

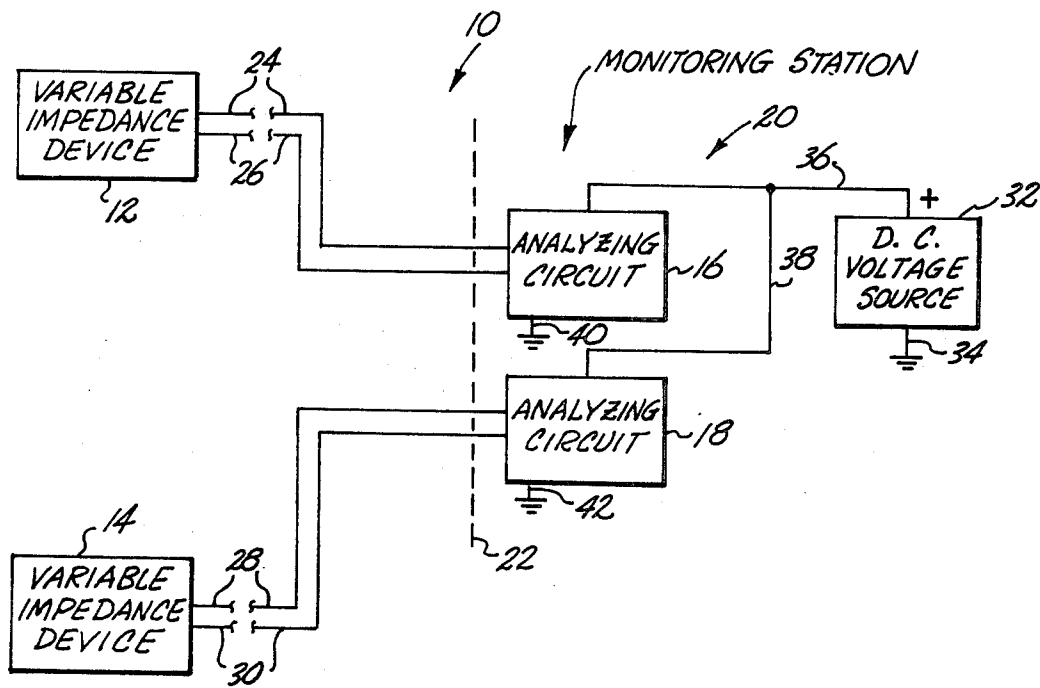
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[21] Appl. No. 740,149
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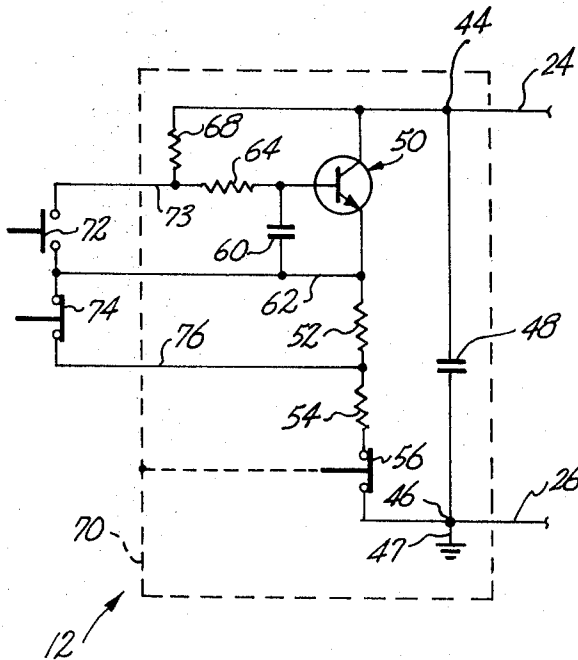
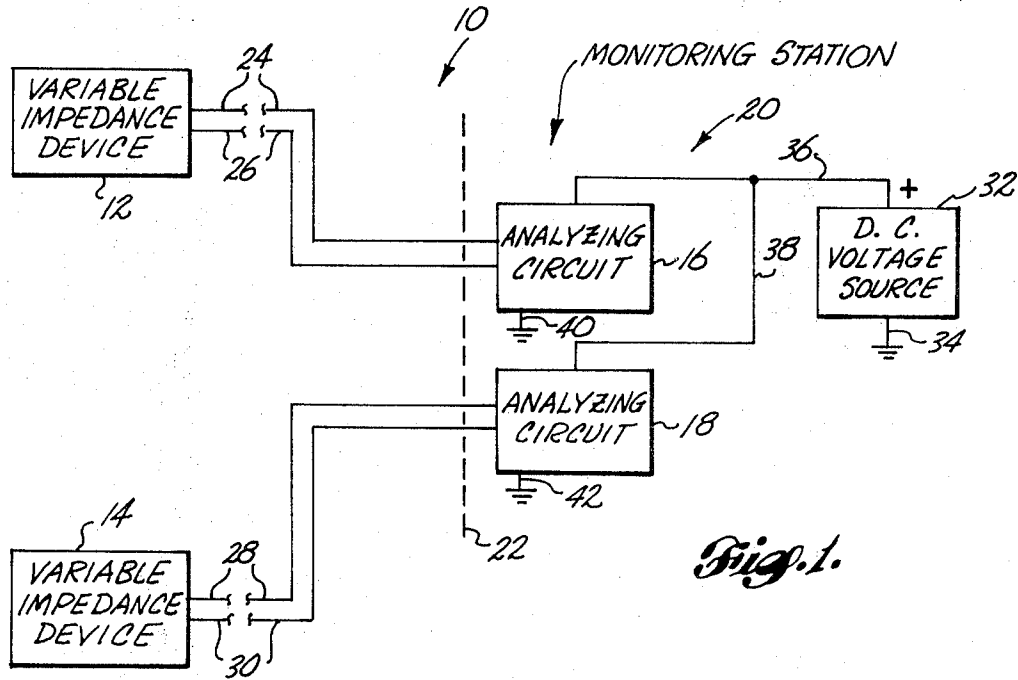
[50] Field of Search..... 340/213,
248 (B,C), 324, 172, 409

