March 17, 1964 D. R. WINTERS 3,125,751

PROXIMITY ALARM

Filed July 21, 1961 2 Sheets-Sheet 1

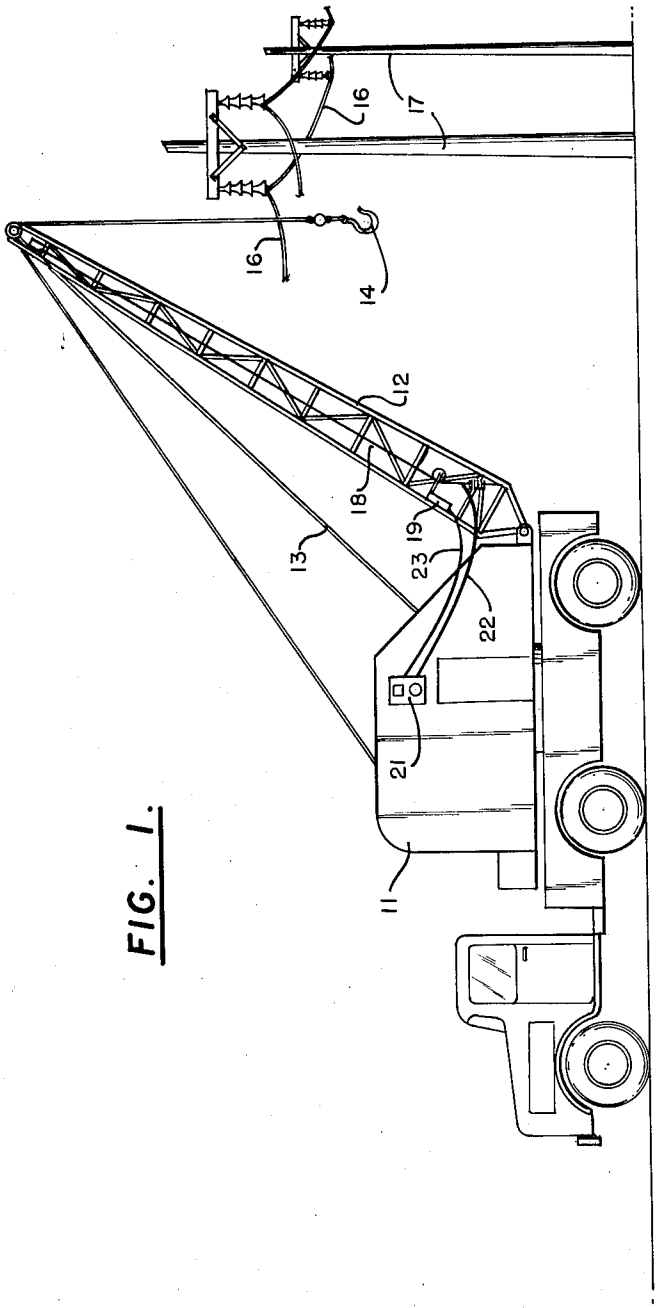

FIG. 1.

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FIG. 2.

