June 3, 1969 W. E. ROWLEY, JR., ET AL 3,448,448

SUPERVISED ALARM CIRCUITS

Filed Nov. 19, 1965

FIG. 1

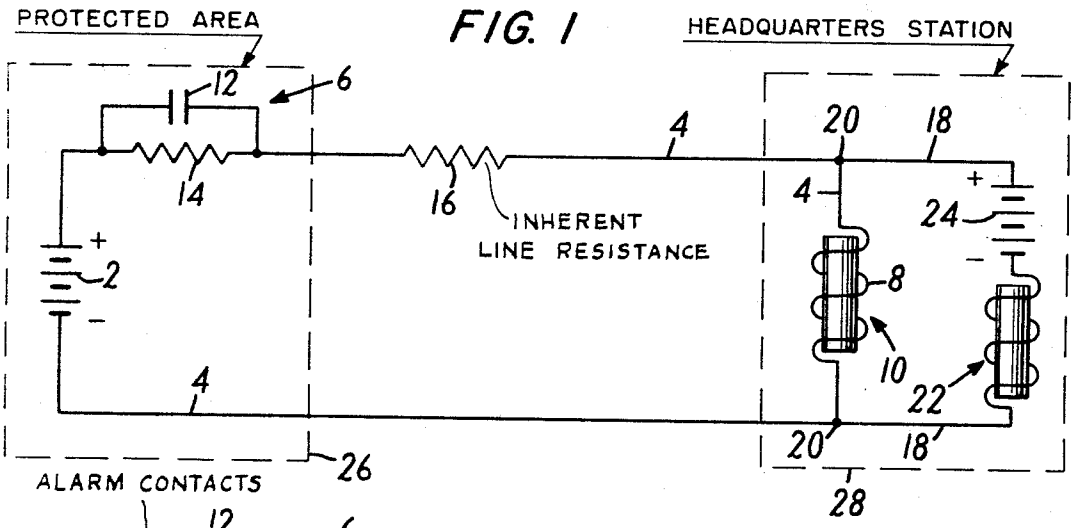
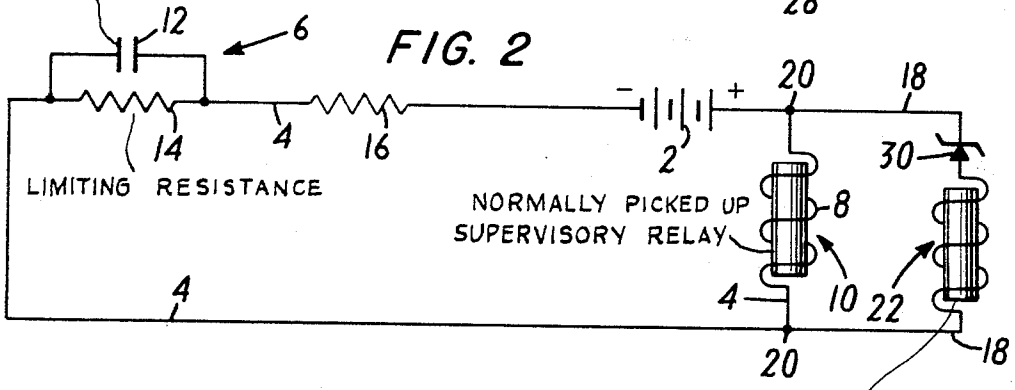


FIG. 2



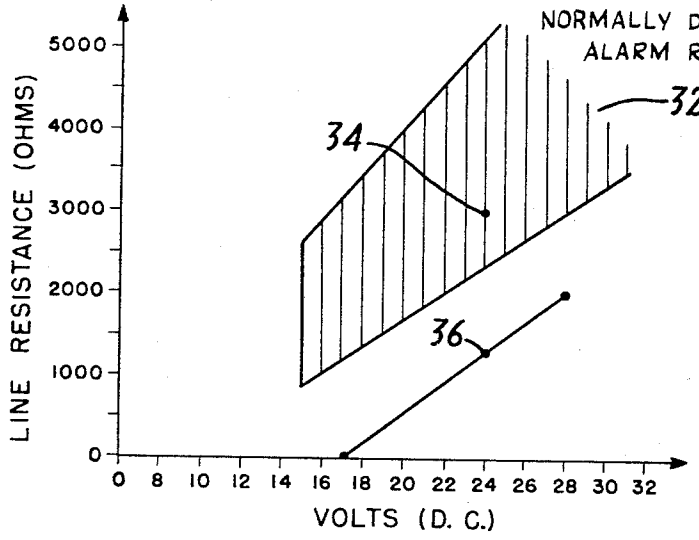


FIG. 3

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United States Patent Office 3,448,448
Patented June 3, 1969