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[54] ELECTRICAL SIGNALING SYSTEM INCLUDING
SELECTIVELY VARIABLE IMPEDANCE DEVICE
10 Claims, 3 Drawing Figs.
[52] U.S. Cl..... 340/149
[51] Int. Cl..... G08b 29/00

ABSTRACT: An electrical signaling system including a non-voltage-generating changeable value impedance device which is actuatable to produce at a pair of output terminals different select impedance values, and an analyzing circuit remote from and connected to the device which produces different output signals in response to different impedance values produced at the output terminals of the device. A single DC voltage source located adjacent the analyzing circuit supplies all electrical power required in the system.





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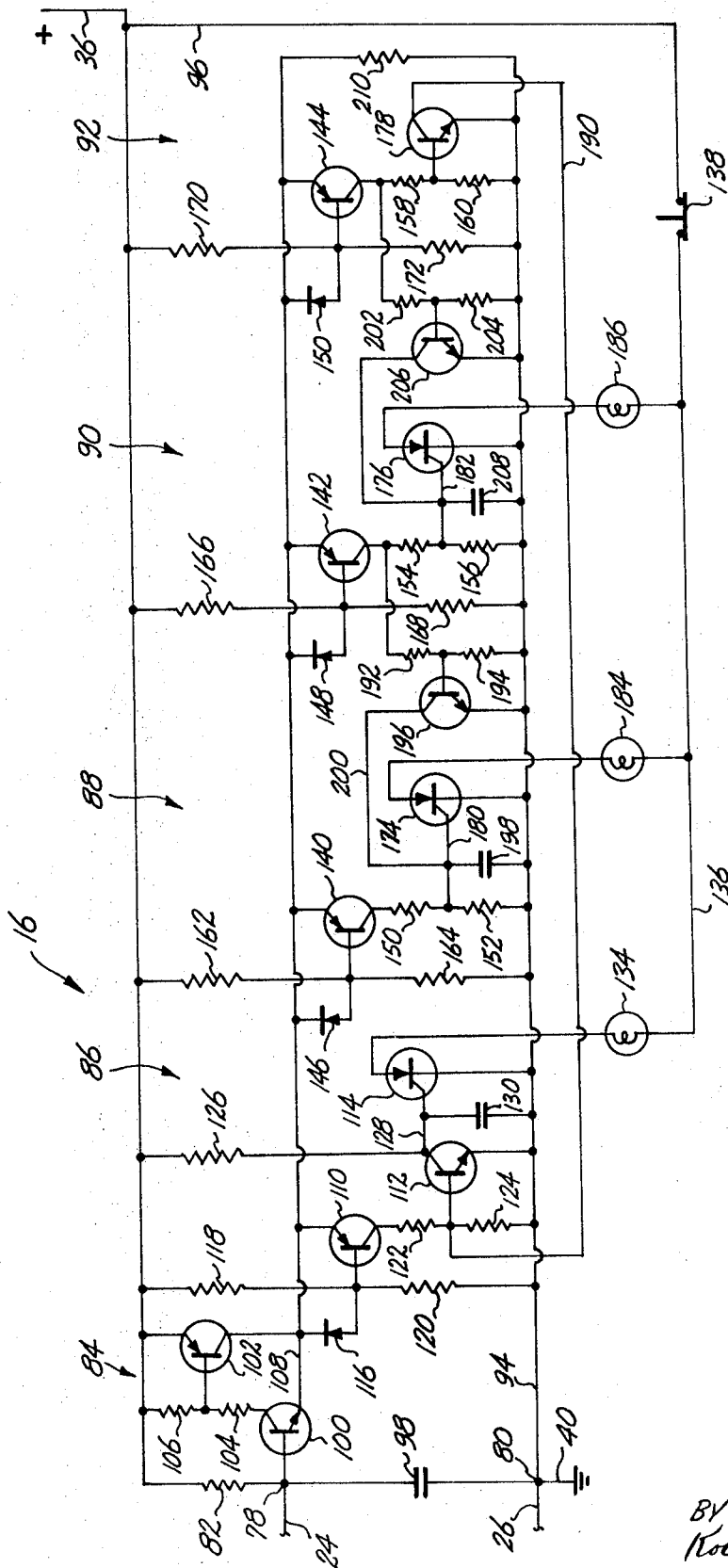