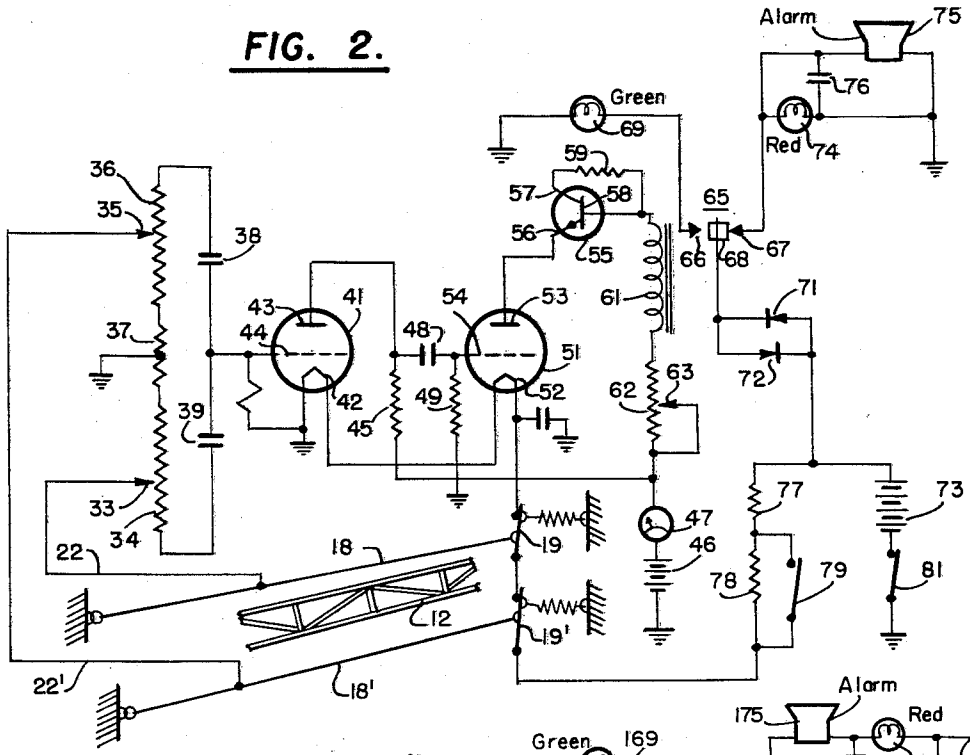
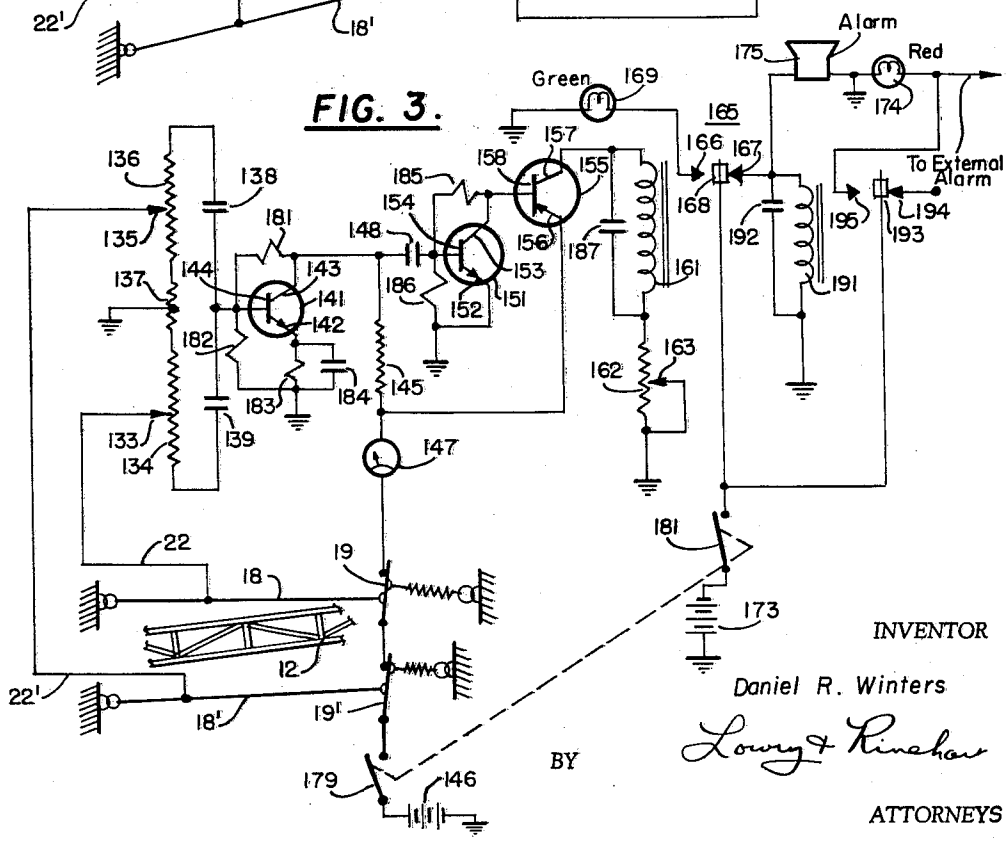


FIG. 3.



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3,125,751
PROXIMITY ALARM

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This invention relates to alarms, and, more particularly to automatic alarms for indicating to operating personnel when a projecting portion of a vehicle or other apparatus too closely approaches an energized electric power line.

The recent rapid expansion of construction of all types; homes, commercial buildings, and roads; has increased the number of vehicles which have projecting arms or booms and which are in use and moving over our highways. This, plus the expansion of the networks of lines for the transmission of electricity, has greatly increased the dangers of inadvertent improper contact between the projections of vehicles and electrical transmission lines. In addition to the obvious dangers of such contact to the vehicle operators, there are the secondary dangers to local residents of hanging power lines and the failure of electrical power in domestic and commercial establishments resulting from such contacts. It is far cheaper and safer to prevent improper contacts with electrical transmission lines than to repair the damage such contacts cause.

It is, therefore, an object of this invention to provide a new and improved alarm system for indicating the proximtiy of an energized electrical power line.