3,448,448

SUPERVISED ALARM CIRCUITS

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Filed Nov. 19, 1965, Ser. No. 508,703
Int. Cl. G08b 29/00
U.S. Cl. 340—409 1 Claim

ABSTRACT OF THE DISCLOSURE

A supervised alarm circuit having a pair of line wires connecting a protected area station with a headquarters station. The wires are connected at the protected area station through a resistor in multiple with normally open contacts of an alarm detector. The circuit is energized by a source of energy connected in series with the line wires to provide a normally low level of energization and a higher level of energization when the detector is actuated. A normally picked up supervisory relay is connected across the line wires at the headquarters station, and a normally dropped away alarm relay is connected across the line wires at that station through a Zener diode.

The present invention relates generally to electric circuits for detecting trouble and alarm signals by current differential and specifically to differential sensing circuits for fire alarm systems.

Alarm systems which warn against a fire, burglars or the like have been known for many years. In the conventional embodiments the emergency sensing apparatus is located at the area to be protected while a monitoring panel and warning signals are positioned at the fire headquarters or remote station. Telephone lines are commonly employed to transport signals between the two stations.

During trouble free periods a DC power source maintains a supervisory relay in a constantly picked up condition. A signal light associated with the supervisory relay will light up if the system become inoperative. The operator at the headquarters station is thereby made aware that the alarm system is not functioning properly. When an emergency arises at the protected area, for example a fire, a pair of contacts which are sensitive to that particular condition, will close and initiate a flow of current in the system. This current picks up an alarm relay and energizes its associated warning light, horn or bell at the headquarters station and if desired at various locations in the protected premises.

Since the supervisory and alarm relays are conventionally arranged in series it has been necessary to delicately balance the current flow through the relays by manual adjustment of the resistance in the circuit. This has proved expensive and time consuming. Furthermore the distance between the protected area and headquarters station has been limited and in the conventional system sensitive relays are required.

These drawbacks have now been overcome and there has been devised a new current differential method of signaling which senses changes in current amplitude and exhibits many advantages over conventional warning signal circuits. The invention consists in arranging a normally picked up supervisory relay in series with a DC voltage source and then adding an auxiliary circuit across the supervisory relay which contains a normally dropped away alarm relay in series with a Zener diode. The biased relay is thereby made insensitive to the normal operation potential applied to the supervisory relay. Both relays are located at the headquarters station and an increase in potential generated by the closing of alarm sensitive contacts at the protected area causes the biased alarm relay to be picked up.

In a warning system which utilizes the present differential sensing circuit it is possible to expand the distance between the protected area and the headquarters station over that of the conventional systems and only minimum voltages need by applied. Furthermore the conventional resistance balancing is not necessary and relatively insensitive relays may be employed.

Other advantages of the present invention will become apparent from the drawings and specification which illustrate some preferred embodiments of the present invention.

FIG. 1 is a simplified illustration of a differential sensing circuit which employs a DC battery to supply the bias of bucking voltage and which illustrates the principle of the invention.

FIG. 2 is the preferred embodiment which utilizes a Zener code to supply the bias of bucking voltage.

FIG. 3 is a graphic illustration of the wide range of voltages and line resistances with which the present invention is capable of functioning. It also compares the present invention with a conventional system.

FIG. 1 shows a source of DC current **2** which supplies power to the circuit loop formed by the connector **4**. The circuit loop includes an impedance unit **6** connected in series with the DC source **2** and the coil **8** of the supervisory relay **10** is also connected in series in the circuit loop. The impedance unit **6** consists of a pair of normally open contacts **12**, and a large resistor **14** which is shunted out of the circuit when contacts **12** close in response to an alarm condition which decreases the impedance or resistance in the circuit loop. Under normal conditions the resistor **14** and the inherent line resistance **16** and resistance of coil **8** serve as a voltage divider and a potential substantially lower than the source **2** appears across the supervisory relay **10**. This voltage is sufficient to maintain the supervisory relay constantly energized and if the voltage in the loop falls below operable level the supervisory relay becomes deenergized and a warning light (not shown) comes on to indicate that the system is inoperative. Connected across the supervisory relay **10** in circuit loop **4** at points **20** is an auxiliary circuit **18** consisting of the series arrangement of an alarm relay **22** and a second DC voltage source **24**. The polarity of this voltage source **24** is opposite to that of source **2** and will buck the voltage from the battery to prevent the flow of current through the alarm relay **22** under normal supervisory conditions. Some current may of course flow through the alarm relay **22** but the flow must be below that which would actuate the alarm relay.