Fig. 3.

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ELECTRICAL SIGNALING SYSTEM INCLUDING SELECTIVELY VARIABLE IMPEDANCE DEVICE

This invention pertains to an electrical signaling system. More particularly, it pertains to such a system wherein signaling takes place through the action of a selectively variable impedance device whose selected impedance values result in different output signals being produced by a remote analyzing circuit connected to the device. For purposes of illustration, and not with any intent to limit other uses of the invention, the same is described in conjunction with the transmission of emergency signals, for example, to indicate the occurrence of a fire or burglary at some location.

In an electrical signaling system, reliability and simplicity are particularly important features. These features are especially critical in a system wherein information is transmitted from a relatively large number of remote locations to a central station for observation. Reliability is important if the system is to be capable of transmitting information accurately, and if it is to require little maintenance and to remain as trouble-free as possible. Simplicity is important since it usually contributes to reliability, and makes for economical construction and installation.

A general object of the present invention, therefore, is to provide a novel electrical signaling system which takes these factors into account in a practical and satisfactory manner.

More specifically, an object of the invention is to provide such a system which offers good reliability and which is relatively simple in construction.

In many prior art signaling systems, signaling takes place through the transmission of electrical energy from one location to another. Such transmission requires considerable electrical power, and usually requires the provision of a separate power source for each transmitting device in the system. Where a large number of transmitting devices are utilized, with each having a separate power source, the likelihood of a power source failure in different parts of the system is relatively high, and thus, reliability may be quite poor.

Accordingly, another object of the invention is to provide a system of the type so far mentioned which enables signaling to occur from multiple remote locations, but which requires only a single power source which may be centrally located and readily accessible.

According to a preferred embodiment of the invention, signaling takes place through a novel variable or changeable valve impedance device which produces at a pair of output terminals different selected impedances reflecting different conditions. As an illustration, the invention may take the form of a building alarm system adapted to monitor certain conditions in the building, and to relay information concerning such conditions to some remote location for observation. For example, the system may be employed to indicate such things as the existence of a fire, the occurrence of a break-in or a burglary, or some other condition in a building. The system is also capable of indicating certain types of internal malfunctions which might occur and which might prevent the system from properly relaying information.

For each event which is to be monitored by the system, the novel proposed impedance device includes a switch which is actuated upon occurrence of the particular event. Actuation of a particular switch always causes a particular specific impedance value to be presented to the output terminals of the impedance device. To distinguish between different events which are monitored, different specific impedance values are associated with the different switches employed.

A novel analyzing circuit, which may be located remote from the device and is connected to the device's output terminals, produces different responses for different impedances. In the illustration just given, such a circuit might be located in a fire or police station, or some other suitable place. Different numbers of associated impedance devices and analyzing circuits may be used in the system, with each impedance device positioned at a different remote location, and all of the analyzing circuits located closely adjacent one another at a single location. Electrical power may be supplied the various com-

ponents in the system from a single DC source which is located closely adjacent and connected to the analyzing circuits employed.

With such a system, a number of important advantages are obtained. One of the chief advantages is that multiple power sources, which tend to increase maintenance problems and to decrease reliability, are not required. This is possible because of the construction of the variable impedance devices. More specifically, these impedance devices relay information, not through transmitting electrical energy, but rather through changing their respective impedance values (in response to particular events or occurrences) to effect a change in the operating conditions of their respective associated analyzing circuits. As a consequence, a separate power source for each impedance device is not needed.

Another advantage is that the proposed impedance devices may be relatively simple in construction whereby little maintenance or periodic on-the-spot inspection is required. This contributes to economical operation, since maintenance and inspection can become quite costly, particularly in a system equipped to relay information from a large number of remote and widely separated locations.

