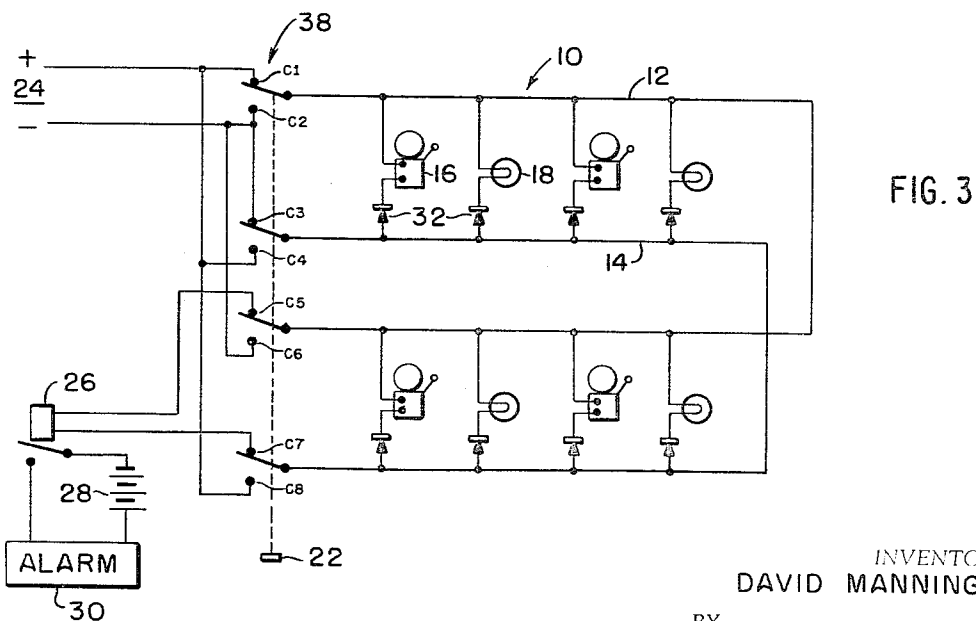
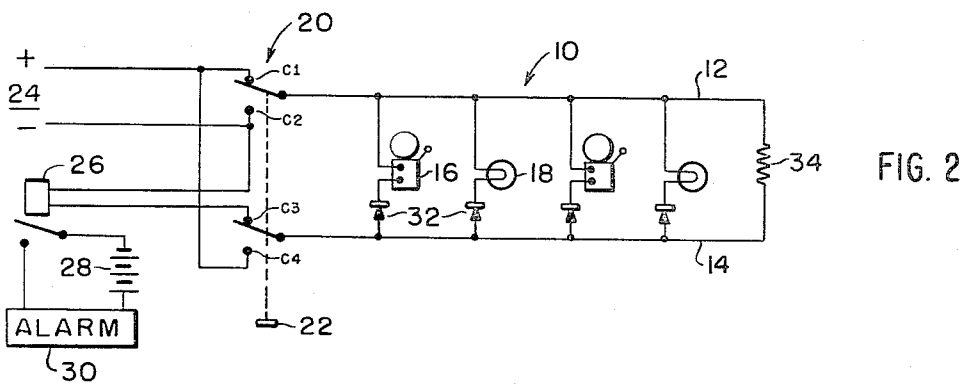
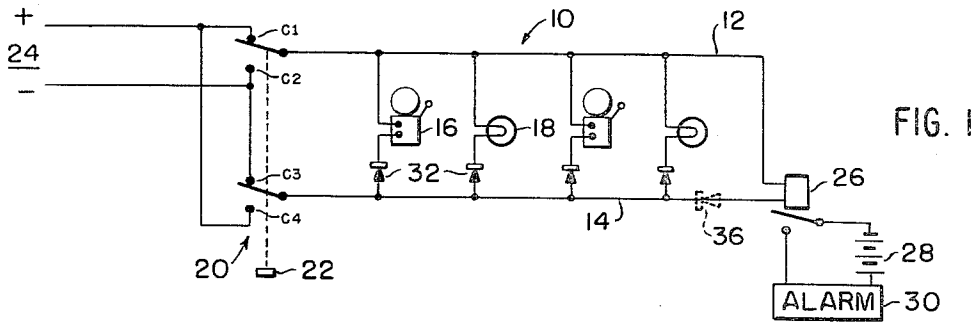


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SUPERVISORY CIRCUIT

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SUPERVISORY CIRCUIT

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2 Claims. (Cl. 340-213)

This invention relates generally to electrical supervisory or monitoring circuits and more particularly to circuits for the supervision of direct current operated emergency devices.

Supervision of various electrical circuits is frequently desired and is particularly necessary for alarm circuits, emergency lighting circuits and the like which, though only infrequently used, must respond instantly when needed, for example upon the actuation of a fire alarm or the failure of standard lighting.

According to the techniques heretofore employed, a plurality of fire alarm bells and fire indicating lamps, for example, are connected in series with a source of direct current. The series connection, normally a loop about the premises to be protected, includes a relay which, when actuated, operates an alarm indicating that the electrical continuity of the emergency circuit has been interrupted and that the several emergency alarm devices are inoperative. The relay is normally maintained in energized condition by a small continuous electrical current having sufficient value to energize the relay without energizing the alarm devices.

Various serious drawbacks are inherent in this type of supervisory circuit. Since the emergency alarm devices are in series connection, addition or removal of one or more devices requires a compensating adjustment elsewhere in the circuit. Yet another disadvantage of such series connections is the disabling of the entire series circuit upon the failure of any one emergency alarm device. For example, an emergency lamp filament may have aged to the point where it will open at the next application of its rated voltage, yet will give no indication of such future failure when the supervisory current is passing through it. Perhaps the most serious disadvantage of a series circuit is its inapplicability to direct current operated devices such as bells and buzzers. These devices operate as vibrators on the make and break principle, and cannot generally be employed in series circuits because of the virtual impossibility of synchronizing the vibrator strokes.

Because of these several serious disadvantages inherent in the use of series circuits for emergency and alarm devices, the employment of parallel circuits would be desirable. Electrical supervision of such parallel circuits has, however, heretofore posed substantial problems since, for example, the continuous current which energizes the fault indicating relay in the series circuit, will follow multiple paths in the parallel circuit. Additionally, the use of a series relay in a parallel circuit provides supervision only to the device nearest the current source.

It is, accordingly, the most important object of this invention to supervise the electrical continuity of a circuit which includes a plurality of current consuming devices connected in parallel with a source of operating potential, and in which the devices are normally in "stand-by," non-operating condition.

It is another object of this invention to supervise the electrical continuity of an emergency alarm circuit including a plurality of direct current operated bells and the like.

In the practice of the invention in a preferred embodiment thereof, a circuit comprising a plurality of emergency devices including direct current operated bells, signal lamps and the like, is established with the emergency devices connected in parallel to a direct current source.

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Switch means are employed to shift the effective polarity of the direct current source, and consequently the direction of current flow within the emergency circuit, from a "stand-by" condition to an "emergency" condition. Polarity sensing means, for example, diodes, are interposed between each emergency device and the source of potential to prevent current flow through the emergency device when the switch means is in "stand-by" position and to allow current to flow through the emergency device when the effective polarity of the source of potential is reversed by movement of the switch means to the "emergency" position. Thus, each emergency device is normally isolated from the electric current passing through the circuit when the switch means is in "stand-by" position. A relay is, however, operatively connected in the parallel circuit when the switch means is in "stand-by" position and is normally energized from the source of potential. Upon a failure of continuity in the wiring of the circuit during "stand-by" operation, the relay is de-energized and completes an independent circuit to operate an alarm device indicating a fault in the emergency circuit.

It is a feature of the invention that individual emergency devices may be added to or removed from the emergency circuit without requiring other compensating changes in the circuit.

It is a further feature of the invention that the electrical continuity of the circuit to the point of attachment of each emergency device is supervised and not the continuity to the first device only.

These and other object and features of the invention will be more readily understood and appreciated from the following detailed description of a preferred and alternative embodiments thereof selected for purposes of illustration and shown in the accompanying drawings, in which:

FIG. 1 is a diagram of an electrical circuit according to a preferred embodiment of the invention;

FIG. 2 is a diagram of an electrical circuit according to an alternative embodiment of the invention; and

FIG. 3 is a diagram of an electrical circuit showing yet another alternative embodiment of the invention.

FIG. 1 shows an emergency circuit, for example, a fire alarm circuit indicated generally at 10. The circuit includes a pair of conductors 12 and 14 between which the emergency devices are connected. The devices may take the form of direct current operated bells 16, lamps 18 or similar devices.

Switching means indicated generally at 20 are employed to connect the emergency circuit 10 to a source of direct current potential (hereinafter described). The switching means 20 may be a manually operated mechanical switch, an electrically operated relay or other electronic switching means. For the purposes of illustration the switching means 20 is shown as a mechanical switch and a switch handle 22 is shown for use in shifting the switch contacts. The switch 20 is a double-pole double-throw switch, one pole thereof being connected to the conductor 12 and the other pole to conductor 14. The switch includes four input contacts C1, C2, C3 and C4.

A source of direct current potential is indicated generally at 24 and has a determinable polarity indicated by plus and minus signs. The positive pole of the source 24 is connected to contacts C1 and C4 of the switch 20 and the negative pole is connected to contacts C2 and C3. With the switch 20 in "stand-by" position as shown in FIG. 1, current is free to flow unidirectionally through the emergency circuit 10. The circuit 10 includes a circuit fault alarm relay 25 connected between the conductors 12 and 14 and hence in series connection with them and with the direct current source 24. The fault alarm relay

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26 is normally energized from the source 24 to maintain its contacts in open condition. The contacts of the relay 26 are connected in series with an independent fault alarm power supply 28 and a fault alarm device 30, for example a horn or bell.

It will thus be noted that an electrical circuit is completed through the alarm relay 26 which will remain open so long as the conductors 12 and 14 are intact, the switch 20 is operative and the direct current source 24 is effective. Upon the failure of any of these, however, the alarm relay 26 will be de-energized causing its contacts to close to complete the circuit between the alarm power supply 28 and the fault alarm 30 to give an immediate indication of system failure.

In order to prevent continuous operation of the emergency bells 16 and lamps 18 when the supervisory current is impressed on the circuit to energize the fault alarm relay 26, polarity sensitive means, for example a diode 32 is connected between each of the emergency devices and the conductor 14 to prevent current from passing through the associated emergency device when the switch 20 is in "stand-by" position, as shown. Each emergency device is consequently isolated from the emergency circuit during "stand-by" operation and is inoperative.

When the appropriate emergency event takes place, the switch means 20 is thrown, reversing the polarity of the direct current flowing through the emergency circuit 10. The diodes 32 associated with the several emergency devices now pass current, and consequently each of the emergency devices is operated. It should, of course, be noted that failure of any one of the emergency devices to operate upon movement of the switch 20 to "emergency" position will not disable the entire emergency circuit 10 since the several devices are connected in parallel with respect to the direct current source 24.

FIG. 2 shows a modification of the circuit of FIG. 1 wherein the fault alarm relay 26 is located at the control center rather than at the remote end of the alarm circuit and is connected in series between contacts C2 and C3 of the switch 20 with the negative side of the direct current source 24 connected to contact C2. Since the conductors 12 and 14 must be joined at the remote end of the alarm circuit during "stand-by" operation to complete the supervisory circuit, a resistor 34 connects the conductors 12 and 14 in place of the fault alarm relay 26 of FIG. 1 to prevent a short circuit disabling the bells 16 and lamps 18 when the switch 20 is in "emergency" position. In the circuit of FIG. 2 the supervisory current in the "stand-by" position of the switch 20 passes through the fault alarm relay 26, the resistance 34 and the conductors 12 and 14. The fault alarm relay operates as before to indicate a system failure.

When the switch 20 is shifted to "emergency" position conductors 12 and 14 are again connected respectively to contacts C2 and C4 thus reversing the effective polarity of the direct current supplied to the circuit and actuating the several emergency devices. With the circuit of FIG. 2, however, the fault alarm relay 26 is continuously de-energized when the switch 20 is in "emergency" position and continuously sounds the fault alarm 30. Continuous de-energizing of the fault alarm relay 26 in the circuit of FIG. 1 during emergency operation may also be accomplished by modifying the circuit of FIG. 1 to include a diode 36 indicated in dotted lines in FIG. 1 and reversed with respect to the diodes 32 to permit current to flow through the fault alarm relay 26 only when the circuit is in "stand-by" condition. The fault alarm 30 will thus also be actuated whenever the circuit of FIG. 1 is switched to "emergency" condition. The choice between the circuit of FIG. 1 and the circuit of FIG. 2 will then depend upon the physical position which is desired for the fault alarm 30, whether at a distant point as in FIG. 1 or at the switch as in FIG. 2.

FIG. 3 shows yet another alternative embodiment of the invention which is a modification of the circuit of

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FIG. 1 and provides an additional safety feature in that the conductors 12 and 14 form a double loop with respect to the direct current source 24 under emergency operating conditions which permits either conductor 12 or 14 to be severed at any one point without thereby influencing the operation of any of the emergency devices.

The switch 20 of FIG. 1 is replaced in the modification of FIG. 3 by a four-pole double-throw switching means indicated generally at 38 provided with input contacts C1 through C8 inclusive. The positive side of the direct current source 24 is connected to contacts C1, C4 and C8 of the switch 38. The negative side of the direct current source 24 is connected to contacts C2, C3 and C6. The fault alarm relay 26 is connected between contacts C3 and C7. It will be noted that the fault alarm relay 26 assumes the same position with respect to the direct current source 24 as it does in FIG. 1 when the switch 38 is in "stand-by" position. Under these conditions current flows from the source 24 through contacts C2 and C3 to the conductor 14, thence by way of contact C7 to the fault alarm relay 26 and through contact C5 to the conductor 12 which is connected at contact C1 to the direct current source 24. As before, the fault alarm relay 26 is energized when the switch 38 is in "stand-by" position as shown. As in FIG. 2, when the switch 38 is thrown to "emergency" position, the effective polarity of the direct current source 24 is reversed and the fault alarm relay 26 is de-energized to actuate the fault alarm 30.

The novel feature of the circuit of FIG. 3 when the switch 38 is in "emergency" position and the effective polarity of the source 24 is reversed is that both ends of the conductor 12 are connected to the negative side of the source 24 and both ends of the conductor 14 are connected to the positive side of the source 24. In this manner it will be seen that either the conductor 12 or the conductor 14 may be severed without in any way affecting the operation of the emergency circuit. If two breaks occur in either conductor only those emergency devices included between the breaks will be disabled.

It will thus be seen that a novel circuit arrangement is disclosed which makes possible the electrical supervision of the circuit conductors to parallel connected devices such as may be employed in fire alarm signals or emergency lighting circuits. Moreover, according to the invention, emergency devices may be added or removed without requiring compensating adjustments elsewhere in the circuit.

With the circuit disclosed it is possible to supervise successfully a number of direct current devices operating on the vibrator principle such as bells or buzzers.

It will further be observed that in one embodiment of the invention a dual loop circuit of parallel connected devices may be supervised employing the polarity reversal technique.

Many other modifications and uses of the technique disclosed and illustrated will be apparent to those skilled in the art, and it is my intention to claim all changes and modifications thereof as fall within the spirit and scope of the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In an alarm system including a plurality of signaling devices, a control circuit including a source of direct current, a pair of conductors connecting said source to said devices in parallel array, switch means, a relay connected in series with said conductors, said switch means and said source, said switch means being interposed between said source and said conductors and operable to reverse the polarity of the connection therebetween and to reverse the flow of current in said conductors from a first to a second direction, a polarity sensing device interposed in series with each said signaling device to pass current to each said device only when said current flows in said second direction and normally to prevent the flow of current to each said device when said current flows in

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said first direction, said relay being energized only when said current flows in said first direction and deenergized when said current flows in said second direction, and means responsive to deenergization of said relay for actuating an alarm.

2. In apparatus as defined in claim 1 the combination in which said switch means includes a plurality of contacts connected to said pair of conductors, operation of said switch means to reverse the polarity of the connection therebetween and to reverse the flow of current from a first to a second direction causing both ends of each said conductor of said pair to be connected to the same side of said source.

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