The signal lines which stretch between the protected area at **26** and the headquarters station shown at **28** are conventionally lines owned by the telephone company and leased to the parties using the alarm system.

When an emergency condition arises in the protected area the operation is as follows: In the circuit loop **4**, the sensitive alarm contacts of the impedance unit **6** close and shunt out resistor **14**, which decreases the impedance of the unit. Consequently current in the circuit loop **4** increases in the direction of the supervisory relay. A high potential then appears across the supervisory relay which exceeds the bucking or bias potential of the battery **24** in the auxiliary circuit **18**. This causes current from source **2** to flow in the auxiliary circuit to energize the relay **22** thereby signaling an emergency condition at the protected area. Warning lights, horns or bells (not shown) which are conventionally associated with the alarm relay are energized as is well known by those skilled in the art. As is also known in the art one or more impedance units may be added to the circuit loop **4** if desired.

A preferred embodiment is shown in FIG. 2 and its operation is the same as that of FIG. 1. In this embodi-

ment however a Zener diode **30** is located in the auxiliary circuit **18**, in series with relay **22** as a replacement for the biasing battery **24**. The Zener diode provides a bias which performs the same function as the bucking voltage of battery **24**. The Zener diode is selected and polarized so that alarm relay **22** will have insufficient current to energize it when the alarm contacts **12** in the protected area are open but will break down and conduct when those contacts are closed. The Zener diodes found most suitable for this purpose are 1N746 and 1N753 which have breakdown reverse bias potential of 3.3 and 6.2 volts respectively. Other solid state devices such as stabistors or thermistors, which do not pass appreciable current below a predetermined value, may be substituted for the Zener diode **30**. A number of conventional diodes may be connected in series to obtain the required gating potential.

The values of the circuit elements for the preferred embodiments of this invention are as follows:

DC supply voltage (4) ----------v--	17 to 27
Supervisory relay coil resistance ------ohms--	3,600
Alarm relay coil resistance ----------do----	420
Impedance unit resistor ----------do----	10,000

It should also be noted that in FIG. 2 the regular power source **2** is positioned at the headquarters station rather than at the protected area.

In the graph of FIG. 3, the shaded area **32** represents the maximum long line response for the preferred embodiment of differential sensing circuits of FIG. 2. Referring to the values on the graph it can be shown that the differential sensing circuit will exhibit extremely high long line run characteristics at moderately low voltages. As is evidenced at point **34** which is located at the center of shaded area and is truely an average value, a 24 volt DC source will actuate a discernible signal over lines of 3000 ohms. This 3000 ohms resistance value corresponds to a distance of nineteen miles of number 22, copper telephone wire.

On the other hand the conventional system using the same voltage will only transmit up to 1500 ohms of line resistance as shown at point **36**. This corresponds to a distance of nine and one-half miles.

It will be understood that it is intended to cover all changes and modifications of the preferred embodiment of the invention, herein chosen for the purpose of illustration, which do not constitute departures from the spirit and scope of the invention.

What is claimed is:

1. A supervised alarm circuit partly at a protected area station and partly at a headquarters station having a pair of line wires connecting the two stations wherein the improvement comprises,

(a) means for connecting the line wires at the protected area station through a resistor and normally open contacts of an alarm detector in multiple,

(b) means including a source of energy connected in series with the line wires for energizing the supervised alarm circuit at a relatively low level through the resistor when the contacts are open and at a higher level when the contacts are closed,

(c) means including a normally picked up supervisory relay connected across the line wires at the headquarters station for checking the continuity of the circuit, and

(d) means including a normally dropped away alarm relay connected across the line wires at the headquarters station through a Zener diode for sensing an alarm condition in response to the higher level of energization of the circuit.

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U.S. Cl. X.R.

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