Other objects and advantages are attained by the invention, and such will become more fully apparent as the description which follows is read in conjunction with the accompanying drawings, wherein:

FIG. 1 is a simplified block diagram illustrating a system constructed according to the present invention;

FIG. 2 is a schematic diagram of a variable impedance device employed in the system of FIG. 1; and

FIG. 3 is a schematic diagram of an analyzing circuit employed in the system of FIG. 1.

Turning now to the drawings, and referring first to FIG. 1, indicated generally at 10 is an electrical signaling system constructed according to the invention. The system shown includes variable, or changeable value, impedance devices 12, 14, and analyzing circuits 16, 18 which are remote from, but associated with impedance devices 12, 14, respectively. Devices 12, 14, which are nonvoltage-generating in nature, are remote from each other. Circuits 16, 18, on the other hand, are placed closely adjacent one another in a monitoring station 20 located to the right of dashed line 22. While two variable impedance devices and two analyzing circuits only are shown, it should be understood that more or fewer may be employed.

Impedance device 12 is connected to analyzing circuit 16 through conductors 24, 26, and device 14 is connected to circuit 18 through conductors 28, 30. All electrical power required in the system is supplied by a single DC voltage source 32 located in station 20 closely adjacent circuits 16, 18. The negative voltage side of source 32 is grounded at 34, and the positive voltage side of the source is connected to circuits 16, 18 through conductors 36, 38 as shown. Circuits 16, 18 are provided with ground connections 40, 42, respectively.

The variable impedance devices are similar in construction. Considering device 12, which is shown in detail in FIG. 2, it includes a pair of output terminals 44, 46 connected to previously-mentioned conductors 24, 26, respectively. Terminal 46 is grounded at 47. Interconnecting terminals 44, 46 is a capacitor 48 which serves to remove transient electrical pulses from conductors 24, 26. Also interconnecting the output terminals is a series circuit including a transistor 50, a pair of resistors, or impedance units, 52, 54 and a normally closed switch 56.

Interconnecting the base and emitter of transistor 50 is a capacitor 60 and a conductor 62, and interconnecting the transistor's base and collector are resistors, or impedance units, 64, 68. For reasons which will become apparent later, resistor 52 is selected to have a resistance value which is considerably smaller than that of resistor 68.

The parts so far described in device 12 are preferably mounted within a protective housing indicated generally in dashed outline at 70 to prevent tampering with such parts.

Switch 56 is suitably connected to the housing in such a fashion that the switch opens upon opening of the housing.

Further included in device 12, but preferably located outside of housing 70, are switches 72, 74. Switch 74 has one side connected through a conductor 73 to the junction between resistors 64, 68. The other side of this switch is connected to conductor 62. Switch 72 comprises a conventional normally open fire-sensitive (thermally actuated) switch which closes upon sensing the presence of a fire near it. Switch 74 has one side connected to conductor 62, and its other side connected through a conductor 76 to the junction between resistors 52, 54. In the embodiment illustrated, switch 74 is a normally closed switch of the type which may be placed in a position to be opened upon an intruder breaking into a particular part of a building. It will be noted that switch 74, when closed, short-circuits resistor 52.

Explaining briefly the operation of impedance device 12, with switches 56, 72, 74 in their normal positions, and with a DC voltage applied across terminals 44, 46 in a direction making terminal 44 positive relative to terminal 46, transistor 50 conducts and acts as a short circuit between terminal 44 and conductor 62. With device 12 in this state, which is the normal state of the device, the impedance value presented to terminals 44, 46 is substantially the resistance value of resistor 54. Typically, this might be about 15,000 ohms.

Independent actuation of switches 56, 72, 74 results in different selected impedance values being presented to the output terminals. More specifically, when switch 74 opens, this removes the previously-mentioned short circuit across resistor 52, whereupon the impedance value presented to terminals 44, 46 includes the sum of the resistance values of resistors 52, 54. This sum might be about 37,000 ohms. When switch 72 closes, transistor 50 stops conducting and removes the short circuit mentioned earlier between terminal 44 and conductor 62. As a consequence, the impedance value then presented to the output terminals of the device includes the sum of the resistance values of resistors 54, 68. This sum might be about 97,000 ohms. Finally, when switch 56 opens (as a result of opening of housing 70), a nearly infinite impedance is presented to terminals 44, 46.

Considering now the construction of analyzing circuit 16 (the two circuits being substantially the same), this circuit is illustrated in FIG. 3. Circuit 16 includes a pair of input terminals 78, 80, a resistor, or impedance, 82, an isolating circuit indicated at 84, and four voltage sensors indicated generally at 86, 88, 90, 92. Terminal 80 is connected to ground through previously-mentioned ground connection 40, and to a ground conductor 94. Positive DC voltage is supplied the circuit through conductor 36 and a conductor 96 which is connected to conductor 36.

