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POLARIZED D.C. SIGNALING SYSTEM AND MEANS FOR SUPERVISING SAME

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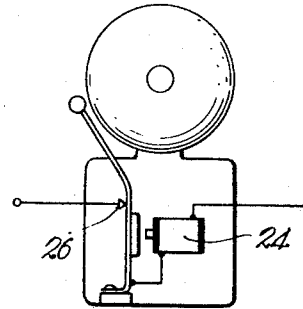
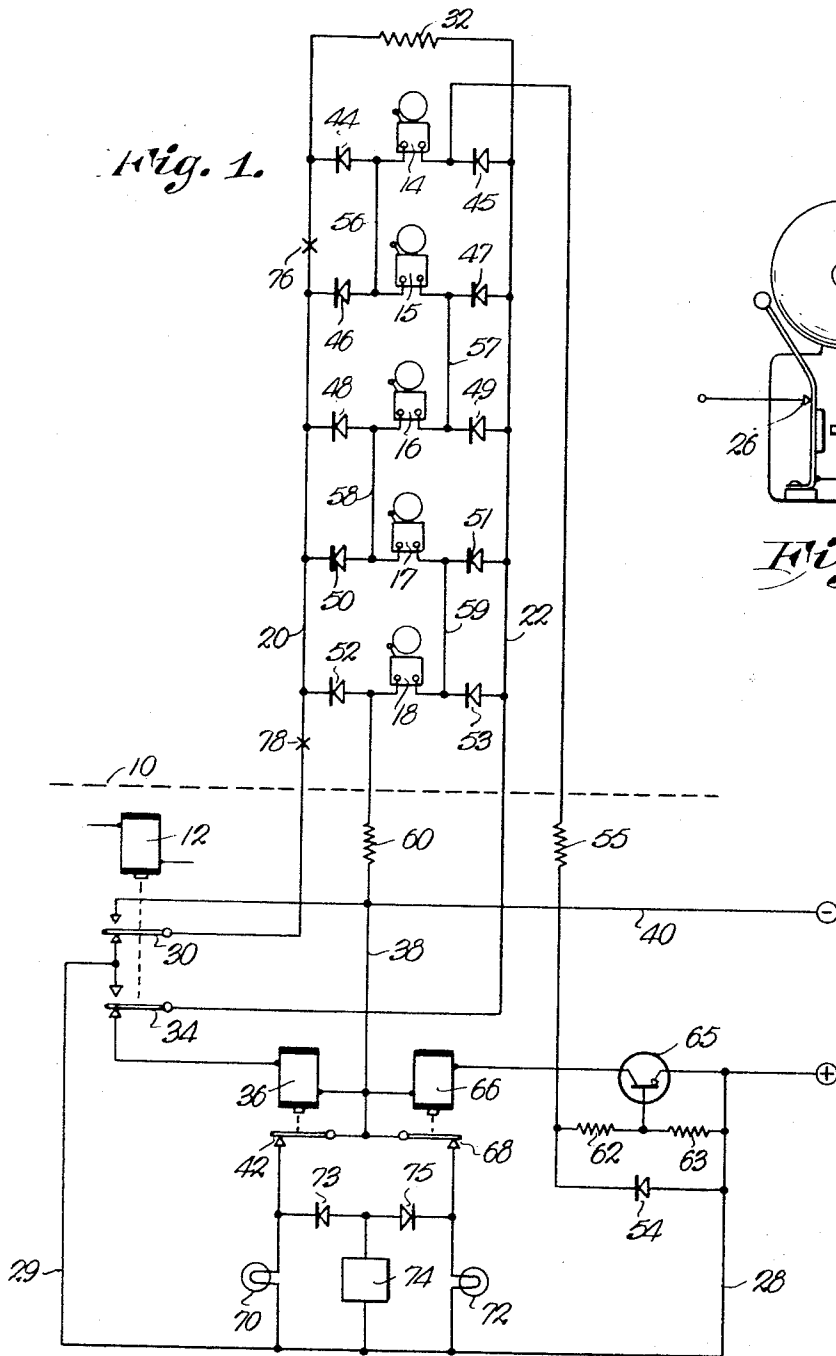


Fig. 4.

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Fig. 2.

