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REVERSE CURRENT SIGNALING SYSTEM

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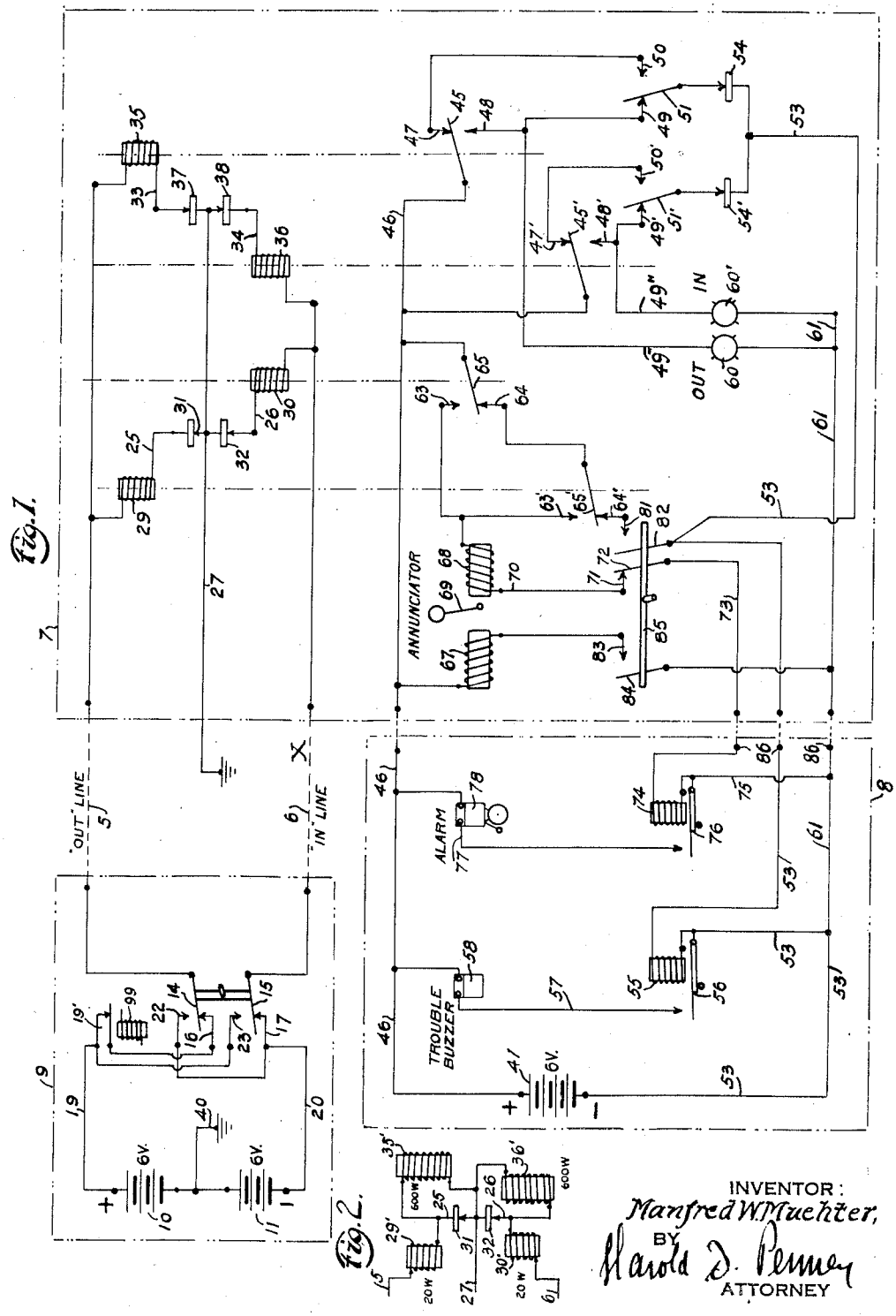


Fig. 1.

Fig. 2.

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REVERSE CURRENT SIGNALING SYSTEM

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This invention relates to electric signaling systems and more particularly to two line, current-reversing systems adapted to send non-code signals for fire-alarm, water-flow or other purposes though it is noted that in some of the claims the invention is not limited to two line systems or to current-reversing.

One object of the invention is to provide an improved simple supervised system of this kind in which both lines are supervised, in which trouble in either line cannot interfere with the sending of an alarm, and in which no trouble or combination of troubles on the outside lines can cause a false signal.

Other objects of the invention are to provide a system of this kind which is suitable for sprinkler supervision, night watch and delinquency alarms.

Additional objects of the invention are to improve generally the simplicity and efficiency of such systems and to provide a simple system of this kind which is economical and reliable in operation, and economical to install.

Still other objects of the invention will appear as the description proceeds; and while herein details of the invention are described in the specification and some of the claims, the invention is not limited to these, since many and various changes may be made without departing from the scope of the invention as claimed in the broader claims.

The inventive features for the accomplishment of these and other objects are shown herein in connection with current-reversing signaling systems, each of which briefly stated, includes a receiving set comprising branch conductors each having one end connected to one of two lines and the other to a ground, each branch conductor having interposed, in series therein, a signal-receiving electromagnet and a static rectifier, the rectifiers pointing toward and from said ground respectively. The sending set comprises a source of current having a ground, and a pole changer for selectively sending positive or negative current from said source into said lines. Said electromagnets operate suitable signal means.

In the drawing.

Fig. 1 shows a diagram illustrating one form of a two line signaling system;

Fig. 2 is a diagram showing a modified arrangement of magnets and rectifiers.

This system, as shown in Fig. 1 includes an "out" line 5 and an "in" line 6 extending from the receiving or headquarters station 7, 8 to the sending or subscribers station 9.