Input terminals 78, 80 are connected to output terminals 44, 46, respectively, of impedance device 12 through conductors 24, 26, respectively. Thus, the impedance value presented by device 12 at terminals 44, 46, plus the relatively small impedance values of conductors 24, 26, are presented across terminals 78, 80. The input terminals, additionally, are interconnected by a capacitor 98 which performs substantially the same function as capacitor 48 in device 12. Resistor 82 connects terminal 78 and conductor 36. As a consequence, resistor 82 and impedance device 12 together form a voltage divider that determines the portion of the DC voltage appearing between conductor 36 and ground which is applied across input terminals 78, 80. The greater the impedance value presented to terminals 44, 46 in device 12, the greater the portion of voltage between conductor 36 and ground which is applied to input terminals 78, 80, and vice versa. With device 12 capable of producing at terminals 44, 46 selected impedance values such as the ones suggested above, resistor 82 might typically be selected to have a resistance value of about 47,000 ohms.

Circuit 84 includes a pair of transistors 100, 102. The base of transistor 100 is connected to terminal 78, and the collector of the transistor is connected to conductor 36 through re-

sistors 104, 106. The emitter of transistor 100 is connected to a line 108. Transistor 102 has its emitter connected to conductor 36, its base connected to the junction between resistors 104, 106, and its collector connected to line 108. Circuit 84 functions to prevent the remaining components in circuit 16 from affecting the voltage appearing at any given time across terminals 78, 80. In addition, circuit 84 ensures that the voltage between line 108 and conductor 94 is at all times substantially the same as the DC voltage present across the input terminals.

Voltage sensor 86 includes a pair of transistors, 110, 112, and a silicon-controlled rectifier, or signal output device, 114. The emitter of transistor 110 is connected directly to line 108, and the base of the transistor is connected to the line through a diode 116. The base is biased by a pair of resistors 118, 120 which form a voltage divider between conductors 36, 94. Resistors 118, 120 together constitute a reference voltage producer for sensor 86. The collector of transistor 110 is connected through resistors 122, 124 to conductor 94.

Transistor 112 has its emitter connected to conductor 94 and its base connected to the junction between resistors 122, 124. The collector of transistor 112 is connected through a resistor 126 to conductor 36. In addition, the collector is connected through a conductor 128 to the cathode gate of rectifier 114, and through conductor 128 and a capacitor 130 to conductor 94.

The cathode of rectifier 114 is connected to conductor 94, and the anode is connected through a lamp 134, a conductor 136, and a normally closed switch 138 to conductor 96.

Voltage sensors 88, 90, 92 are similar in some respects to voltage sensor 86. Thus, sensors 88, 90, 92 include transistors 140, 142, 144, respectively, which correspond to transistor 110. The emitters of transistors 140, 142, 144 are each connected to line 108, and the bases of the transistors are connected to the line through diodes 146, 148, 150, respectively. The collectors of these transistors are connected to line 94 through pairs of resistors with resistors 150, 152 provided for the collector of transistor 140, resistors 154, 156 provided for the collector of transistor 142, and resistors 158, 160 provided for the collector of transistor 144.

Forming a reference voltage producer for sensor 88 are resistors 162, 164. Resistor 162 connects the base of the transistor to conductor 36, and resistor 164 connects the base to conductor 94. Resistors 166, 168 form a reference voltage producer for sensor 90, with resistor 166 connecting the base of transistor 142 to conductor 36 and resistor 168 connecting the base of the transistor to conductor 94. Resistors 170, 172 form a reference voltage producer for sensor 92, with resistor 170 connecting the base of transistor 144 to conductor 36, and resistor 172 connecting the base to conductor 94.

The various reference voltage producers are constructed whereby, with a given voltage existing between conductors 36, 94, different voltages are applied to the different transistor bases. In particular, the base of transistor 144 receives the highest voltage, the base of transistor 142 the next highest, the base of transistor 140 the next highest, and the base of transistor 110 the lowest voltage.

Further describing sensors 88, 90, 92, silicon-controlled rectifiers 174, 176 constitute signal output devices in sensors 88, 90, respectively, and a transistor 178 constitutes a signal output device in sensor 92. Rectifier 174 has its cathode gate connected through a conductor 180 to the junction of resistors 150, 152, and its cathode connected to conductor 94. The anode of rectifier 174 is connected through a lamp 184 to conductor 136. Rectifier 176 is connected in a similar fashion in sensor 90, with its cathode gate connected through a conductor 182 to the junction between resistors 154, 156, its cathode connected directly to conductor 94, and its anode connected through a lamp 186 to conductor 136. Transistor 178 has its base connected to the junction between resistors 158, 160, and its emitter connected to conductor 94. The transistor's collector is connected through a conductor 190 to the junction between resistors 122, 124 in sensor 86.

