United States Patent

Zinn

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[54] DEVICE FOR CONNECTING A SUBSTITUTE CURRENT PATH IN CASE OF LINE BREAK

[72] Inventor: **Leon Zinn**, Syossit, N.Y.

[73] Assignees: **Milton Bocin**, Teaneck, N.J.; **AFA Protective Systems, Inc.**, New York, N.Y.

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[51] **Int. Cl.** **H02j 3/00,** G08b 25/00

[58] **Field of Search** 307/43, 51, 85, 86; 340/292; 317/26

[56] **References Cited**

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Primary Examiner—William M. Shoop, Jr.

Assistant Examiner—Harvey Fendelman

Attorney—Blum, Moscovitz, Friedman & Kaplan

[57] **ABSTRACT**

A system for providing a path between two series-connected devices should the line therebetween break including a bypass switch means for interconnecting the output of a first of said devices to the input of a second of said devices through ground upon such a break. The system is particularly adapted for application to central station alarm systems.

11 Claims, 3 Drawing Figures

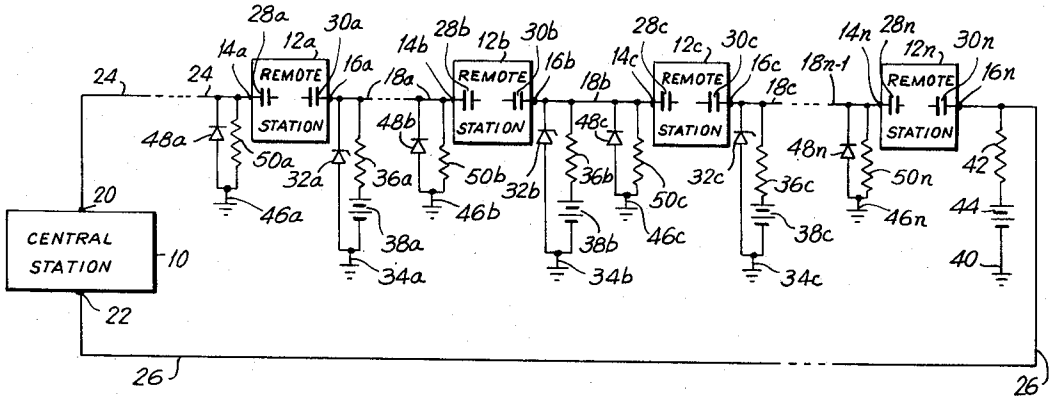


FIG. 1

FIG. 2

FIG. 3

INVENTORS
LEON ZINN
MILTON BOCIN
BY
Blum, Moscovitz, Friedman & Kaplan
ATTORNEYS

DEVICE FOR CONNECTING A SUBSTITUTE CURRENT PATH IN CASE OF LINE BREAK

BACKGROUND OF THE DISCLOSURE

This invention relates generally to systems including series-connected devices and more particularly to central station alarm systems wherein a plurality of widely spaced remote stations are connected in series with each other and with a central station for the transmission along the series-connection of state information with regard to alarm devices at each remote station to the central station. A break in the line interconnecting the remote stations can result in the disabling of the entire system in the absence of some form of protective device. Where the central station system is utilized to provide fire and/or theft protection, this result cannot be tolerated.

In the art, the most widely utilized protective system for such series-connected central station systems is the McCulloh system. This system, disclosed in U.S. Pat. No. 253,080 issued Jan. 31, 1882 to Chauncey F. McCulloh, requires the provision in each remote station of a normally open connection to ground which is closed upon a break in the line. The central station is also provided with a normally open connection to ground which is also closed upon a break in the line. By this arrangement, a DC path is provided between the central station and the remote stations on either side of the break so that in effect, two separate series connected circuits are produced, one located on either side of the broken line. However, in the case of a break in a second segment of the line, all of the remote stations intermediate the two breaks would be disabled until at least one of the breaks is corrected since the McCulloh system requires at least one metallic wire connection to one end of the series-connected remote stations. As the central alarm systems increase in size and complexity, with large numbers of series-connected remote stations in each system, the likelihood of a break in two spaced line segments becomes greater.