It is another object of this invention to provide a new and improved alarm system for installation on vehicles having projecting portions.

It is a further object of this invention to provide a new and improved alarm system for vehicles to warn of the impending contact between an arm of the vehicle and an electrical transmission line.

Other objects and advantages of this invention will become apparent as the following description proceeds, which description should be considered together with the accompanying drawings in which:

FIG. 1 is a pictorial illustration of a vehicle having a boom and upon which the alarm of this invention is installed;

FIG. 2 is a circuit diagram of the alarm of this invention; and

FIG. 3 is a circuit diagram of a modification of the alarm of this invention.

Referring now to the drawings in detail, and to FIG. 1 in particular, the reference character 11 designates a crane or other vehicle having a boom 12 or other such projecting arm. The boom 12 is supported in its raised position by cables 13 and carries a hook 14, or other objects, on another cable (not shown). As the crane 11 moves in the forward direction it approaches electrical transmission lines 16 which are carried on poles 17 and lie in the path of travel of the boom 12. A taut sensor wire of a pair of such wires 18 and 18' is stretched along each side of the boom 12 and is attached in any suitable manner to a switch of a pair of such switches 19 and 19' which are normally spring-biased to the open position but which is maintained in the closed position by the taut wires 18 and 18'. An alarm circuit 21 is located in a convenient location, such as in the cab of the crane 11, and is connected with the wires 18—18' by a line 22 and with the switches 19—19' by a line 23.

The alarm circuit 21 is better illustrated in FIG. 2 and comprises a pair of sensors 18 and 18', or other pick-up devices shown separated by a portion of the boom 12. The sensor wire 18 is connected to a tap 33 of a potentiometer 34, and the sensor 18' is connected to a tap 35

of a potentiometer 36. One end of each of the potentiometers 34 and 36 is connected to one end of a resistor 37, the center tap of which is grounded, and the other ends of the potentiometers 34 and 36 are connected together through coupling capacitors 38 and 39 respectively. The junction of the two capacitors 38 and 39 is connected to the control grid 44 of a triode 41 which also contains a filamentary cathode 42 and an anode 43. The anode 43 is connected through a load resistor 45 and a meter 47 to a source of direct current, such as battery 46, the other end of which is connected to ground.

The output from the triode 41 is taken across the load resistor 45 and is applied through a coupling capacitor 48 across a grid input resistor 49 to a second triode 51 which comprises a filamentary cathode 52, an anode 53 and a control grid 54. The anode 53 of the triode 51 is connected to the emitter electrode 56 of a transistor 55 which also comprises a collector electrode 57 and a base electrode 58. The collector electrode 57 is connected to the base electrode 58 through a bias resistor 59, and the junction of the resistor 59 and the base electrode 58 is connected to one end of a coil 61 of a relay 65. The other end of the coil 61 is connected to one end of a current limiting variable resistor 62, the other end of which is connected through the meter 47 to the battery 46.

The relay 65 comprises two stationary contacts 66 and 67 and a movable contact 68. The stationary contact 66 is connected through a signal lamp 69 to ground, and the stationary contact 67 is connected through a parallel arrangement of a signal lamp 74 and an alarm 75 to ground. A capacitor 76 is connected across the lamp 74. The movable contact 68, which is under the control of the coil 61, is connected to a pair of reversely connected rectifier diodes 71 and 72, which are, in turn, connected to one side of a source of direct current such as a battery 73, the other side of which is connected through a power switch 81 to ground. A fuse or other protective device may be inserted into the power circuit adjacent the switch 81 if desired. The filaments 42 of the triode 41 and 52 of the triode 51 are connected in series with one end of the filament 42 connected to ground and one end of the filament 52 connected through the spring biased switches 19 and 19' and through a pair of current limiting resistors 77 and 78 to the one side of the battery 73. A switch 79 is provided across the resistor 78 so that resistor may be bypassed if batteries having lower potentials are used. This enables the use of either 6 or 12 volt storage batteries, for example.

