

March 14, 1967

M. M. MOFFITT

3,309,690

HELMET WITH DETECTING CIRCUIT MOUNTED THEREON FOR  
INDICATING APPROACH TO AN ENERGIZED POWERLINE

Filed May 19, 1966

2 Sheets-Sheet 1

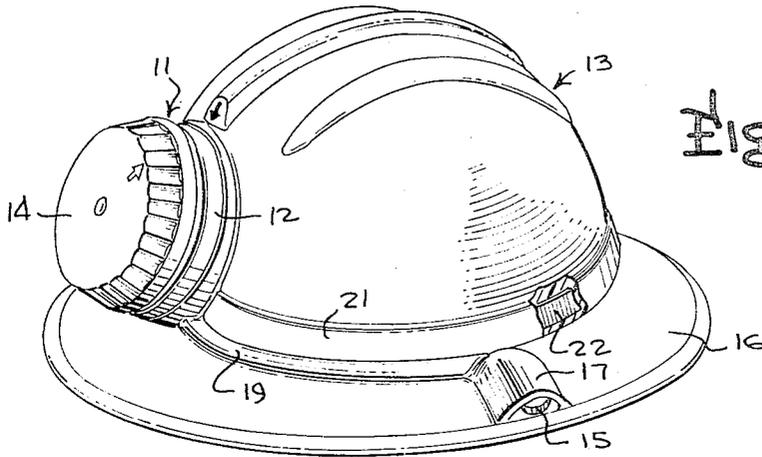


Fig-1

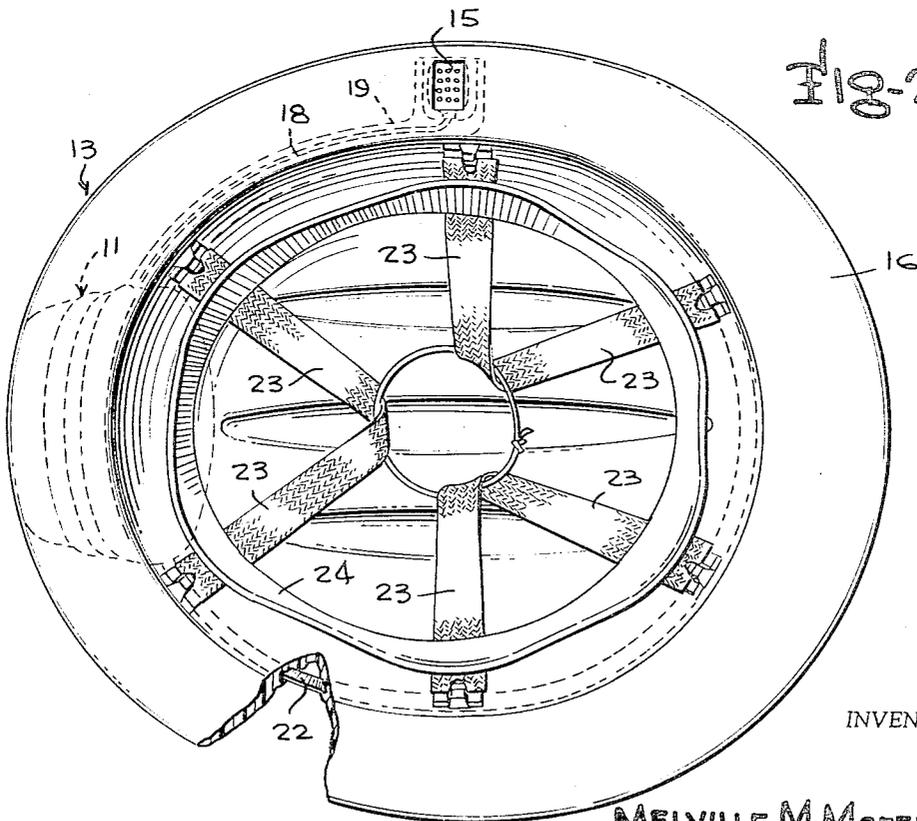


Fig-2

INVENTOR

MELVILLE M. MOFFITT

BY

Mason, Fennell & Lawrence

ATTORNEYS

March 14, 1967

M. M. MOFFITT

3,309,690

HELMET WITH DETECTING CIRCUIT MOUNTED THEREON FOR  
INDICATING APPROACH TO AN ENERGIZED POWERLINE

Filed May 19, 1966

2 Sheets-Sheet 2

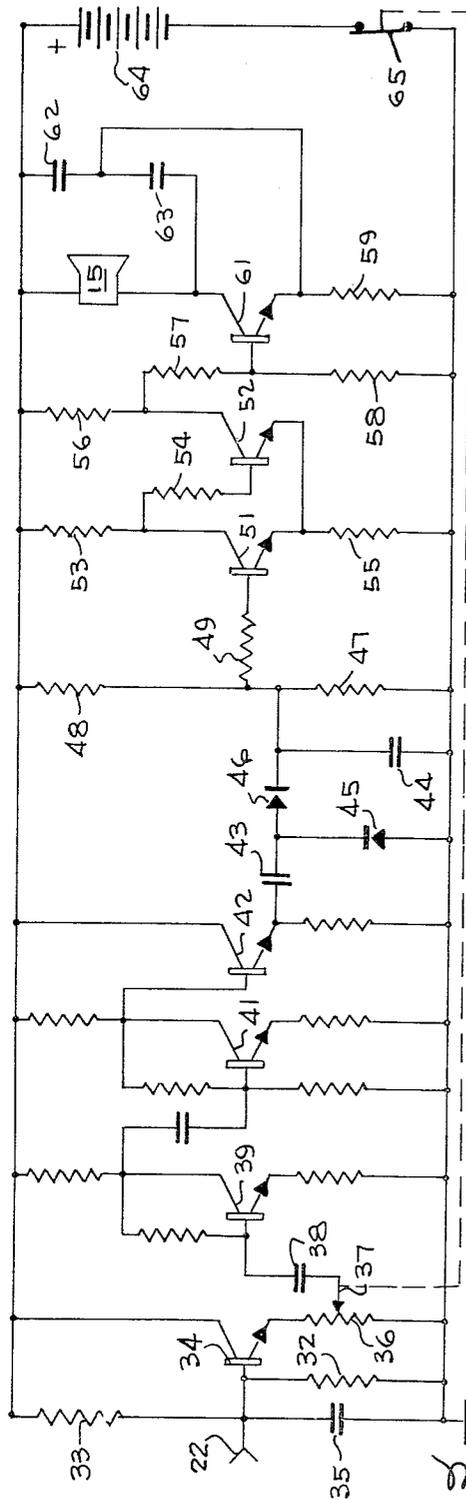
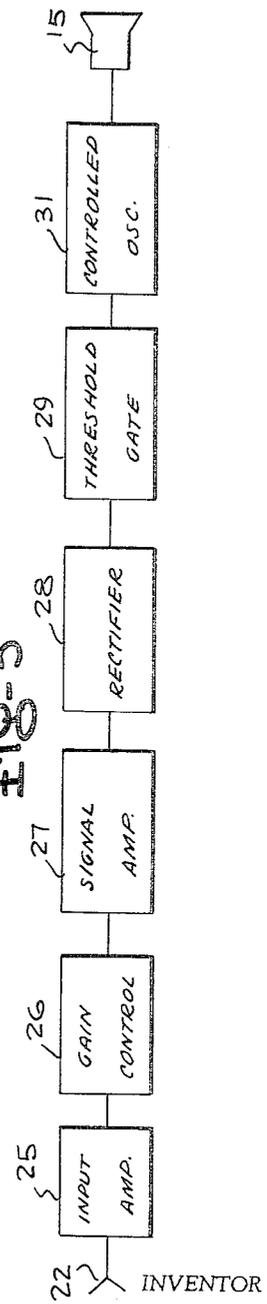


FIG. 4

FIG. 3



MELVILLE M. MOFFITT

BY  
*Mason, Fenwick & Lawrence*  
ATTORNEYS

1

2

3,309,690

**HELMET WITH DETECTING CIRCUIT MOUNTED THEREON FOR INDICATING APPROACH TO AN ENERGIZED POWERLINE**

Meilville M. Moffitt, 26 Oxford St.,  
Chevy Chase, Md. 20015  
Filed May 19, 1966, Ser. No. 551,272  
2 Claims. (Cl. 340—258)

This invention relates in general to safety devices and more particularly to devices for warning workers exposed to lethal high-tension electric lines and the like of proximity to electric current. This application is a continuation-in-part of my co-pending application S.N. 860,544, filed Dec. 18, 1959 now abandoned.

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 of the presence of dangerous electrical lines. In addition, and individual could not easily control these 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 series 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.

Basically, the present invention will operate both in broken power line situations and in a situation where the power line is operating normally. However, because of the special considerations involved in the broken power line situation, it is preferable to have a safety device of the type herein described specifically constructed to operate in a broken line situation wherein it will also operate satisfactorily in a situation where the power lines are normal.