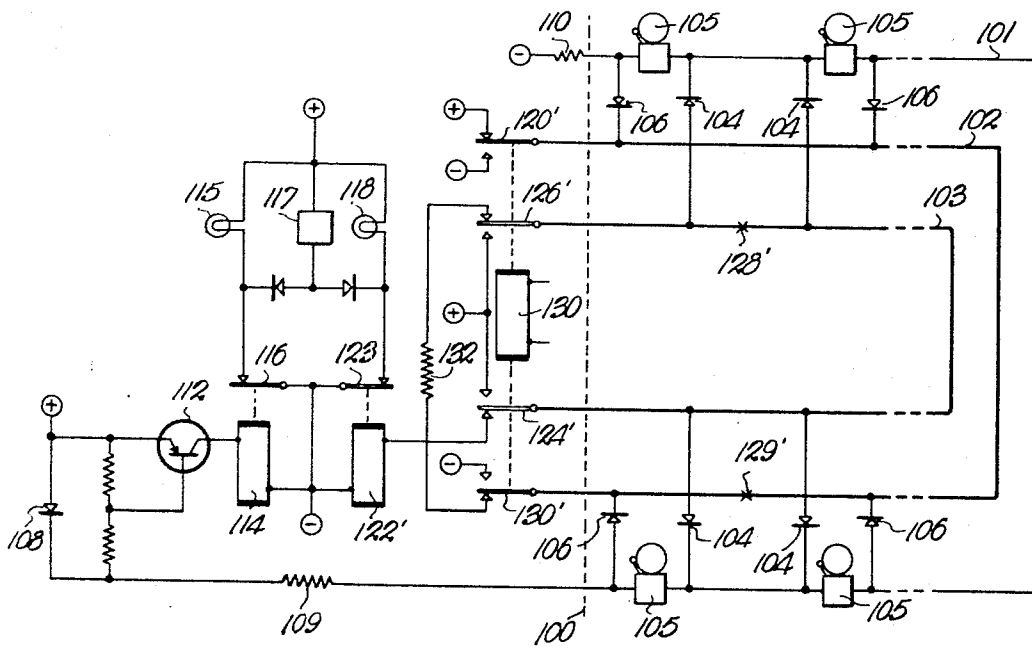
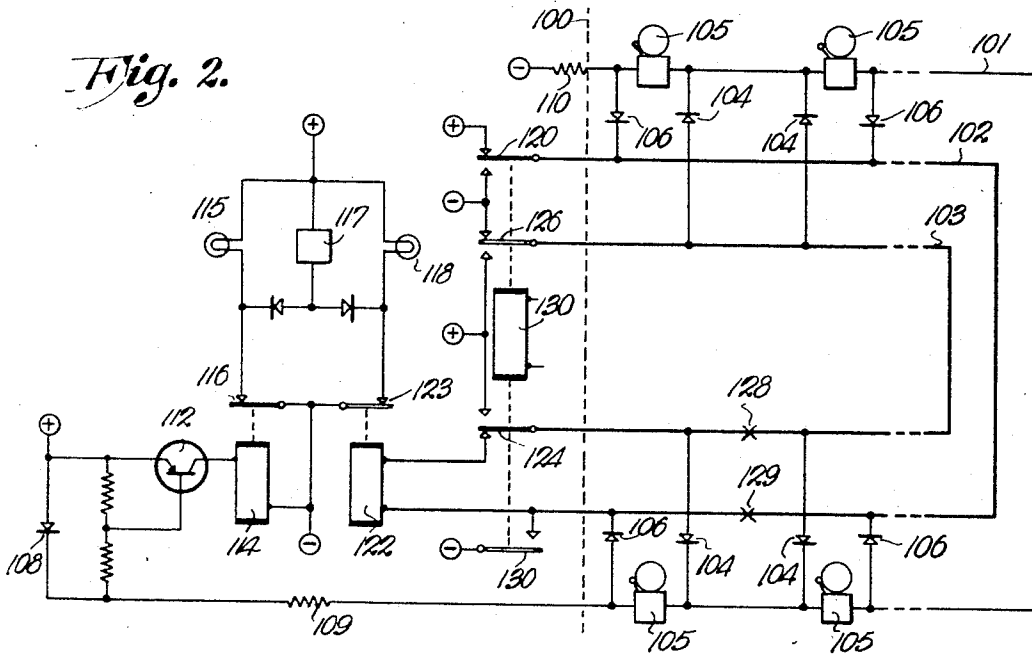


Fig. 3.