In operation, as the boom 12 of the crane 11 approaches a transmission line such as line 16 of FIG. 1, an A.C. potential is induced in at least one of the sensor wires 18 or 18'. The sensor wires 18 or 18' are insulated at both ends from the boom or other metallic body and act as antennas which sense the alternating field of an energized electric power line. Since the two sensors 18 and 18' are effectively isolated from each other by the boom which is interposed between them, the taps 33 and 35 of the potentiometers 34 and 36 may be set at different values of resistance to provide the two sensors with different levels of sensitivity. This provides an instrument which will permit the operation of a boom between two power lines energized at different potentials. The potential induced in either of the sensors 18 or 18' is applied through the lines 22 and 22' and potentiometers 34 and 36 to the control grid 44 of the triode 41, and is amplified therein. The amplified output from the triode 41 is applied through the coupling capacitor 48 to the control grid 54 of the second triode 51. The second triode 51 serves as a variable impedance which is controlled by the amplitude of the signal applied to its control grid. As such, it determines the amount of current flowing from the battery 46

through both the transistor 55 and the coil 61 of the relay 65. As the signal applied to the control grid 44 of the triode 41 increases, the amplitude of the signal applied to the control grid 54 of the second triode 51 decreases, thereby decreasing the flow of current through the triode 51 and through the coil 61. The relay 65 then reverts to the position shown and allows the movable contact 68 to break connection with the stationary contact 66 and to engage the stationary contact 67. This connects the alarm 75 and the red signal lamp 74 with the battery 73 to energize them both.

The coil 61 of the relay 65 retains the movable contact 68 in engagement with the stationary contact 66 to energize the green signal lamp 69 and indicate that all is well only so long as there is current flowing through the circuit containing the coil 61 and the triode 51. Should either of the taut sensor wires 18 or 18' break for any reason and be incapable of functioning as a sensor, its switch, 19 or 19', will open under the influence of its spring and break the filament circuits of the triodes 41 and 51. Current flow through the triode 51 then ceases, deenergizing the relay coil 61 and permitting the movable contact 68 to disengage stationary contact 66 and engage contact 67, extinguishing the green signal lamp 69, lighting the red signal lamp 74 and sounding the alarm 75.

As pointed out above, two signal lamps are also provided in addition to the aural alarm 75. The green lamp 69 indicates when lit that all is well and that there is no danger present; the red lamp 74 when lit indicates when the relay 65 has operated and the alarm 75 is energized. Should the operator be hard-of-hearing or the alarm 75 itself become broken, the signal lamps will continue to serve and produce the proper indication.

In FIG. 3 there is shown a modified circuit of the alarm system. The circuit of FIG. 3 uses transistors and no electron tubes, eliminating the need for a filament supply rendering the entire unit more portable, and reducing the size of the power supplies required.

In FIG. 3 two taut sensor wires 18 and 18' are respectively connected to taps 133 and 135 of potentiometers 134 and 136 respectively. The potentiometers 134 and 136 are connected together at one end through a resistor 137, the center tap of which is grounded, and at the other end through coupling capacitors 138 and 139 respectively. The junction of the coupling capacitors 138 and 139 is connected to the base electrode 144 of a transistor 141 which also comprises an emitter electrode 142 and a collector electrode 143. The collector electrode 143 is connected to a source of energy 146 through a load resistor 145, a meter 147 switches 19 and 19' which are maintained closed by the taut wires 18 and 18' and a power switch 179. The other side of the battery 146 is grounded. The output of the transistor 141 is taken across the load resistor 145 and through a coupling capacitor 148 and is applied to the base electrode 154 of a transistor 151 which also comprises an emitter electrode 152 and a collector electrode 153. The collector electrode 153 of the transistor 151 is connected in series with the base electrode 158-collector electrode 157 circuit of a transistor 155, the emitter electrode of which is connected through the meter 147, the switches 19 and 19' and switch 179 to the battery 146. The collector electrode 157 is connected to one end of a coil 161 of a relay 165, the other end of which is connected through a variable resistor 162 to ground. The relay 165 comprises a stationary contact 166 connected through a signal lamp 169 to ground, a second stationary contact 167 connected to ground through two branches of a parallel circuit, one branch containing an audible signal 175 and the other branch containing a second relay coil 191, and a movable contact 168 controlled by the coil 161 and connected through a power switch 181 to a battery 173. The second relay has a stationary contact 195 which is connected through a signal lamp 174 to ground, and a movable contact 193 under the control of coil 191 which

is also connected through the power switch 181 to battery 172. The power switches 179 and 181 may be ganged together as shown.