Interposed between sensors 88, 90 is an interlock circuit, or interlock means, including a pair of resistors 192, 194, a transistor 196 and a capacitor 198. Resistors 192, 194 are connected in series between the collector of transistor 142 and conductor 94. Transistor 196, which constitutes a switching means, has its base connected to the junction between resistors 192, 194, and its emitter connected to conductor 94. The collector of transistor 196 is connected through a conductor 200 to conductor 180. Capacitor 198, also referred to as delay means, is connected in parallel with resistor 152.

A similar interlock circuit is provided between sensors 90, 92, with such circuit including a pair of resistors 202, 204 corresponding to resistors 192, 194, a transistor 206 corresponding to transistor 196, and a capacitor 208 corresponding to capacitor 198.

Line 108 is connected to conductor 94 through a resistor 210.

Explaining now how device 12 and circuit 16 perform together in the system, let us assume initially that switches 56, 72, 74 occupy their normal positions. With a DC voltage (which typically might have a value of about 22 volts) supplied by source 32 between conductor 36 and ground, a sufficient portion of this voltage is supplied device 12 through conductors 24, 26 to cause transistor 50 to conduct. As a result, the impedance value presented to terminals 44, 46 is the resistance value of resistor 54. With such the case, a voltage is applied across terminals 78, 80, the value of which is determined by the resistance values of resistors 54, 82 and conductors 24, 26. Typically, this voltage might be somewhere in a range of about +4.5 to +8 volts. With resistors 54, 82 having resistance values such as those described earlier, the specific voltage which exists across the input terminals in the range just mentioned will depend upon the lengths of conductors 24, 26. The voltage existing across terminals 78, 80, also exists between line 108 and conductor 94.

Suitable bias voltages are provided the bases of transistors 110, 140, 142, 144 to cause transistor 110 to conduct, and to prevent transistors 140, 142, 144 from conducting, under the conditions just described. Typically, such bias voltages might be about +4.5 volts, +8 volts, +14 volts, +17 volts for the bases of transistors 110, 140, 142, 144, respectively.

With transistor 110 conducting, transistor 112 also conducts and grounds the cathode gate of rectifier 114. Rectifier 114 thus is held in a nonconducting state, and lamp 134 is unlit. With transistors 140, 142, 144 in nonconducting states, rectifiers 174, 176, and transistors 178, 196, 206 are all held in nonconducting states. Also, lamps 184, 186 are unlit.

Should a malfunction occur such as a short circuit across conductors 24, 26, the impedance value presented the input terminals will have a very low value. Such a short circuit might develop, for example, if insulation on conductors 24, 26 were to deteriorate. This will result in the voltage across the input terminals, and hence between line 108 and conductor 94, dropping and causing transistors 110, 112 to stop conducting. For the system described herein, this voltage might be somewhere in the range of about 0 to +4.5 volts. When this occurs, capacitor 130 begins charging through resistor 126. After a short time interval a sufficient voltage exists across the capacitor to switch rectifier 114 to a conducting, or signal-producing state. When rectifier 114 conducts, lamp 134 lights. Rectifier 114 may be returned to a nonconducting state, and lamp 134 turned off, through momentary opening of switch 138.

If instead of a short circuit developing across conductors 24, 26, switch 74 in device 12 opens as the result of a break-in, the impedance value presented the output terminals of device 12, and hence the input terminals of circuit 16, increases. More specifically, and as contemplated by the invention, the new impedance value presented raises the voltage appearing between line 108 and conductor 94 high enough to cause conduction of transistor 140, but not high enough to cause conduction of transistors 142, 144. Such a voltage might typically

be somewhere in the range of about +8 to +14 volts. Transistors 110, 112 continue to conduct.

With transistor 140 conducting, capacitor 198 begins charging through the transistor and resistor 150. After a short time interval, during which rectifier 174 is held in a nonconducting state, a sufficient voltage exists across the capacitor to switch rectifier 174 to a conducting, or signal-producing, state. With rectifier 174 conducting, lamp 184 lights. The rectifier may be returned to a nonconducting state, and lamp 184 turned off, through momentary opening of switch 138.

Considering what happens when switch 72 in device 12 closes in response to a fire, it will be recalled that this causes an even larger impedance value to be presented to output terminals 44, 46 than is presented on opening of switch 74. As a consequence, the voltage appearing between line 108 and conductor 94 becomes large enough to cause both transistors 140, 142 to conduct. Such a voltage might be in the range of about +14 to +17 volts. Transistors 110, 112 continue to conduct.