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 current is present but not flowing in a continuous circuit. Such a broken power line emits a wave of electrical energy which is escaping into free space. This wave travels at the velocity of light and consists of magnetic and electric fields at right angles to each other and also at right angles to the direction of travel. The intensity of the electric and magnetic fields of the wave are such that half of the electrical energy contained in the wave is in the form of electrostatic energy while the remaining half is in the form of magnetic energy. The electric and magnetic fields in the immediate vicinity of an antenna are greater in magnitude and different in phase from the radiation field. The electric and magnetic fields which must be added to the radiation field in order to give the fields actually present are termed induction fields. These induction fields diminish in strength more rapidly than inversely proportionally to distance. Thus the induction magnetic field from an elementary antenna is inversely proportional to the square of the distance, and the induction electric field has one component that is inversely proportional to the square of the distance and another that is inversely proportional to the cube of the distance. Inasmuch as the radiation field is inversely proportional to the distance, the induction fields die away much more rapidly with distance than do the radiation fields. However, at distances from the antenna that are small compared to a

wave length, the magnitude of the induction electric and magnetic fields will be much greater than the radiation field of the antenna. The induction field also differs from the radiation field in that, unlike the latter, the magnetic and electrostatic field intensities of the induction wave are not proportional to each other, nor are they in phase. In the elementary non-loop antenna system, the electric induction field becomes proportionally stronger than the magnetic induction field as the distance to the antenna becomes less. Such is the reason why it is quite necessary for a safety alarm system, as provided by this invention, be dependent primarily upon the electrostatic field.

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

Another object of the invention is the provision of a portable safety device capable of being calibrated by the wearer for warning him of inadvertent approach within an unsafe distance from dangerous electric current.

Still another object of this invention is the provision of a portable safety device which is lightweight and compact and will not hamper the movements of the wearer.

Yet another object of this invention is the provision of a portable safety device which senses the electrostatic field intensity of an induction wave 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 electronic circuit to be incorporated in a portable safety device which will accomplish the purpose of the above objects.

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:

FIGURE 1 is a perspective view of a lineman's helmet which is adapted to incorporate the safety device of the present invention and showing the device mounted upon the helmet;

FIGURE 2 is a bottom plan view of the helmet illustrated in FIGURE 1 showing especially the region where the warning signal is emitted;

FIGURE 3 is a block diagram illustrating the main components of the electronic circuitry of the present invention; and

FIGURE 4 is a schematic wiring diagram of the electronic circuitry utilized in the present invention.

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 the numeral 11. In FIGURES 1 and 2 the safety detector 11 is shown mounted upon the exterior of a safety helmet; however, it should be noted that this is merely an illustrative embodiment, as the safety detector may well be incorporated into other portable devices to be carried by persons working in hazardous electrical areas. Such other portable devices might well be in the form of pocket or belt attached or be incorporated with other electrical testing apparatus.

As illustrated, the present invention comprises a novel electronic circuitry as shown in FIGURES 3 and 4, which, in the presently shown embodiment, is encased in a molded plastic block 12 which is affixed in a suitable manner to the exterior of a safety helmet 13. At the forwardmost portion of the block 12 is a rotatable serrated knob 14 which functions as both an on and off switch and an amplifier gain control. As the present invention anticipates that the electronic circuitry of the invention will emit an audible signal, there is provided a

suitable speaker 15 mounted at the outermost rim portion of the helmet brim 16 and enclosed by molded protective covering 17. Interconnecting the speaker 15 with the electronic circuitry mounted in the block 12 are suitable speaker leads 18 running along a protective molded raceway 19. As the speaker 15 is mounted near the outermost rim portion of the helmet brim 16, the safety helmet retains its required dielectric strength throughout the entire head encompassing portion.

As the safety detector 11 needs an antenna to pick up the inductive electrostatic field, there is provided at the juncture of the brim to the helmet, a continuous molded enclosure 21 in which is placed a strip antenna 22. This antenna may be of any required length and interconnects in the plastic block 12 with the required electronic circuitry.

The helmet is of standard design on the interior and includes the normal head encompassing webbing strips 23 to which is attached a sweat band 24. As is obvious, the safety detector of the present invention may be attached relatively easily to a standard lineman's helmet without destroying its dielectric properties.

The electronic circuitry of the present invention is shown broadly by FIGURE 3 in block diagram form and includes the antenna 22 connected to an input amplifier stage 25 which has a high impedance in the input circuit to present the largest possible signal to the amplifier. Coupled to the input amplifier is a gain control stage 26 which permits the operator to set the level of the signal the system will respond to. From the gain control stage 26 the input signal is then amplified by a signal amplification stage 27 to a value necessary to operate the remainder of the circuits. Coupled to the signal amplifier 27 is a rectifying stage 28 which is preferably included to convert the usually received A.C. signal to a D.C. signal which is then used to bias the threshold gate 29 into a conducting stage so that the bias on the controlled oscillating stage 31 will cause the latter to assume oscillation. As the speaker 15 is in the oscillating circuit, it will provide an audible warning signal.

In operation of the present invention, an electrostatic radiation signal is received by the antenna which is coupled to the high impedance input of the input amplifier. Resistors 32, 33 provide the high impedance, together with the emitter follower circuitry of transistor 34. Condenser 35 is used to bypass any high frequency noise which may be picked up by the antenna 22. So that the operator may establish his own desired safe proximity distance to an electric line, there is provided a potentiometer 36. Coupled to the wiping arm 37 of the potentiometer 36 is a capacitor 38 which couples the input signal to the signal amplifier which consists of the circuits including transistors 39, 41 and 42.

The signal amplifier generally includes three typical stages of audio amplification. The output from the signal amplifier is rectified through the voltage doubler rectifier comprising capacitors 43 and 44 and diodes 45 and 46. The D.C. voltage developed across resistor 47 augments the bias developed across resistors 48 and 49. When the voltage across resistor 47 reaches 0.5 volts, the threshold gate which is, in effect, a modified Schmitt trigger comprising transistors 51 and 52 and resistors 53, 54, 55 and 56, turns on the controlled oscillator. The oscillator stage of this particular circuit is a modified Colpitts oscillator comprising resistors 57, 58, 59 and transistor 61. In addition, the oscillator also includes capacitors 62 and 63 along with the inductance present in the speaker 15.

In the absence of a signal being received by the antenna 22, the controlled oscillator is biased to an off stage. When a signal of sufficient amount is detected, amplified and rectified and the threshold gate turned on, the increased voltage in the juncture of resistors 57, 58 will cause the controlled oscillator to oscillate. The frequency of oscillation is determined by the inductance of the

speaker 15 and the capacitors 62 and 63. When the signal is received from antenna 22, the voltage at the juncture of resistors 57 and 58 drops and the oscillator is turned off. The turn on and turn off points of the oscillator are very precise and provides the desirable feature of a sharp boundary at which the operation of the safety detector occurs. In order to provide the energy to operate the circuit, there is provided a battery 64 and a suitable off and on switch 65, which is, in effect, coupled to the wiper 37 of the potentiometer 36 to be controlled by the operator manipulating knob 14.

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.

The present invention has proved very reliable in actual use and has detected electrostatic radiations of power lines from approximately a distance of four feet to seventy-five feet depending, of course, upon the voltage impressed upon the power line and the particular radiating pattern. The device is also provided with a fail-safe system for protection of the operator, in that when the gain control is turned to its maximum, the normal transient radiations in the atmosphere will trigger the device causing an alarm signal that will enable the operator to discern whether the device is in proper operating condition. The operator will normally move to the vicinity of the power lines with which he will work and then adjust the gain control by manipulating the serrated knob 14 so as to calibrate the circuit to operate at a distance from the power line the operator feels to be safe. Each time the operator approaches a new area, he moves his own adjustment of the safety detector, making this instrument very versatile in its operation.

While I have particularly shown and described one particular embodiment of the invention, it is 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. In combination, a helmet to be placed upon the head of a wearer having mounted thereupon a portable multi-stage miniaturized detection circuit means for detecting a radiated inductive field and giving a warning to the wearer when the detection circuit means approaches closer than a variable pre-determined distance to an energized powerline, the detection circuit means including an energizing means, a normally closed switch means for completing the circuit, an antenna means mounted on the helmet and connected to the circuit means for receiving the inductive electric field input signal, a high impedance amplification means coupled to the antenna means to receive the input signal and to direct the input signal to a gain control stage having manually adjustable means for setting a pre-determined signal level, audio-amplification means capacitively coupled to the gain control stage to raise the input signal to a pre-determined voltage value, rectifying means connected to the output of the audio-amplification means to convert the input signal voltage to a D.C. signal voltage, switching means coupled to the rectifying means and operative in response to a pre-determined voltage value therefrom, an oscillating means controlled by the switching means adapted to operate at such times as a pre-determined voltage value is received by the switching means from the rectifying means, audible signal means mounted on the helmet and connected to the oscillating means so as to transmit an audible signal to the wearer responsive to the setting of the gain control adjustable means.

2. The combination recited in claim 1 wherein the helmet has a partial head encompassing portion and an outwardly extending brim portion, the detection circuit means being mounted upon the head encompassing por-

5

tion, the audible signal means being mounted upon the  
brim portion.

References Cited by the Examiner

UNITED STATES PATENTS

2,109,189	2/1938	Bly	-----	324—67
2,338,245	1/1944	Hays et al.	-----	324—52
2,554,270	5/1951	Rosenberg	-----	324—310

6

2,615,969	10/1952	Albrecht	-----	340—258
2,651,021	9/1953	Hays	-----	324—52
2,789,282	4/1957	Winters	-----	324—67
2,904,645	9/1959	Sarles	-----	325—310 X
3,009,099	11/1961	Muller	-----	324—52

WALTER L. CARLSON, *Primary Examiner.*  
G. R. STRECKER, *Assistant Examiner.*