Further, in the art, the central station alarm systems generally rely on a specially installed cable for the provision of the series-connection. Consideration is now being given to the use of already existing telephone lines as the transmission line for central station alarm systems and the use of AC signals for communication between the remote and central stations, rather than the DC systems of the McCulloh arrangement. By providing bypass switch means for interconnecting the output of a first of a pair of series-connected devices and the input of a second of said pair of series-connected devices through ground upon a break in the line interconnecting said pair of devices, substantial advantages have resulted.

SUMMARY OF THE INVENTION

Generally speaking, in accordance with the invention, a system having at least first and second series-connected devices, each of said devices having first and second terminals and a line connecting the second terminal of a first of said devices with the first terminal of the second of said devices, is improved by providing bypass switch means for interconnecting the second terminal of said first device to the first terminal of said second device through ground upon a break in said line.

The bypass switch means preferably includes DC circuit means for defining a DC circuit including the line, the second terminal of said first device, a ground path, and the first terminal of said second device; and first and second switch means for providing an AC path between said first device second terminal and ground, and between said second device first terminal and ground respectively, when said DC circuit is open by a break in the line, whereby an AC path is provided between the first device second terminal and the second device first terminal when the line is broken.

The DC circuit means preferably includes a source of DC potential and a voltage divider circuit having first and second portions. The source of DC potential and a first of the voltage divider portions are connected across the first switch means

which may be in the form of a zener diode having a cathode connected to the first device second terminal and an anode connected to ground or a first relay coil means and a first normally open contact operable by said first relay coil means connected in parallel between said first device second terminal and ground. Said first switch means is adapted to provide an AC path when the voltage across the DC source of potential and the first voltage divider portion rises above a predetermined level.

The second voltage divider portion is preferably connected between the second device first terminal and ground and may include a diode having its cathode connected to the second device first terminal and its anode connected to ground or a second relay coil means and a second normally open contact means operable by said second relay coil means and connected in parallel with said second voltage divider portion between the second device first terminal and ground. The series-connected device are AC coupled to the line. The foregoing arrangement may be incorporated in a signaling system having a central station, a plurality of remote stations and a transmission line connecting said central station and said plurality of remote stations in series-connection for the transmission of signals to said central station, by provision of said bypass switch means intermediate each adjacent pair of remote stations in said series-connection.

Accordingly, it is an object of this invention to provide a system for providing an alternate path for signals between two series-connected devices upon a break in the line therebetween.

Another object of the invention is to provide a central station alarm system which remains fully operable despite one or more breaks in the lines connecting the remote stations in series to the central station.

A further object of the invention is to provide a system for bypassing a break in a line between two series-connected, AC coupled devices by providing an AC path through ground between said devices.

Still other objects and advantages of the invention will in part be obvious and will in part be apparent from the specification.

The invention accordingly comprises the features of construction, combinations of elements, and arrangement of parts which will be exemplified in the constructions hereinafter set forth, and the scope of the invention will be indicated in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

For a fuller understanding of the invention, reference is had to the following description taken in connection with the accompanying drawings, in which:

FIG. 1 is a schematic representation and circuit diagram of the line fault protection system for series-connected devices according to the invention;

FIG. 2 is a schematic and circuit diagram of the terminal circuitry of a central station according to the invention; and

FIG. 3 is a circuit diagram of an alternate construction of the bypass switch means of the system according to the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIG. 1, the central station signaling system shown schematically therein consists of a central station **10** and a plurality of remote stations **12***a*, *b*, *c*, ...,*n*. Each remote station is provided with a first terminal **14***a*, *b*, *c*, ..., *n* and a second terminal *a*, *b*, *c*, ..., *n*.

Remote stations **12** are connected between their terminals **14** and **16** by transmission line segments **18***a*, *b*, *c*, ..., *n*−1. The length of the various transmission line segments **18** varies considerably, since remote stations **12** can be positioned in scattered locations throughout an area or within the same building. Central station **10** has a first terminal **20** and a second terminal **22**. Said central station first terminal is connected to

first terminal 14*a* of remote station 12*a* by transmission line segment 24 while central station second terminal 22 is connected to the second terminal 16*n* of remote station 12*n* by means of transmission line segment 26.