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12 Claims

The present invention relates in general to electrical signaling systems, and it deals more particularly with systems of the type in which a plurality of responding devices (for example, electric fire alarm bells installed at scattered locations in or about a given building) are connected in parallel to a common signaling line so that they can be actuated simultaneously over said line from a central control point.

An object of the invention is to provide a system of this character having means for maintaining the entire signalling line under continuous supervision during non-signaling intervals, so that a fault occurring anywhere along the length of the line will automatically be called to attention for prompt corrective action.

Another object is to provide, in such a system, means for continuously supervising the internal circuits of the signal responding devices connected to the signaling line, so that a fault occurring in any one of said devices likewise will be called to attention for correction.

A further object is to provide supervisory means which will distinguish between faults occurring in devices which are connected to a signaling line and faults occurring in the conductors of the line itself, thereby to facilitate locating a difficulty in the event that a fault occurs either in the line conductors or in the devices connected thereto.

Still another object is to provide a fully supervised signaling system in which all devices connected in parallel to the signaling line will be operated by the desired signal even if a fault exists on one or more conductors of the signaling line.

Other objects of the invention, together with the features of novelty whereby the objects are achieved, will appear in the course of the following description.

In the accompanying drawings which form a part of the specification and are to be read in conjunction therewith:

FIGURE 1 is a schematic circuit diagram of a polarized and fully supervised signaling system embodying the invention;

FIGURES 2 and 3 are schematic circuit diagrams showing alternate embodiments of the invention which permit operating the responding devices even if the signaling line is faulty; and

FIGURE 4 is a diagram of a typical responding device which may be employed in these systems.

Referring more particularly to FIGURE 1, the portion below the dotted line 10 conveniently may be, for example, the central station or panel of a fire alarm system having the relay 12 which is adapted to operate under control of means not shown in the event of a fire. This is arranged to actuate a number of responding devices (e.g., alarm bells) 14, 15, 16, 17 and 18 situated at various locations about the protected premises, all of them being connected to the central panel by a single two-conductor signaling line 20, 22, as shown.

The individual responding devices can be bells, buzzers, horns or any other type of device designed for direct current operation. For present purposes it will be assumed that they are conventional self-interrupting bells of the kind illustrated schematically in FIGURE 4. As is well known, such bells have an electromagnet 24 in series

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with a normally closed contact 26 which is arranged to open upon energization of the magnet, whereby the bell operates intermittently throughout the time that direct current is applied to its terminals.

The operation of the signaling system shown in FIGURE 1 is as follows. In stand-by or non-signaling condition (i.e., with relay 12 deenergized), a supervisory circuit is completed which extends from positive battery through conductors 28 and 29, relay contact 30, conductor 20, resistor 32, conductor 22, contact 34, relay winding 36 and conductors 38 and 40 to negative battery. Relay 36 operates over this circuit, opening its contact 42.

Although line conductor 20 now is positive and line conductor 22 is negative relative thereto, bell 14 cannot operate since it is connected to the respective conductors through diodes 44 and 45 which are so poled as to block the flow of current through the bell under this condition. Similarly, bells 15, 16, 17 and 18 are polarized and maintained inoperative by their associated diodes 46, 47; 48, 49; 50, 51; 52 and 53.

In addition to the aforementioned supervisory circuit extending through line conductors 20 and 22, a second supervisory circuit is completed which extends from positive battery through diode 54, resistor 55, bell 14, conductor 56, bell 15, conductor 57, bell 16, conductor 58, bell 17, conductor 59, bell 18, resistor 60 and conductor 40 to negative battery. Resistors 55 and 60 limit the flow of current in this circuit to a value much too low to operate the bells. Also, the value of resistors 55 and 60 is such as to maintain the portion of the supervisory circuit between said resistors at a potential which is below (i.e., more negative) than that of line conductor 20, but above (i.e., more positive) than that of line conductor 22; accordingly, diodes 44 to 53 inclusive effectively isolate the second supervisory circuit from the potential of the line conductors 20 and 22.

So long as current flows in the second supervisory circuit, the voltage divider 62, 63 causes the base of transistor 65 to be biased negatively relative to the emitter, whereby current flows from positive battery through the transistor, relay 66, conductors 38 and 40 to negative battery. Relay 66 energizes over this circuit, opening its contact 68.

Summarizing, then, when the system is in stand-by condition, relay 36 normally is energized over a first supervisory circuit which includes line conductors 20 and 22 in series; and relay 66 normally is energized as a result of current flow in a second supervisory circuit which includes all of the bells 14-18 in series. Accordingly, relay contacts 42 and 68 are open, so that the supervisory lamps 70 and 72 are not lighted and the trouble buzzer 74 is inoperative.

Let it be assumed, however, that at some remote location along the signaling line one or both of the line conductors are broken, causing an open circuit at the point 76, for example. This immediately interrupts the normal current flow through the first supervisory circuit, causing relay 36 to release. The resultant closing of contact 42 completes a circuit from positive battery through conductor 28, lamp 70 (and, in parallel therewith, through buzzer 74 and diode 73), thence through contact 42 and conductors 38 and 40 to negative battery. Therefore, the trouble buzzer 74 sounds and lamp 70 lights to identify the trouble as being in one of the conductors of the signaling line.

(If the open fault is in line conductor 20—for example at the point 76 or at point 78—it may be noted that there is some tendency for current to flow from positive battery through diode 54, resistor 55, bell 14, one or more of the diodes 44, 46, 48, 50 and 52, conductor 20, resistor 32,

conductor 22, contact 34 and the winding of relay 36 back to negative battery; however, resistor 55 limits this current flow to a value too small to maintain relay 36 operated. On the other hand, if the open fault occurs in the line conductor 22, there is some tendency for current to flow from positive battery through conductors 28 and 29, contact 30, line 20, resistor 32, thence through one or more of the diodes 45, 47, 49, 51 and 53 and their associated bells, and resistor 60 back to negative battery; however, resistor 60 limits this current to a value too small to actuate any of the bells. Resistors 55 and 60 also serve to protect the transistor circuit upon operation of relay 12 as will be described hereinafter.)

Now, let it be assumed that an open fault develops internally in one of the alarm bells, for example due to a break in the winding of the electromagnet 24 (FIGURE 4) or due to failure of contact 26 to close because of dust fouling the contact points. The consequent cessation of current flow in the aforementioned second supervisory circuit will remove the negative bias from the base of transistor 65, rendering the transistor nonconductive and causing relay 66 to release. This causes contact 68 to close, completing a circuit from positive battery through conductor 28, lamp 72 (and in parallel therewith, through buzzer 74 and diode 75), thence through contact 68 and conductors 38 and 40 to negative battery. As a result, the trouble buzzer 74 sounds, and lamp 72 lights to identify the trouble as being in one of the alarm bells rather than in the signaling line conductors proper.

Thus, a fault occurring either in the line conductors or in the responding devices connected to them is immediately called to the attention of supervisory personnel for correction, insuring that the system will be in proper working order in the event that an alarm condition arises.

Under an alarm condition, the relay 12 is operated by means not shown. This reverses the polarity of the D.C. potential connected to the conductors of the signaling line. More particularly, a circuit is completed from positive battery through conductors 28 and 29, contact 34, line conductor 22, thence through the paralleled bell circuits bridging said line (the diodes in series with the individual bells now being conductive), conductor 20, contact 30 and conductor 40 to negative battery. Accordingly, all of the bells connected to the signaling line are operated simultaneously to sound the alarm. Although five alarm bells have been shown, it will be understood that this is only exemplary, and that more or fewer bells, or other responding devices, can be connected to the signaling line, as desired.

For practical reasons, I prefer that each alarm bell be connected to the respective conductors of the signaling line through its own pair of diodes as shown in FIGURE 1. However, any or all of the diodes 46, 47, 50 and 51 can be omitted, if desired, without affecting the supervisory operations which have been described and without impairing the operation of the system under alarm conditions. If diodes 46 and 47 are omitted, for example, bell 15 still will be connected to the line conductor 20 and 22 through diodes 44 and 49, so under all conditions will function in exactly the same fashion as already explained.