Conduction of transistor 142 causes transistor 196 also to conduct, whereupon transistor 196 grounds the cathode gate of rectifier 174. This action prevents rectifier 174 from conducting, and occurs before there is a sufficient voltage across capacitor 198 to switch the rectifier to a conducting state. Thus, transistor 196 and capacitor 198 prevent sensor 88 from producing an output signal when the voltage on line 108 is high enough to cause conduction in transistor 142.

As a further consequence of transistor 142 conducting, capacitor 208 charges through the transistor and resistor 154, and after a short time interval, has a sufficient voltage across it to switch rectifier 176 to a conducting, or signal-producing, state. On conduction of rectifier 176, lamp 186 lights. To return rectifier 176 to a nonconducting state, and to turn off lamp 186, switch 138 may be momentarily opened.

In the event that switch 56 in device 12 opens, or that one or both of conductors 24, 26 become broken, a nearly infinite impedance is presented to input terminals 78, 80. As a consequence, the voltage between such terminals, and between line 108 and conductor 94, becomes high enough to cause transistor 144, as well as transistors 140, 142 to conduct. Under these circumstances, the voltage between line 108 and conductor 94 might be somewhere in the range of about +17 to +22 volts. Transistors 110, 112 also conduct. As just explained, conduction in transistor 142 presents sensor 88 from producing an output signal. In a similar fashion, conduction in transistor 144 prevents sensor 90 from producing an output signal.

More specifically, on conduction of transistor 144, transistor 206 conducts whereupon the gate of rectifier 176 becomes grounded. This occurs before the voltage across capacitor 208 becomes large enough to switch rectifier 176 to a conducting state. As a consequence, the rectifier is held in a nonconducting state. Transistor 178 is switched to a conducting, or signal-producing, state whereupon it grounds the base of transistor 112. When this occurs, capacitor 130 charges, and after a short time interval supplies a sufficient voltage to the gate of rectifier 114 to cause it to conduct. Lamp 134 thereupon lights. As was previously mentioned, switch 138 may be opened momentarily to turn off lamp 134 and to return rectifier 114 to a nonconducting state.

It will be apparent, therefore, that the proposed system offers a number of important advantages. To begin with, signaling takes place through the action of a selectively variable impedance device which may be placed at a location remote from its associated analyzing circuit. With such an organization, power for operating the system may be supplied from a source located adjacent the analyzing circuit. In other words, a remote power source is not required for the variable impedance device. While this is an important advantage even in the case of a system employing a single impedance device and analyzing circuit, it is particularly important where multiple associated impedance devices and analyzing circuits are used. The requirement for only a single power source greatly

enhances the reliability of the system, and substantially reduces maintenance problems.

A further advantage obtained through the use of a variable impedance device to produce signaling is simplicity. And it will be appreciated that a variable impedance device may readily be constructed to accommodate a greater or lesser number of selected impedance values than the number illustrated herein. Further, an impedance device may be constructed to incorporate different combinations of normally open and normally closed switches to select the various impedance values which are to be applied to the output terminals.

The novel analyzing circuit offers a practical means for responding to the different selected impedance values produced by a variable impedance device. Through employing an impedance, such as resistor 82, to form a voltage divider with the circuit's associated impedance device, voltage sensors are readily employed to respond to the different voltage values produced in response to the different selected impedance values of the device. The interlock circuitry therein ensures that only one output signal is produced at a given time. With each voltage sensor sensitive to a voltage within a range, resistance in conductors, such as conductors 24, 26, extending between the analyzing circuit and its associated impedance device, poses no problem.

Another important advantage is that the proposed system is constructed to operate successfully with relatively small currents required to flow in the lines interconnecting an impedance device and its associated analyzing circuit. For example, in the embodiment described herein, such currents would not exceed about one-half milliamperes. As a consequence of such construction, relatively long distance signaling is possible without line impedance appreciably affecting proper performance. As an illustration, a system constructed according to the invention has been used successfully with an impedance device connected to its associated analyzing circuit, through as much as fifty miles of lines.

Another important feature of the system described is that the condition of a transistor in a remote variable impedance device, such as transistor 50 in device 12, can readily be tested from the location of the associated analyzing circuit. Considering how this may be done, and referring to device 12 and circuit 16, the device may be disconnected from the circuit for a short interval (sufficiently long to allow discharge of capacitor 60). The two units may then be reconnected to reapply voltage through conductors 24, 26 to the impedance device. Initially, due to recharging of capacitor 60, transistor 50 will be held in a nonconducting state, and an impedance value substantially the same as that presented on closing of switch 72 will appear across terminals 44, 46. If the transistor is working properly, it will soon begin conducting to reduce the impedance value presented the output terminals. This action may, of course, be observed through noting whether sensor 90 produces an output signal upon reconnecting the circuit and device. If transistor 50 is functioning properly, such a signal should occur, and should be able to be terminated through momentary opening of switch 138.