The signaling system depicted is adapted to transmit information from each of the remote stations 12, through transmission lines segments 24, 18 and 26 to central station 10. The signaling system may be a central system alarm system, in which case each of the remote stations 12 will include one or more automatically or manually operable monitoring devices such as relays, switches, gating circuits, or switching circuits disposable in a plurality of states each representative of a particular condition, the existence of which is to be transmitted to the central station. The central station 10 would include displays for providing both visual and audible indicators of the received state information, as well as printing and other storage devices for such information. Transmission line 24, 18 and 26 may be a special cable or existing telephone lines. Each of the central and remote stations are preferably AC coupled to the line for use in modern telephone systems wherein the signal transmitted is an AC signal. Thus, as shown in FIG. 1, each remote station 12 is coupled with its first terminal 14 by a capacitor 28*a*, *b*, *c*, ..., *n*, and is coupled to its second terminal 16 by a second capacitor 30*a*, *b*, *c*, ..., *n*.

It is apparent from an examination of the system of FIG. 1, that a break in any transmission line segment will disable the system. In order to avoid the effects of a break in a line, which is quite common in such systems, a line fault protection system has been incorporated into the system of FIG. 1. This line fault protection system includes zener diodes 32*a*, *b*, *c*, ..., *n*−1, connected respectively between the second terminal 16*a*, *b*, *c*, ..., *n*−1 of remote stations 12*a*, *b*, *c*, ..., *n*−1 and ground 34*a*, *b*, *c*, ..., *n*−1. Said zener diodes are each connected with their respective cathodes connected to the corresponding remote station second terminal 16.

Connected in parallel between each of said ground 34*a*, *b*, *c*, ..., *n*−1 and the corresponding second terminal 16*a*, *b*, *c*, ..., *n*−1 of remote station 12*a*, *b*, *c*, ..., *n*−1 are a series connection of resistor 36*a*, *b*, *c*, ..., *n*−1 and source of DC potential 38*a*, *b*, *c*, ..., *n*−1. Each of said sources of DC potential are connected with their respective negative terminals connected to the corresponding ground 34. The second terminal 16*n* of the last remote station 12*n* is connected to ground 40 by a series connection of resistor 42 and source of DC potential 44. The negative terminal of source of DC potential 44 is connected to ground 40.

Connected in parallel between each first terminal 14*a*, *b*, *c*, ..., *n* of remote stations 12*a*, *b*, *c*, ..., *n*, respectively, and a ground 46*a*, *b*, *c*, ..., *n* are diode 48*a*, *b*, *c*, ..., *n* and resistor 50*a*, *b*, *c*, ..., *n*. The diodes 48, which may be of the germanium type, are each connected by their respective cathodes to said remote station first terminals 14.

Referring now by way of example to the line segment 18*a* between remote stations 12*a* and *b*, a DC circuit is defined between source of DC potential 38*a*, resistor 36*a*, line 18*a*, resistor 46*b* and a ground path between ground 46*b* and 34*a*. This ground path is usually an earth ground path. Resistors 36*a* and 50*b* serve as a voltage divider, dividing the voltage produced by source of DC potential 38*a* between them. When line segment 18*a* is unbroken, the voltage across zener diode 32*a* is of a value sufficient to place said zener diode in a non-conducting state. Further, the voltage across resistor 50*b*, which defines a portion of a voltage divider, back biases diode 46*b* so that said diode presents a high resistance to ground. Under such circumstances, the AC signal will pass from remote station 12*a* along line 18*a* to remote station 12*b*. The high impedance presented by zener 32*a*, resistors 36*a* and 50*b* and diode 48*b* effectively prevents the AC signal from passing to ground.

However, should line 18*a* open, the voltage across zener diode 32*a* would increase above the threshold voltage of said zener diode so that said zener diode would fire to present a low impedance between second terminal 16*a* of remote station 12*a* and ground 34*a*. Similarly, diode 48*b* would have no voltage across it and would provide a relatively low impedance to ground, providing a conductive path from ground terminal 46*b* to first terminal 28*b* of remote station 12*b*. Thus, in the event of a break in line segment 18*a*, an AC path is provided from remote station second terminal 16*a*, through zener diode 32*a*, along a ground path between grounds 34*a* and 46*b*, through diode 46*b* to remote station first terminal 14*b*. In this manner, the broken line is bypassed and the continuity of the central station is maintained. In like manner, if any of the line segments 18*a*, *b*, *c*, ..., *m*−1 break, the corresponding bypass switch means including zener diodes 32, resistor 36 and 50, source of DC potential 38, and diode 48*b*, would provide a bypass path including a ground path 40 AC signal. The fact that more than one of the line segments is broken does not effect the operation of the system. The same bypass effect will also occur if a line segment 18 is grounded.

Reference is had to FIG. 2, which shows a portion of the internal circuitry of central station 10 in order to explain the arrangement according to the invention for operating the system in the event line segments 24 or 26 are broken. As in the case of the remote stations, central station 10 is AC coupled to line segment 24 through a capacitor 52 and to line segment 26 through a capacitor 54. Output terminals 20 and 22 are shunted by a resistor 56. A normally open switch 58 is connected between internal line 60 and a ground 62, said internal line 60 being connected to capacitor 54, which is, in turn, connected to transmission line segment 26. Central station 10 is preferably adapted to detect the complete failure of transmission of signals from the remote stations, which will occur if transmission line segment 26 is open. Upon detection of the visual or audible signal produced by central station 10 indicating such a condition, it is merely necessary to close switch 58 to provide a ground path bypassing line 26 for the AC signal.

Similarly, to deal with a break in line 24, a normally open switch 64 is connected between internal line 66 and ground 68. Internal line 66 is connected to capacitor 52, which in turn is connected to transmission line segment 24. Further, a reversing switch 70 is connected between internal line 60 and 66 for the selective reversal of the output at the central station terminals. Thus, in order to provide a ground path for the AC signal in the case of a break in line 24, it is merely necessary to reverse the output of the central station by means of reversing switch 70, and to close switch 64.

The bypass switch construction shown in FIG. 1 is merely one embodiment of the arrangement according to the invention. Referring again to the case of a break in line segment 18*a*, the arrangement according to the invention merely requires the provision of a first switch means between the second terminal 16*a* of remote station 12*a* and ground and a second switch means between the first terminal 14*b* of remote station 12*b* and ground, said first and second switch means being adapted to close a path, between said second terminal 16*a* and said first terminal 14*b* which includes a ground path bypassing the broken line 18*a*. Thus, another embodiment of the arrangement according to the invention is shown in FIG. 3, again using the example of the line segment between remote stations 12*a* and 12*b*. In the embodiment of FIG. 3, line segment 18*a*′ normally interconnects second terminal 16*a*′ and first terminal 14*b*′. A DC circuit is provided in the manner of the arrangement of FIG. 1 by a source of DC potential 38*a*′, and a voltage divider including resistor 36*a*′ and resistor 50*b*′, said DC circuit including a ground path between ground 46*b*′ and ground 34*a*′ as described above. However, in place of zener diode 32, a first relay coil 72 is connected by lines 74 and 76 between ground 34*a*′ and second terminal 16*a*′. Said first relay coil is adapted to close normally open relay contact 78 which is connected by leads 80 and 82 in parallel with said first relay coil 72 between second terminal 16*a* and ground 34*a*′. Said first relay coil would be adapted to close first relay contact 78 when the voltage across the coil rises to a predetermined level due to a break in line 18*a*′.

Further in the embodiment of FIG. 3, diode **48** is replaced by a second relay coil **84** connected by leads **86** and **88** between first terminal **14***b'* and ground **46***b'*. Said second relay coil is adapted to close a normally open second relay contact **90** connected by leads **92** and **94** between first terminal **14***b'* and ground **46***b'*. Second relay coil **84** would be adapted to close second relay contact **90** in the absence of a voltage across resistor **50***b'*.

Accordingly, the embodiment of FIG. 3 operates in the same manner as the embodiment of FIG. 1 to provide an AC path through ground to bypass a broken line segment.

The bypass switch means according to the invention may be connected directly to the first and second terminals of the corresponding remote stations, or can be connected to the line segment **18** in the region of said terminals. As used herein, these two connections are deemed to be equivalents. In one example of the arrangement of FIG. 1, resistors **36** and **50** were selected to have a resistance of 47 K, the source of DC potential were selected to have a voltage of 12 volts and zener diodes **32** were selected to have a threshold voltage of about 8 volts. In this arrangement, where the line segment **18** was unbroken, the voltage across zener diode **32***a* was only 6 volts.

While the line fault protection system according to the invention is shown in a central station alarm system, it is equally applicable to any system incorporating a group of series-connected devices where it is desired to provide a bypass path in the event of failure of the line interconnecting said devices.

It will thus be seen that the objects set forth above, and those made apparent from the preceding description, are efficiently attained and, since certain changes may be made in the above constructions without departing from the spirit and scope of the invention, it is intended that all matter contained in the above described or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

What is claimed is:

1. In a system including at least first and second series-connected devices, each of said devices having at least one terminal and a line connecting said first device terminal with said second device terminal, the improvement which comprises DC circuit means for defining a normally closed DC circuit including said line and a ground path; first switch means for providing a pulsating current path between said first device terminal and ground when said DC circuit is opened by a break in said line; and second switch means for providing a pulsating current path between ground and said second device terminal when said DC circuit is opened by a break in said line, said first and second switch means and said ground path providing an AC path between the first device terminal and said second device terminal when said line is broken.

2. The combination of claim **1**, and wherein said DC circuit means includes a source of DC potential and a voltage divider circuit having first and second portions.

3. The combination of claim **2**, and wherein said source of DC potential and a first of said voltage divider portions are connected in parallel with said first switch means, said first switch means being adapted to provide said pulsating current path when the voltage across said DC source of potential and said first voltage divider portion rises above a predetermined level.

4. The combination of claim **3**, and wherein said first switch means comprises a zener diode having a cathode connected to said first device terminal and an anode connected to ground.

5. The combination of claim **4**, and wherein said second voltage divider portion is connected between said second device terminal and ground, said second switch means comprising diode means having its cathode connected to said second device terminal and its anode connected to ground.

6. The combination of claim **3**, and wherein said first switch means includes first relay coil means connected between said first device terminal and ground and a first normally open contact means operated by said first relay coil means and connected between said first device terminal and ground.

7. The combination of claim **6**, and wherein said second switch means includes second relay coil means and a second normally open contact means operated by said second relay coil means, said second normally open contact means, said second relay coil means and said second voltage divider portion all being connected in parallel between said second device terminal and ground.

8. The combination of claim **1**, and wherein said first and second devices are AC coupled to said line.

9. In a signaling system including a central station, a plurality of remote stations, and a transmission line connecting said central station and said plurality of remote stations in series for the transmission of signals to said central station, each of said remote stations having a first and second terminal for connection to said transmission line, the improvement which comprises DC circuit means for defining a normally closed DC circuit including said line and a ground path; first switch means for providing an AC path between the second terminal of the first of each pair of adjacent remote stations and ground when said DC circuit is opened by a break in said line; and second switch means for providing an AC path between ground and said first terminal of the second of each adjacent pair of remote devices when said DC circuit is opened by a break in said line, said first and second switch means and said ground path providing an AC path between said second terminal of the first of said pair of adjacent remote stations and said first terminal of the second of said pair of adjacent remote stations when said line is broken.

10. The combination of claim **12**, and wherein said signalling system is a central station alarm system.

11. The combination of claim **12**, and wherein said remote stations are AC coupled to said transmission line.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 3,652,867

DATED : March 28, 1972

INVENTOR(S) : Leon Zinn and Milton Bodin

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

On the title page, cancel "[72] Inventor: Leon Zinn, Syossit, N.Y." and substitute --[72] Inventors: Milton Bodin, Teaneck, N.J., and Leon Zinn, Syosset, N.Y.--

Cancel "[73] Assignees: Milton Bocin, Teaneck, N.J.; AFA Protective Systems, Inc., New York, N.Y." and substitute --Coditron Corporation, New York, N.Y.--.

Signed and Sealed this

Twenty-first Day of *February 1978*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

LUTRELLE F. PARKER
Acting Commissioner of Patents and Trademarks

UNITED STATES PATENT OFFICE

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Signed and Sealed this

Twenty-first Day of *February 1978*

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Attest:

RUTH C. MASON
Attesting Officer

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Acting Commissioner of Patents and Trademarks