Turning to FIGURE 2, the portion shown to the left of the dotted line 100 comprises the central station or panel, and the remainder of the circuit is an external loop having a two-conductor signaling line 102, 103, both ends of which terminate at the central panel. As in the arrangement previously described, a number of bridging circuits are connected in parallel across the external portion of the signaling line, each bridging circuit, comprising a diode 104, a responding device 105 and another diode 106 in series. There may be as many of these bridging circuits as desired, and they may, of course, be spaced as far apart along the signaling line as the physical layout of the system requires. The responding devices 105 are connected in series independently of the signaling line to form a supervisory circuit, 75

the external portion of which is generally designated as 101.

The supervisory functions are performed in essentially the same way as explained in connection with FIGURE 1. That is to say, first, current flows from positive battery through diode 108, resistor 109, thence through the series supervisory circuit 101 including all responding devices 105, and through resistor 110 to negative battery. This biases the base of transistor 112 negatively, so that the transistor is conductive; and accordingly relay 114 is energized causing its contact 116 to be held open.

An open fault in any of the responding devices 105 will interrupt this supervisory circuit, thus deenergizing relay 114 which, by closing its contact 116, completes an obvious circuit for lighting lamp 115 and energizing buzzer 117.

A second supervisory circuit is completed over the signaling line proper. This extends from positive battery, through relay contact 120, conductor 102, relay 122, contact 124, conductor 103 and relay contact 126 to negative battery. Relay 122 is energized over this circuit and normally maintains its contact 123 open. However, in the event of an open fault in either or both of the signaling conductors (for example at the points 128 and/or 129) relay 122 will be deenergized, closing its contact 123 and thus completing an obvious circuit for actuating buzzer 117 and lighting the supervisory lamp 118.

The D.C. potential normally applied to the line conductors 102 and 103 via contacts 120 and 126 for supervisory purposes will have no effect on the responding devices 105 due to the polarizing diodes 104 and 106 in series with each of the latter devices. In the event of an open fault in either line conductor, resistors 109 and 110 limit the current flow through these diodes to a value too small to maintain relay 122 operated or to actuate any of the responding devices 105.

Under signaling condition, relay 130 is operated by means not shown. This interrupts the circuit for relay 122 at contact 124, and it also reverses the polarity of the D.C. potential connected to the signal line conductors; more particularly, relay contacts 124 and 126 now connect both ends of conductor 103 to positive battery, while contacts 120 and 130 connect both ends of conductor 102 to negative battery. With the polarity of conductors 102 and 103 thus reverse, diodes 104 and 106 are conductive so that all of the responding devices 105 operate simultaneously in parallel.

Even if there is an open fault in either or both line conductors (for example at 128 and/or 129) this will not interfere with the aforementioned actuation of any of the responding devices 105 inasmuch as those connected to the line in the region between the fault and contacts 124, 130 will be energized via the latter contacts, while the remaining devices 105 will be energized via contacts 120 and 126. Resistor 109 provides protection for the transistor circuit during signaling condition, that is to say, during the period that relay 130 is operated for the purpose of actuating devices 105.

FIGURE 3 shows an alternate circuit arrangement which operates in essentially the same manner as that in FIGURE 2; insofar as the circuits are alike, the parts have been numbered the same. Supervisory relay 114 is normally energized under control of the current flowing through supervisory circuit 101 and the serially connected responding device 105, as previously described, but, in the event of an open fault in any one of these devices, the relay will release causing lamp 115 to light and causing buzzer 117 to sound.

The signaling line proper is supervised independently by means of a circuit which extends from positive battery, through relay contact 120', conductor 102, contact 130', resistor 132, contact 126, conductor 103, contact 124' and relay 122' to negative battery. Relay 122' is energized over this circuit and normally maintains its contact 123 open; in the event of an open fault on either

or both of the signaling conductors 102, 103, however, relay 122' releases and, by closing its contact 123, lights the supervisory lamp 118 and causes buzzer 117 to sound.

The positive potential normally applied to conductor 102 and the negative potential normally applied to conductor 103 for supervisory purposes will have no effect on the responding devices 105 due to the diodes 104 and 106 in series with each responding device. Under signaling conditions, relay 130 is operated by means not shown. This interrupts the circuit for relay 122' at contact 124', while contacts 126' and 130' disconnect the resistor 132 from the line conductors. At the same time, the polarity of the D.C. potential connected to the line conductors is reversed, which causes all of the responding devices 105 to operate in parallel. As in the case of the arrangement shown in FIGURE 2, it will be noted that upon operation of the signaling relay 130 contacts 124' and 126' connect both ends of conductor 103 to positive battery, while contacts 120' and 130' connect both ends of conductor 102 to negative battery. Accordingly, even if there is a break in one or both of the line conductors (for example at 128' and/or 129') all of the responding devices 105 nevertheless will be operated by the reversed potential connected to one end of the signaling line or the other.

From the foregoing it will be seen that my invention is one well adapted to attain all of the ends and objects hereinbefore set forth, together with other advantages which are obvious and which are inherent to the apparatus.

Inasmuch as many possible embodiments of the invention may be made without departing from the scope thereof, it is to be understood that all matters herein set forth or shown in the accompanying drawings are to be interpreted as illustrative and not in a limiting sense.

It should also be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations.

Having thus described my invention, I claim:

1. In a signaling system, a signaling line comprising two conductors, a source of D.C. potential normally connected to said line to maintain one conductor thereof positive and the other conductor negative, a plurality of circuits bridging said line at intervals along its length, each of said bridging circuits comprising, in series, a pair of diodes with a signal responding device intermediate the diodes, said diodes being so poled as to normally prevent the flow of current from said source through said devices, means for at times reversing the polarity of the D.C. potential connected to said line thereby to operate said devices, a supervisory circuit normally energized by direct current from said source and having means for responding to a cessation of the current flow in said supervisory circuit, said supervisory circuit including both conductors of said line in series, means connecting said source and all of said devices in series independently of said line to form a second normally energized supervisory circuit, and means controlled by said second supervisory circuit to operate responsive to a cessation of the current flow in said second supervisory circuit.

2. In a signaling system, a signaling line comprising two conductors, a source of D.C. potential normally connected to said line to maintain one conductor thereof positive and the other conductor negative, a plurality of circuits bridging said line at intervals along its length, each of said bridging circuits comprising, in series, a pair of diodes with a signal responding device intermediate the diodes, said diodes being so poled as to normally prevent the flow of current from said source through said devices, means for at times reversing the polarity of the D.C. potential connected to said line thereby to operate said devices, means connecting said source and all of said devices in series independently of said line to form a normally energized supervisory circuit, and means controlled by said supervisory circuit to operate responsive to a cessation of the current flow in said supervisory circuit.

3. A signaling system as in claim 2, wherein said supervisory circuit includes means normally maintaining all of said responding devices at a potential whose value is intermediate the potential of the line conductors of said signaling line.

4. In a signaling system, a line comprising a pair of conductors, a source of D.C. potential connected in bridge to said line, a plurality of circuits bridging said line at intervals along its length, each of said bridging circuits comprising, in series, a pair of diodes with a signal responding device intermediate the diodes, said diodes being poled to prevent the flow of current from said source through said devices, means for at times reversing the polarity of the D.C. potential connected to said line thereby to operate said devices, means connecting said source and said devices in series independently of said line to form a normally energized supervisory circuit, the value of the current flow in said supervisory circuit being smaller than that required to operate said devices, a supervisory device, and means including a transistor biased in accordance with the current flow in said supervisory circuit for operating said supervisory device responsive to a cessation of the supervisory current flow.

5. In a signaling system, a central station, a signaling loop comprising a two-conductor line having its medial portion outside of said station and both ends of the line at said station, a source of D.C. potential at said station normally connected to said line to maintain one conductor thereof positive and the other conductor negative, a plurality of circuits connected in bridge to said line in the medial portion thereof, each of said circuits comprising a signal responding device in series with at least one diode, said diodes being poled to substantially block current flow through said circuits when said one conductor is positive and said other conductor is negative, a supervisory circuit normally energized by direct current from said source and having means for responding to a cessation of the current flow in said supervisory circuit, said supervisory circuit including both conductors of said line in series, and switching means at said station operative at times to interrupt the normal connection of said D.C. source to said line, said switching means effective at said times to connect both ends of said one conductor to the negative terminal of said source and to connect both ends of said other conductor to the positive terminal of said source, thereby to energize said signal responding devices.

6. In a signaling system, a central station, a signaling loop comprising a two-conductor line having its medial portion outside of said station and both ends of said line at said station, a source of D.C. potential at said station normally connected to said line to maintain one conductor thereof positive and the other conductor negative, a plurality of circuits connected in bridge to said line in the medial portion thereof, each of said circuits comprising, in series, a pair of diodes with a signal responding device intermediate the diodes, said diodes being poled to substantially block current flow through said devices when said one conductor is positive and said other conductor is negative, a supervisory circuit normally energized by direct current from said source and having means for responding to a cessation of the current flow in said supervisory circuit, said supervisory circuit including both conductors of said line in series, means connecting said source and said devices in series independently of said line to form a second normally energized supervisory circuit, means for responding to a cessation of the current flow in said second supervisory circuit, and switching means at said station operative at times to interrupt the normal connection of said D.C. source to said line, said switching means effective at said times to connect both ends of said one conductor to the negative terminal of said source and to connect both ends of said other conductor to the positive terminal of said source thereby to energize said signal responding devices.

7. In a signaling system, a signaling line having two conductors, a plurality of circuits bridging said line, each

of said bridging circuits including a signal responding device, means connecting said devices in series independently of said line to form a first supervisory circuit, means connecting the two conductors of said line in series independently of said devices to form a second supervisory circuit, means for applying a D.C. potential to both supervisory circuits to cause current to flow therein, each supervisory circuit having means operative in the event of cessation of the current flow therein, each bridging circuit including at least one diode poled to prevent operation of that circuit's responding device from the D.C. potential applied to said second supervisory circuit, and means for reversing the polarity of the D.C. potential connected to said second supervisory circuit thereby to operate all of said responding devices simultaneously.

8. A system as in claim 7 wherein each signal responding device comprises an electromagnetic and a contact operated by said electromagnet upon each energization thereof to deenergize said electromagnet.

9. In a signaling system, a signaling line having two conductors; a first supervisory circuit having, in series, one of said conductors, a resistance, and the second of said conductors; a plurality of signal responding devices; a second supervisory circuit having said devices in series therein; means for applying a D.C. potential to both supervisory circuits to cause current to flow therein, the value of the current flow in said second supervisory circuit being smaller than that required to operate said responding devices; each supervisory circuit having current sensing means operative in the event of cessation of the current flow in that circuit; a plurality of circuits bridging said signaling line, each of said bridging circuits comprising, in series, a pair of rectifiers with one of said signal responding devices intermediate the rectifiers, said rectifiers being so poled as normally to be nonconductive with respect to the D.C. potential applied to said first supervisory circuit; and means for reversing the polarity of the D.C. potential

connected to said first supervisory circuit thereby to operate all of said responding devices simultaneously.

10. In a signaling system, a signal line having two conductors, a source of D.C. potential normally connected to said line to maintain one conductor thereof positive and the other conductor negative, a plurality of circuit means bridging said line at intervals along its length, each of said bridging circuits including a signal responding device, said circuit means being so polarized as to be inoperative when said one conductor is positive and said other conductor is negative, means connecting said devices in series independently of said line to form a supervisory circuit, means controlled by said supervisory circuit to operate responsive to any discontinuity in said supervisory circuit, means in each bridging circuit substantially isolating said supervisory circuit from the potential normally applied to said line by said source, and means for at times reversing the polarity of the D.C. potential connected to said line thereby to operate said devices.

11. A signaling system as in claim 10, wherein said isolating means in each bridging circuit comprises a diode.

12. A signaling system as in claim 10 having means connecting the two conductors of said line in series to form a second supervisory circuit, and means controlled by said second supervisory circuit to operate responsive to any discontinuity in that supervisory circuit.

References Cited

UNITED STATES PATENTS

2,355,934	8/1944	Weld	340—292
2,840,802	6/1958	Deir	340—409
3,128,457	4/1964	Culbertson	340—326

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340—176, 292