzer vibrator 81. Switch contacts 75 and 76 are enclosed in a sealed container, and will provide long service without necessity of repair.

The emergency alarm is responsive only to the signal frequency which is generated at a central emergency headquarters and transmitted over the power lines to homes and buildings which the power lines serve. It rejects the 60 cycle line frequency and other spurious signals, and will be actuated only after the alarm signal has been applied for a predetermined period of time. Thus, even if by chance a spurious voltage at the alarm frequency is generated for a time period less than the predetermined period of time delay the alarm will not operate to unnecessarily give alarm to people within hearing distance.

An alarm signal received over the power lines 11 and 12 is passed by the filter network 13. Unwanted signals are rejected by the filter network. The signal frequency passing the filter network is coupled through transformer 24 to the first transistor amplifier 32. The amplified alarm signal from the first transistor amplifier 32 is coupled by capacitor 43 to the base 45 of the second transistor amplifier 44.

The amplified alarm signal from the second stage amplifier is then rectified by the bridge rectifier 55. The rectified signal voltage is then applied through a turn-on time delay network to transistor switch 67.

The turn-on time delay network including resistors 65, 66 and capacitor 71 functions to delay the actuation of the switch 67 for a predetermined period of time for the purpose of preventing spurious signals of the alarm frequency from actuating the alarm buzzer. The values of the components of the turn-on time delay network are selected in order to provide the predetermined time delay.

The transistor switch 67 functions as an open switch until such time as the turn on time delay network permits sufficient negative voltage to build up at the base 68 of the transistor to cause it to short and act as a switch to energize coil 74 and close contacts 75 and 76 of switch 73.

When switch 73 is closed alternating current is applied through the primary winding 78 of transformer 77 from power lines 82 and 83 to actuate the vibrator type alarm buzzer 81. The buzzer 81 creates a very loud alarm, thus indicating that Conelrad or other radio signals are in progress and alarming the individual or individuals that an emergency or disaster does exist.

When transformer 77 has been energized the voltage appearing across the secondary winding 79 and cut-off time delay network 87' is sufficient to hold transistor 67 in operating condition for a predetermined period (50 seconds for purpose of illustration). Then enough positive voltage builds up through the arrangement of the cut-off time delay network 87' to overcome the negative operating voltage applied to the base 68 of transistor switch 67 and cause the transistor switch 67 to appear as an open circuit.

The alarm will remain deenergized for the time delay period of the turn on time delay network, after which time it will be again energized providing the alarm signal is still being transmitted constantly over the power lines. If the alarm signal is discontinued any time after the buzzer 81 has been energized and before the expiration of the turn on time delay period of the next cycle, the alarm will not be reenergized until another constant alarm signal is sent over the power lines.

The invention thus provides an electrical alarm which includes an electronic timer. The alarm operates cyclically as long as a constant alarm signal is transmitted over power lines to which the alarm is connected. The cycle includes a turn on delay period of a predetermined time and an alarm period of a second predetermined time when the alarm will operate of its own accord regardless of whether the alarm signal continues to be transmitted. The cycle will repeat itself continuously until transmission of the alarm signal is discontinued.

While in the foregoing there has been described and shown the preferred embodiment of the invention, various modifications may become apparent to those skilled in the art to which the invention relates. Accordingly, it is not desired to limit the invention to this disclosure and various modifications may be resorted to falling within the spirit and scope of the invention as claimed.

What is claimed is:

1. An electrical emergency alarm apparatus responsive to alarm signals transmitted over power lines comprising a pair of power supply lines, a filter network for passing the alarm signals with maximum amplitude and for maximum rejection of other frequencies, amplifier means for amplifying the alarm signals passed by said

filter network, a first normally open switch, a turn-on time delay means for closing said first switch after a predetermined period of time, rectifier means retifying and coupling the amplified alarm signals from said amplifier means to said turn-on time delay means, a second normally open switch, actuating means for closing said second switch, said actuating means being in series circuit with said first switch and a direct current power source whereby said actuating means is energized by said power source when said first switch is closed, an alarm buzzer for sounding an audible alarm, buzzer actuating means in circuit with said second switch for actuating said buzzer when said second switch is closed, and cut-off time delay means energized when said second switch is closed for opening said first switch after said buzzer has been actuated for a predetermined period of time, said cut-off time delay means when energized being effective to open said first switch irrespective of whether alarm signals continue to be transmitted to said emergency alarm apparatus or not.

2. The apparatus as set forth in claim 1 wherein said first switch is a transistor which includes a base, an emitter and a collector, a capacitor connected across said base and said collector, a first resistor connected across said base and said emitter, a common terminal, said emitter being connected to said common terminal, a second resistor connected on one side to said base and on its opposite side to a negative side of said rectifier means, a positive side of said rectifier means being connected to said common terminal, said first and second resistors and said capacitor being included in said turn-on time delay means.

3. A time delay switching device comprising a signal voltage source, a rectifier, a time delay network, a transistor, a relay and a direct current voltage source, said rectifier having a pair of input terminals connected to said signal voltage source, positive and negative output terminals, said transistor comprising a base, a collector, and an emitter; said time delay network comprising a time limiting resistor connected between said negative terminal of said rectifier and said base, a time base capacitor connected between said base and said emitter, and a bleed-off resistor connected between said base and the positive terminal of said rectifier; said relay including an electromagnetic coil having a pair of terminals, said direct current voltage source having a positive side connected to said positive terminal of said rectifier and to said collector, and a negative side connected to one terminal of said relay coil, the other terminal of said relay coil being connected to said emitter, an asymmetrically conducting impedance device having positive and negative terminals connected across the terminal of said relay with its positive terminal connected to said emitter and its negative terminal connected to the negative side of said direct current voltage source.

4. An electrical emergency alarm apparatus responsive to alarm signals transmitted over power lines comprising a pair of power supply lines, a filter network for passing the alarm signals with maximum amplitude and for maximum rejection of other frequencies, amplifier means for amplifying the alarm signals passed by said filter network, a first normally open transistor switch, a turn-on time delay means for actuating said first switch after a predetermined period of time, said turn-on time delay means having resistive and capacitive circuit components for effecting a time delay, rectifier means rectifying and coupling the amplified alarm signals from said amplifier means to said turn-on time delay means, a second normally open switch, electrically energized actuating means for closing said second switch, said actuating means being in series circuit with said first switch and a direct current power source whereby sad actuating means is energized by said power source when said first switch is closed, an alarm buzzer for sounding an audible alarm, and buzzer actuating means in circuit with said second switch for actuating said buzzer when said second switch is closed; said transistor including a base, an emitter and a collector, a capacitor connected across said base and said collector, a first resistor connected across said base and said emitter, a common terminal, said emitter being connected to said common terminal, a second resistor connected on one side to said base and on its opposite side to a negative side of said rectifier means, a positive side of said rectifier means being connected to said common terminal, said first and second resistors and said capacitor being included in said time delay means.

5. An electrical emergency alarm apparatus responsive to alarm signals of predetermined frequency transmitted over electric power lines, said predetermined frequency being other than the frequency of the electric power line current normally carried by said power lines comprising: a pair of power supply lines, a selective frequency filter network connected to said power lines and offering low impedance to alarm signals of said predetermined frequency and high impedance to signals of other frequency, a first normally open switch, a turn-on time delay means interposed between said filter network and said first switch for turning on said first switch a predetermined time after an alarm signal is received, a second normally open switch, electric actuating means connected in circuit with said first switch for closing said second switch when said first switch is turned on, an electrically actuated alarm device in circuit with said second switch for giving an alarm when said second switch is closed, and a cut-off time delay means receiving energy from the circuit including said second switch and said electrically actuated alarm device for opening said first switch a predetermined time after said second switch is closed, said cut-off time delay means when energized being effective to open said first switch irrespective of whether alarm signals continue to be transmitted to said emergency alarm apparatus or not.

6. An electrical emergency alarm apparatus responsive to alarm signals of predetermined frequency transmitted over electric power lines, said predetermined frequency being other than the frequency of the electric power line current normally carried by said power lines comprising: a pair of power supply lines, a selective frequency filter network connected to said power lines and offering low impedance to alarm signals of said predetermined frequency and high impedance to signals of other frequencies, a first normally open switch, said first switch being a normally non-conductive transistor switch having an emitter, a collector, and a base electrode, a turn-on time delay means interposed between said filter network and said first switch for turning on said first switch a predetermined time after an alarm signal is received, a second normally open switch, electric actuating means connected in circuit with said first switch for closing said second switch when said first switch is turned on, an electrically actuated alarm device in circuit with said second switch for giving an alarm when said second switch is closed, and a cut-off time delay means receiving energy from the circuit including said second switch and said electrically actuated alarm device for opening said first switch a predetermined time after said second switch is closed, said cut-off time delay means when energized being effective to open said first switch irrespective of whether alarm signals continue to be transmitted to said emergency alarm apparatus or not.

7. An electrical emergency alarm apparatus responsive to alarm signals of predetermined frequency transmitted over electric power lines, said predetermined frequency being other than the frequency of the electric power line current normally carried by said power lines comprising: a pair of power supply lines, a selective frequency filter network connected to said power lines and offering low impedance to alarm signals of said predetermined frequency and high impedance to signals of other frequency, a first normally open switch, a turn-on time delay means

having resistive and capacitive circuit elements interposed between said filter network and said first switch for turning on said first switch a predetermined time after an alarm signal is received, a second normally open switch, electric actuating means connected in circuit with said first switch for closing said second switch when said first switch is turned on, an electrically actuated alarm device in circuit with said second switch for giving an alarm when said second switch is closed, and a cut-off time delay means receiving energy from the circuit including said second switch and said electrically actuated alarm device for opening said first switch a predetermined time after said second switch is closed, said cut-off time delay means when energized being effective to open said first switch irrespective of whether alarm signals continue to be transmitted to said emergency alarm apparatus or not.

8. An electrical emergency alarm apparatus responsive to alarm signals of predetermined frequency transmitted over electric power lines, said predetermined frequency being other than the frequency of the electric power line current normally carried by said power lines comprising: a pair of power supply lines, a selective frequency filter network connected to said power lines and offering low impedance to alarm signals of said predetermined frequency and high impedance to signals of other frequency, a first normally open switch, a turn-on time delay means interposed between said filter network and said first switch for turning on said first switch a predetermined time after an alarm signal is received, a second normally open switch, electric actuating means connected in circuit with said first switch for closing said second switch when said first switch is turned on, an electrically actuated alarm device in circuit with said second switch for giving an alarm when said second switch is closed, and a cut-off time delay means receiving energy from the circuit including said second switch and said electrically actuated alarm device for opening said first switch a predetermined time after said second switch is closed, said electrically actuated alarm device being a combination buzzer and transformer, the transformer having a primary winding, a secondary winding, and a magnetic core, said buzzer including a hammer actuated in response to magnetic flux set up in said core and a sounding element positioned to be struck by said hammer, said primary winding being in series circuit with a source of alternating current and with said second switch, said secondary winding being in circuit with said cut-off time delay means, said cut-off time delay means when energized being effective to open said first switch irrespective of whether alarm signals continue to be transmitted to said emergency alarm apparatus or not.

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