The operation of the circuit of FIG. 3 is similar to that of FIG. 2. When the vehicle upon which the alarm system is mounted approaches an electrical transmission line such as line 16 of FIG. 1, an alternating potential is induced in the sensor wires 18 and 18'. As in the circuit of FIG. 2, the sensor wires are mounted on each side of the boom 11 but are insulated therefrom. The boom effectively isolates one sensor from the other to permit individual operation. The induced signal is applied through the potentiometers 134 and 136, which are set to provide an appropriate signal level to the base electrode 144 of the transistor 141. This establishes a conduction path from the battery 146, through the closed switch 179, switches 19 and 19', the meter 147, the load resistor 145 and the collector-emitter circuit of the transistor 141 to ground. The potential developed across the load resistor 145 is applied to the base electrode 154 of the second transistor 151 and determines its impedance. As the impedance of the transistor 155 rises due to the signal applied to it, the conduction through the relay coil 161 decreases until the movable contact 168 is permitted to assume the position shown, breaking connection with the stationary contact 166 and establishing a connection with the stationary contact 167. This deenergizes the signal lamp 169, extinguishing the green light, and it energizes the audible alarm 175. In addition, the coil 191 of the second relay is also energized, drawing the movable contact 193 into connection with the stationary contact 195 and lighting the signal lamp 174. An additional lead may be connected to the contact 195 to energize a remote alarm whenever the lamp 174 is energized.

The taut wires 18 and 18' provide double protection since the alarm is sounded whenever one of the wires is broken and can no longer function as a sensor. Should the boom 12 collide with an object and cause one of the taut wires 18 or 18' to break, the energization of the relay coil 161 is terminated, energizing the alarm 175 and indicating danger.

This specification has described a new and improved form of proximity alarm which is small, compact and effective to signal the approach of a projection from a moving object toward an energized electric transmission line. In addition, the alarm has built-in safety features which indicate whenever the sensing means is inoperative. It is realized that a reading of the above description may indicate to those skilled in the art other ways of using the principles of this invention without departing from its spirit, and it is therefore, intended that this invention be limited only by the scope of the appended claims.

What is claimed is:

1. A system for indicating the presence of an energized electrical circuit, said system comprising a first antenna means for sensing the presence of the flow of electric current, a second antenna means for sensing the presence of the flow of electric current, means for electrically shielding said first antenna means from said second antenna means, a normally energized relay, an alarm, energizing means connected to said relay and alarm for energizing said alarm when said relay is deenergized, and control means connected to said first antenna and second antenna means and to said relay for deenergizing said relay when said first antenna means detects the presence of an electric current flow and for deenergizing said relay when said second antenna means detects the presence of an electric current flow.

2. A system for indicating the approach of a movable object to an energized electrical transmission line, said system comprising a first pickup means adapted to have electrical potentials induced therein by the presence of an adjacent electrical current flow, a second pickup means

adapted to have electrical potentials induced therein by the presence of an adjacent electrical current flow, said first and said second pickup means being separated by the object upon which they are mounted and being electrically shielded one from the other thereby, means for amplifying electrical potentials induced in each of said first and second pickup means, an alarm, and first means for energizing said alarm in response to potentials amplified by said amplifying means.

3. The system defined in claim 2 further including second means for energizing said alarm upon the mechanical failure of the said first pickup means and upon the mechanical failure of said second pickup means.

4. The system defined in claim 3 wherein said first energizing means includes a normally energized relay connected to said alarm and control means responsive to the potentials amplified in said amplifying means for deenergizing said relay to energize said alarm.

5. The system defined in claim 4 wherein said control means comprises a variable impedance connected to said relay and responsive to the output of said amplifying means to decrease the energization of said relay, and further including threshold means connected to said relay to energize said alarm when the energization of said relay drops to a prescribed level.

6. The system defined in claim 5 further including first adjusting means interposed between said first pickup means and said amplifying means and second adjusting means interposed between said second pickup means and said amplifying means for individually adjusting the sensitivity of said first and second pickup means.

7. The system defined in claim 6 wherein said second energizing means includes a first switch biased to the normally open condition and connected to said first pickup

means, said first pickup means maintaining said first switch closed against the bias, and a second switch biased to the normally open condition and connected to said second pickup means, said second pickup means maintaining said second switch closed against the bias.

8. A system for detecting and indicating when a projection from a movable object comes close to an energized electrical circuit; said system comprising a first sensor wire; means for maintaining said first sensor wire taut; a first switch resiliently biased open; said first wire connected to said first switch to maintain said first switch closed when said first wire is taut; a second sensor wire; a second switch normally resiliently biased open; said second wire being connected to said second switch; means for maintaining said second wire taut and said second switch closed so long as said second wire is taut; said first and second wires being located on opposite sides of a movable object and being shielded from each other thereby; a normally deenergized relay; a variable impedance; means for connecting said relay, said first and second switches, and said variable impedance in series with a means for connection to a source of current; means responsive to potentials induced in said first and second sensor wires for modifying the impedance of said variable impedance to cause deenergization of said relay; an alarm; and means connected to said relay and to said alarm for rendering said alarm operative when said relay is deenergized.

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