Thus, periodic on-the-spot checking to determine the working condition of such a transistor is avoided.

While an embodiment of the invention has been described herein, it is appreciated that variations and modifications may become apparent to those skilled in the art and may be made without departing from the spirit of the invention. Accordingly, it is desired to cover all such variations and modifications which come within the scope of the appended claims.

I claim:

1. An electrical signaling system comprising:
 - a nonvoltage-generating changeable value first impedance device including a pair of output terminals and means connected to said terminals actuable to produce different selected impedance values at the terminals, and
 - an analyzing circuit remote from said first impedance device including

a pair of input terminals connected to the output terminals of said first impedance device, circuit means, including a second impedance device, connected in series with said input terminals and adapted to be supplied a DC voltage, said first and second impedance devices, with respect to a DC voltage supplied said circuit means, forming a voltage divider which applies a portion of such voltage across said input terminals, with the size of such portion determined by the relative impedance values of said first and second impedance devices, and

multiple voltage sensors operatively connected to said input terminals, each sensor being sensitive to a voltage within a different range with a given DC voltage supplied said circuit means, and each sensor being constructed to produce an output signal on sensing a voltage within its range,

a change in the impedance value at the output terminals of said first impedance device to one of said selected impedance values changing the voltage appearing across the input terminals of said analyzing circuit to produce a voltage sensed by one of said sensors.

2. The signaling system of claim 1, wherein, for each sensor in said analyzing circuit, there is a reference voltage producer operatively connected to the sensor adapted to produce a reference voltage for the sensor, and each sensor produces an output signal on the voltage appearing across said input terminals having a certain relationship to the reference voltage produced for the sensor.

3. The signaling system of claim 2, wherein each reference voltage producer includes means operatively connecting the producer to said circuit means whereby the value of a reference voltage produced by the producer is related to the value of a DC voltage supplied said circuit means.

4. The signaling system of claim 2, wherein said analyzing circuit further comprises interlock means operatively interconnecting at least two of said multiple sensors operable to prevent one of said two sensors from producing an output signal when the other sensor is producing an output signal.

5. The signaling system of claim 4, wherein said interlock means comprises delay means operatively connected to said one sensor operable to delay the production of an output signal by the sensor for a certain time interval after the appearance across said input terminals of a voltage sufficient to effect the production of such a signal.

6. The signaling system of claim 5, wherein said one sensor includes a signal output device having a signal-producing state in which it is placed to generate an output signal for the sensor, and said interlock means comprises switching means operatively interconnecting said other sensor and said output device operable to prevent said output device from being placed in its said signal-producing state with a voltage existing across said input terminals which is sufficient to effect the production of an output signal by said other sensor.

7. The signaling system of claim 6, wherein said delay means comprises a capacitor.

8. The signaling system of claim 6, wherein said switching means comprises a transistor.

9. The signaling system of claim 1, wherein the means connected to the output terminals of said first impedance device comprises a circuit including an impedance unit interconnecting said output terminals, and normally closed switching means connected across and short circuiting said impedance unit, said switching means being responsive to an environmental condition adjacent the device, and operable to open in response to a change in such condition.

10. An electrical signaling system comprising:

- at least a pair of nonvoltage-generating changeable value impedance devices remote from one another, each device including a pair of output terminals and means connected between said terminals actuable to produce different selected impedance values at the terminals,
- a monitoring station remote from said devices including an analyzing circuit for each device, and a DC voltage source shared by the analyzing circuits,

each analyzing circuit comprising a pair of input terminals connected to the output terminals of its associated impedance device, circuit means including an impedance operatively connected to said source and in series with said input terminals whereby the impedance in the circuit means and the associated impedance device form a voltage divider applying a portion of the voltage of said source across said input terminals, and multiple voltage sensors operatively connected to the input terminals of the analyzing circuit,

each voltage sensor in an analyzing circuit being sensitive to a voltage within a different range with a given DC voltage supplied by said source, and each sensor producing an output signal on sensing a voltage within its range, a change in the impedance value at the output terminals of an analyzing circuit's associated changeable value impedance device changing the voltage appearing across the circuit's input terminals to produce a voltage sensed by one of the sensors in the circuit.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,588,889 Dated June 28, 1971

Inventor(s) Joseph Schulein

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 8, lines 1-4 should read as follows:

-- a pair of input terminals connected to the output terminals of said first impedance device,
circuit means, including a second impedance device, connected in series with said input terminals and adapted to be supplied a DC voltage, -- .

Signed and sealed this 20th day of March 1973.

(SEAL)

Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents