

[54] **ELECTRIC FIELD PROXIMITY SAFETY ALARM**

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 158,398, June 30, 1971, abandoned.

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[51] Int. Cl. **G08b 13/22**

[58] Field of Search 340/410, 214, 248 R, 340/258 D, 384 E, 258 C; 324/72

[56] **References Cited**

UNITED STATES PATENTS

2,695,399	11/1954	Martin	340/410
3,009,099	11/1961	Muller	340/258 D X
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3,309,690	3/1967	Moffitt	340/258 D
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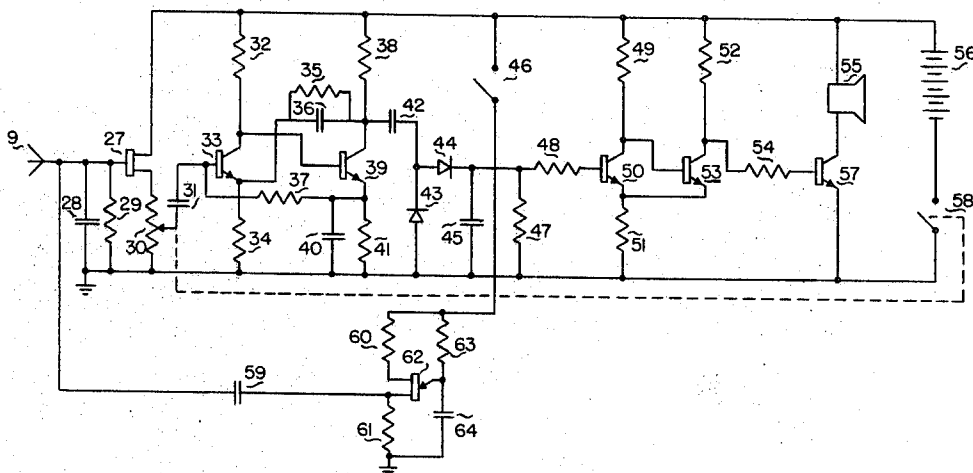
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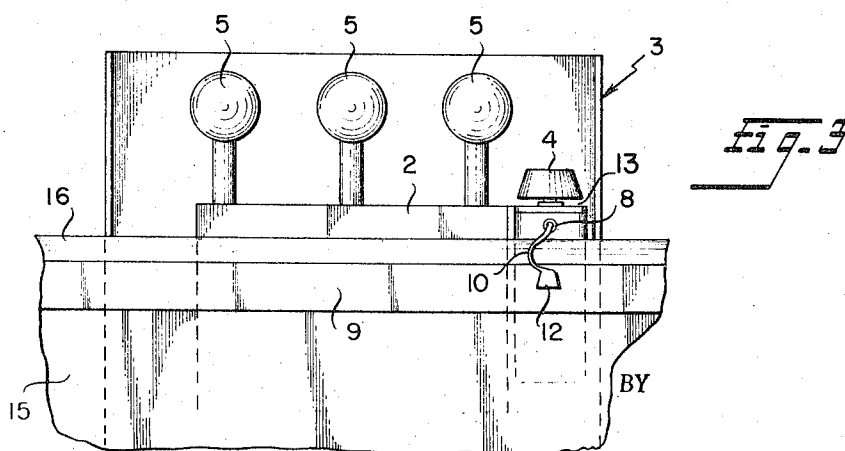
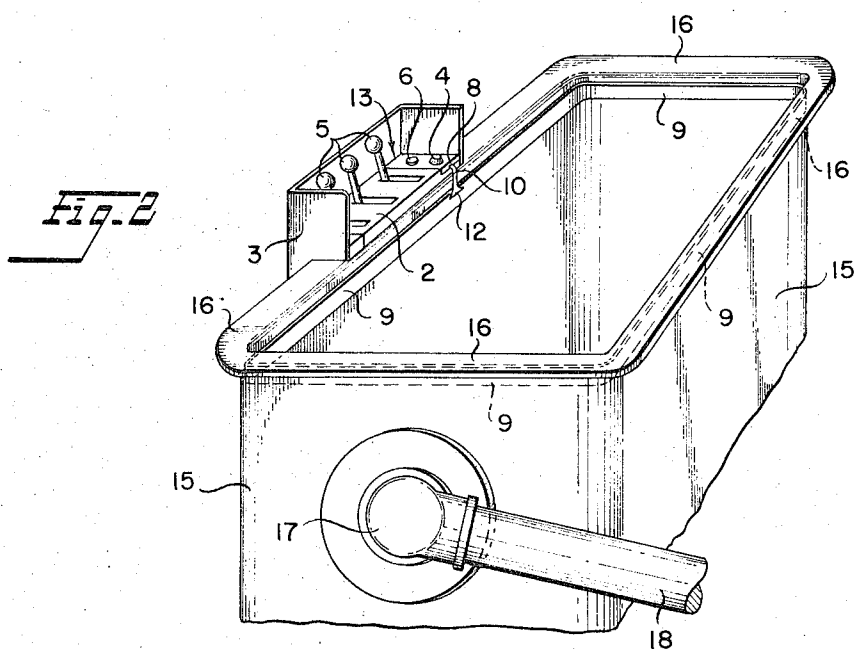
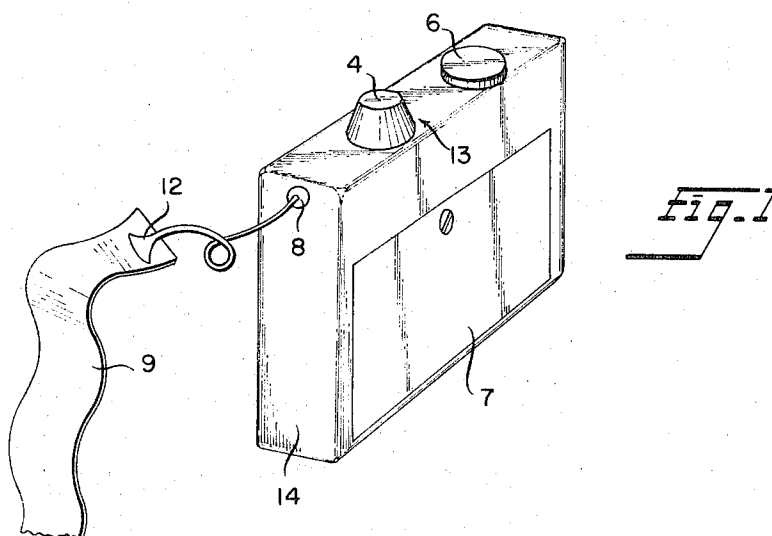
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ABSTRACT

This electric field proximity detector enables a worker to detect the presence of a dangerous power line or other electrical source and to then maintain a safe separation from it. A power line need not carry any current as a condition for detection since the device operates on the electric field about the conductor. Response to spurious radiation is eliminated, a sensitivity control is provided to permit setting the device to respond to various fixed combinations of field strength and distance from power lines, a threshold circuit will mark the boundary of safe operation within very narrow limits once the device is adjusted for a particular set of conditions; and a self-testing feature permits the operator to determine the working condition of the device. This miniaturized device contains its own power supply and loudspeaker, making for easy installation on cranes, aerial personnel baskets, and other types of lifting and construction equipment which may be used near power lines. The alarm circuit may also be used to activate other electrical circuits causing machinery to shut down when the alarm is activated. This device may also be used as a test instrument to detect energized lines and sources.

3 Claims, 5 Drawing Figures





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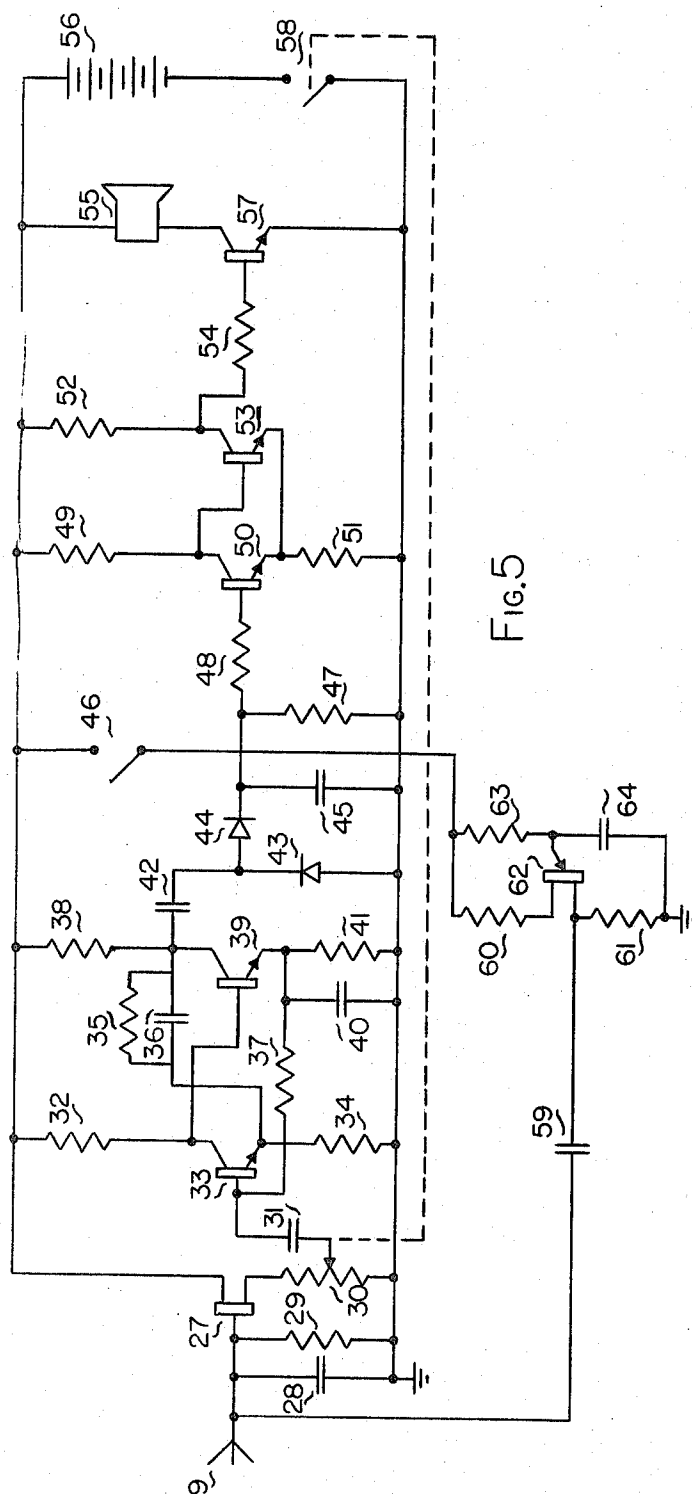


Fig. 5

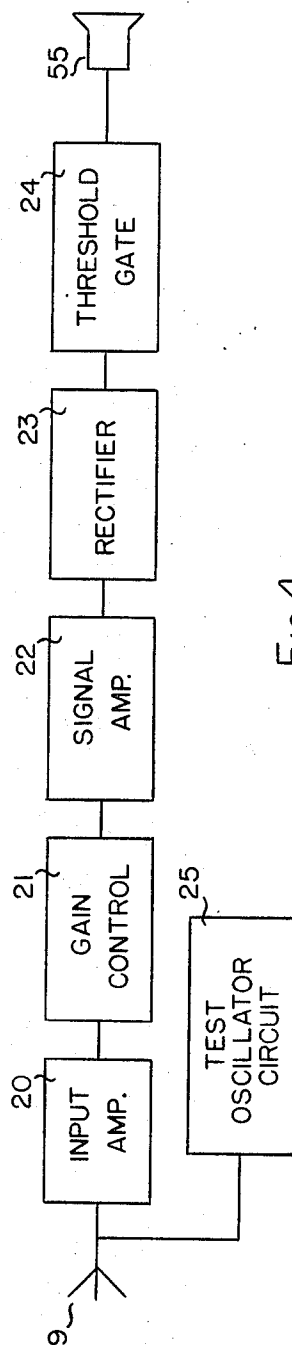


Fig. 4

ELECTRIC FIELD PROXIMITY SAFETY ALARM

This application is a continuation-in-part of my co-pending patent application Ser. No. 158,398 filed June 30, 1971, "ELECTRICAL PROXIMITY ALARM DEVICE", now abandoned.

Disclosure: This invention relates in general to safety devices and more particularly to devices for warning workers, exposed to lethal electric power lines and the like, of proximity to a dangerous electrical potential. This invention was made with knowledge of the following prior art patents: U.S. Pat. Nos. 2,730,245 Auld; 2,789,282 Winters; 3,201,775 Pederson; 3,613,093 Reynolds; and 3,309,690 Moffitt.

Electrical proximity detectors as used in the aforementioned patents suffer from the inability to accurately define the borderline between a safe and unsafe working area and do not have a true fail/safe testing circuit to check the over-all operation of the device.

This application, though intended to accomplish purposes similar to my U.S. Pat. No. 3,309,690, is improved over the original device to permit new uses of it on various construction equipment operated around power lines and further includes a new and improved threshold circuit which makes it more reliable and sharper in its ability to define the border between safe and unsafe areas of operation.

More specifically, the improvements serving to adapt the original helmet unit to these new uses consist in putting the unit into a larger and more rugged package, a longer-lived power supply, a more powerful alarm signal device to overcome ambient sound levels, more sensitivity through an improved amplifier and larger pickup antenna, and a unit-testing signal generator operative to inject into the antenna circuit a 60 hz test signal to check the device.

The threshold circuit has been simplified and improved, resulting in increased reliability because of the reduction in the number of components used.

It is illustrated as mounted on an aerial crane basket but the device may be mounted on any piece of equipment in danger of contacting electric lines or sources and may be carried by a person in danger of exposure to electrical hazards.

Previous devices of the same general nature are of such size and construction as to limit their use to providing protection to the operators of various construction machines or vehicles. These previous devices were not able to satisfactorily indicate to the operator the presence of dangerous electrical lines, and have not proven to have sufficient threshold stability to allow a precise adjustment to fixed distances from energized lines as required by new government safety regulations.

In addition, an individual operator could not easily control these prior-art proximity devices, and it was especially difficult to calibrate them readily in the field. In exceptionally noisy locations, the warning signal emitted from the previous devices was difficult to hear, in that it was usually a 60-cycle hum. Another serious drawback of the prior art devices was that they were designed primarily for use in receiving electromagnetic radiation from in-service power lines. However, it is not always possible to have the workmen engaged in areas where the power lines are operating normally. Quite often the workmen must work in areas where there are fallen power lines. The prior art devices were relatively ineffective in warning the workmen of the presence of

a nearby broken power line which carried no current.

Basically, the present invention will operate both in broken power line situations where the line has a high potential but no current flow, and in a situation where the power line is operating normally. However, because of the special considerations involved in the broken power line situations, it is preferable to have a safety device of the type herein described specifically constructed to operate either in a broken-line situation or else in a situation where the power lines are in normal operation.

In a broken power line situation, the operating characteristics of such a power line are very similar to the characteristics of an antenna in which electrical potential is present but current is not flowing in a continuous circuit. Such a broken power line emits a wave of electrostatic electrical energy detectable similar to a radio broadcast signal at the AC powerline frequency (generally 50 or 60 Hz). This device is sensitive to such oscillations using an amplifier circuit to receive this signal and means to convert it into an audio or electrical signal. It is also capable of reacting to any magnetic radiation from an energized electrical source.

The primary object of this invention is to provide a safety device for preventing injury to persons by warning of the precise distance to which the person or machine can safely approach an unprotected conductor having an electric potential.

Another object of the invention is the provision of a safety device capable of being calibrated by the operator, for warning him of inadvertent approach within unsafe proximity to dangerous electric potential.

Yet another object of this invention is the provision of a portable safety device which senses the electrostatic field intensity to provide a warning that indicates unsafe distance from a conductor of electric current.

A still further object of this invention is the provision of a novel and superior electronic circuit to be incorporated in a portable safety device which will accomplish the purpose of the above objects, and also test itself.

Other objects, advantages and capabilities of the invention will become apparent from the following description taken in conjunction with the accompanying drawings showing only a preferred embodiment of the invention.

IN THE DRAWINGS

FIG. 1 is a perspective view of the safety device with antenna attached;

FIG. 2 is a perspective view of an aerial crane basket showing the relation of the safety device to the basket controls;

FIG. 3 is a view of the control cluster in an aerial crane basket showing the relation of the safety device to the basket controls;

FIG. 4 is a block diagram illustrating the main components of the electronic circuitry of the present invention; and

FIG. 5 is a schematic wiring diagram of the electronic circuitry utilized in the present invention.

In order to clarifying the mechanical locations in FIGS. 1, 2 and 3 of the major components, the following descriptive list designates pertinent parts and their locations as mounted on a crane boom basket:

4. Sensitivity control Knob and Off-On Switch
5. Basket Control Levers
6. Alarm Speaker

7. Removable Battery Panel
8. Connector For Antenna
9. Antenna
10. Antenna Lead Wire
11. (Deleted)
12. Antenna Connection To Lead Wire
13. Complete Device In Housing
14. Front Of Device Housing
15. Aerial Boom Basket
16. Lip Of Basket
17. Basket Control Trunnion
18. Crane Boom

Referring to the drawings wherein like reference characters designate corresponding parts throughout the several figures, the safety detector of the present invention is generally indicated by numeral 13. In FIGS. 2 and 3 the safety detector 13 is shown mounted in the control cluster of the crane boom basket.

The present invention comprises a novel electronic circuitry shown in FIGS. 4 and 5 which in its embodiment is enclosed in a case which is mounted in a suitable manner in the control cluster of the crane boom basket. On the upper surface of the case is the rotatable knob 4 which functions as an on-off switch and variable sensitivity control. The alarm is emitted by a loudspeaker 6 which is also mounted on the upper panel of the detector. Connector 8 is attached at one end of the device to provide connection with the sensing antenna 9. A removable cover 7 facilitates the changing of batteries and servicing of the electronic assembly.

The safety detector 13 requires a sensing antenna 9 to pick up the electrostatic field, and this is provided by installing a metallic tape with adhesive backing around the inside of the basket as shown in FIG. 2. However, many other antenna designs may be used, depending upon practical application of the device.

The electronic circuitry of the present invention is shown by FIG. 4 in block diagram form and includes the antenna 9 connected to an input amplifier stage 20 which has high impedance in the input circuit to present the largest possible signal to the amplifier.

Coupled to the input amplifier is a sensitivity control 21 which permits the operator to set the level of the signal the system will respond to. From the sensitivity control 21 the input signal is then amplified by a signal amplification stage 22 to a level necessary to operate the remainder of the circuits. Coupled to the signal amplifier 22 is a rectifier 23 which is included to convert the usually received AC signal to an integrated DC signal which is then used to bias the threshold gate oscillator 24 into a conducting state so that the bias on the transistor 57 in FIG. 5 will cause the transistor collector 57 to conduct and cause the loudspeaker 55 to deliver an audible warning signal.

In operation of the present invention, see FIG. 5, an electrostatic radiation signal is received by the antenna 9 which is coupled to the high impedance input of the input amplifier. Resistor 29 provides a high input impedance to bias the field-effect transistor 27. Condenser 28 is used to bypass any high frequency noise which may be picked up by the antenna 9. So that the operator may establish his own desired safe proximity distance to an electric line, there is provided a sensitivity-control potentiometer 30. Coupled to the wiper arm of the potentiometer 30 is a capacitor 31 which couples the input signal to the signal amplifier which comprises the circuits including transistors 33 and 39.

The signal amplifier includes two typical stages of audio amplification. The output from the signal amplifier is rectified through a half-wave voltage doubler rectifier comprising capacitors 42 and 45 and diodes 43 and 44. The DC voltage developed across resistor 47 biases the modified Schmitt trigger comprising resistors 48, 49, 51 and 52, and transistors 50 and 53 to conduct and in turn turn "on" the output transistor 57. This transistor 57 acting as a switch turns "on" the warning loudspeaker, which is a proprietary solid state device including a transducer sold under several trade names, one being Sonalert.

In the absence of a signal being received by the antenna 9 the amplifier transistor 57 is biased to an off state. When a signal of sufficient amplitude is detected, amplified and rectified, the threshold gate will cause the transistor 57 to be biased to an "on" state. The turn-on and turn-off points of the transistors 55 and 53 are very precise and provide the desirable feature of a sharp boundary at which the operation of the safety detector occurs in the presence of an electric field. In order to provide the energy to operate the circuit, there is provided a battery 56 and a suitable off and on switch 58, which is coupled to the wiper of the potentiometer 30 to be controlled by the operator manipulating knob 4.

While the elements of the above-described circuit may be modified to suit the situation and the values thereof changed in accordance with whatever modifications may be made, an operable circuit was designed using NPN transistors.

Because of the lethal nature of the potentials being monitored by the present safety alarm system, it is essential that the circuit be pre-adjusted as to sensitivity and pre-tested for operativeness before the operator approaches the powerline. For this purpose the present system is provided with a test circuit 25 which can be momentarily energized by a switch 46. This test circuit 25 uses a unijunction oscillator, FIG. 5, including a unijunction transistor 62 deriving power for its operation through resistors 60, 63, and switch 46, when closed. The capacitor 64 provides a time-constant selected such that the oscillator 25 oscillates at 60 Hz, or 50 Hz, as the case may require depending upon the standard power-line frequency at which the alarm device is intended to operate. The capacitor 59 couples a small component of the oscillation frequency of the oscillator 25 to the antenna input of the alarm circuit and the magnitude of this component is substantially constant, assuming that the battery 56 is not low. Hence, when the operator of the system closes the switch 46, provided the switch 58 is also closed, the oscillator 25 functions as a test signal generator and delivers a Go-No-Go test signal to the alarm circuit input, against which the operator can set his sensitivity control 30 and also test over-all operativeness of the system.

The present invention has proved very reliable in actual use and has detected electrostatic radiations of power lines from approximately a distance of two feet to ninety feet depending, of course, upon the voltage impressed upon the power line and the particular radiating pattern, with no false alarm factor from transient potentials, body capacitance or static electricity, either from work friction in the system, or static charges in heavy work gloves, or insulated materials used by line repairmen.

As an alternative to test circuit calibration, the operator can set the sensitivity control at the maximum setting before moving into the vicinity of power lines. When he gets a response he resets the sensitivity control so that the alarm will sound only when the antenna, or the device, comes too close to the energized line.

While I have particularly shown and described one illustrative embodiment of the invention, it is to be distinctly understood that the invention is not limited thereto, but that modifications may be made within the scope of the invention and such variations as are covered by the scope of the appended claims.

What is claimed is:

1. A highly sensitive alarm system for detecting a radiated electrostatic field and for sounding a warning when the alarm system approaches closer than an adjustable preset distance to the source of said field, comprising an audible alarm generator; an electrical threshold gate circuit including signal rectifying and integrating means and means to operate said alarm generator when the integrated signal reaches a predetermined level; an antenna sensitive to an electrostatic field; amplifier means coupling the antenna to said gate circuit to deliver an input signal from the antenna thereto proportional to the intensity of the field; sensitivity adjust-

ing means coupled to the amplifier means for adjusting its gain; a test signal generator separate from the amplifier means and operative when energized to generate a test signal of the same frequency as the electrostatic field to be detected and to couple to said antenna ahead of the sensitivity adjusting means a small component of the test signal of fixed magnitude approximating the magnitude of an input signal resulting from an electrostatic field detectable by said antenna to which the sensitivity adjusting means should be set; and switch means for selectivity energizing said test generator.

2. In an alarm system as set forth in claim 1 and intended for use in detecting the field in the vicinity of a power line energized at a standard power-line frequency, said test generator comprising an oscillator oscillating at said standard frequency when energized.

3. In an alarm system as set forth in claim 1, a power supply; and a main switch operative when closed to deliver power to said alarm system from said supply, said test generator switch means being coupled to said power supply through said main switch so that the test generator can be energized only when the main switch is closed.

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