The sending station is provided with an intermediately grounded source of direct current 10, 11, and a pole changer comprising a double pole transfer switch having its transfer elements 14, 15 connected to the respective lines, fixed contacts 16, 17 normally engaged by the transfer contacts respectively, and respectively connected through conductors 19 and 20 to the + and — terminals of said source. The other fixed contacts 22, 23 are during signaling engaged by the contacts 14 and 15 respectively and are connected to the — and + terminals respectively, so that the shifting of the transfer element may send positive and negative current into said lines 5 and 6 respectively and vice versa.

At the receiving station, a pair of alarm branch conductors 25, 26 are provided, each having an end connected to the ground line 27 and the other end connected to the lines 5 and 6 respectively and respectively having interposed therein alarm signal-receiving electromagnets 29, 30 and rectifiers 31, 32. Alarm means is set in operation by each electromagnet 29 or 30 when energized as will be explained. The rectifiers 31, 32 point from and toward the ground respectively; that is, they are both disposed to resist current in the normal direction, and the magnets 29 and 30 are, therefore, normally deenergized.

A pair of branch supervisory conductors 33, 34 each having an end connected to the ground 27 and the other end connected to the lines 5 and 6 respectively, have interposed therein supervisory signal-receiving electromagnets 35, 36 respectively and rectifiers 37, 38, the rectifiers pointing toward and from the ground respectively. It will be noted that the rectifiers 31, 37 of the branch conductors connected to the line 5 are pointed in opposite directions, and the rectifiers 32 and 38 connected to line 6 point in opposite directions. Supervisory signal means later to be described are actuated by each supervisory magnet 35 or 36 when deenergized.

The pole-changer switch has a normal closed supervisory position as shown and is raised to alarm position when it is desired to send an alarm to the headquarters or receiving station. The rectifiers 37, 38 of the supervisory branches are connected to receive current in series when the pole-changer switch is in normal position. The alarm rectifiers 31, 32 are connected to receive current when the switch is raised to alarm position.

If either or both grounds are broken, the system will still operate if both lines 5 and 6 are intact. If the contact 19' be opened, the absence of current in the line to which it is not connected will indicate a defective ground 27 or 40.

Normally plus current passes from plus at the battery 10 through line 19, switch elements 16, 14, line 5, normally energized trouble signal magnet 35, static rectifiers 37, 38, trouble signal magnet 36, line 6, switch elements 15, 17, line 20 to minus. But operating current does not flow through alarm magnets 29, 30 and static rec-

tifiers 31 and 32, because, as shown, the rectifiers 31, 32 are opposed to the current.

The trouble signal magnets 35, 36 when deenergized operate a buzzer or other trouble signal as will be explained; and the trouble signals are held silent when their magnets are energized, and are thus silent when the circuit is as above described. The alarms are silent when their magnets 29, 30 are deenergized, and are silent when the circuit is as above described.

Should it be desired to send an alarm, the double pole, pole-changer switch is raised until contacts 22 and 23 are engaged. This sends plus current from + at the battery 10 through line 19, contacts 23, 15, line 6, rectifiers 32, 31, magnets 30, 29, line 5, contacts 14, 22, line 20 to minus, and alarm magnets 29, 30 are energized and the alarm rings. No current passes from line 6 through rectifiers 37, 33. Therefore, magnets 36, 35 are deenergized and the trouble buzzer also operates.

The pole changer switch is normally in the position shown; and should a break develop in the line 6 as at X, no current can pass through line 6 and the magnet 36, being deenergized, will cause the buzzer to sound, thus notifying that there is a break in line 6, and repair men will be sent to mend the line. Current will still pass from plus through 19, 5, 35 and ground 27 to ground of the battery, and electromagnet 35 will still be energized; but the alarm will be silent, as no current will pass 31.

Should there be a ground at X, current will pass direct between the grounds 40 and X, shunting out magnet 36, which will be thus deenergized and will cause a trouble signal. Should there be a break in line 5, the signal magnet 35 will cause a trouble signal as above described for the break at X.

If while the break or ground is still present at X, it be desired to send an alarm, switch 14, 15 is merely raised to the upper position as before described, whereupon plus current passes from plus at the upper end of the lower half of the battery through grounds 40 and 27, rectifier 31, coil 29, line 5, contacts 14, 22, line 20 to minus at the lower end of the battery thus energizing the coil 29 and causing an alarm signal. Should a break or ground be in line 5 only, and an alarm is to be sent, switch 14, 15 is raised, and current passes from plus at 19, through 19', 23, 15, 6, 30, 32, 27, 40 to minus at the lower end of the upper half of the battery, thus energizing the electromagnet 30 and causing an alarm signal.

The supervisory signal means at the receiving station include "out" and "in" trouble relays including said "out" and "in" magnets 35 and 36 respectively. The "out" relay includes a transfer contact 45 connected by conductor 46 to one pole of said receiving station current source 41 and normally attracted by the supervisory magnet, and front and back contacts 47, 48 adapted to be engaged by the transfer contact. The "in" relay is similar and includes transfer contact 45' connected to conductor 46, and front and back contacts 47', 48'.

Silencing switches are associated with the respective relays, each includes a pair of fixed "on" and "off" contacts 49, 50 and 49', 50' respectively connected to said back and front contacts 47, 48 and 47', 48', and silencing transfer contacts 51 and 51' respectively engageable with said pairs of fixed contacts and respectively normally engaging the "on" contacts 49 and 49' connected to the back contacts.

A common conductor 53 is connected to the second pole of said source 41; and rectifier valves 54, 54' are connected between said common conductor and said silencing transfer contacts 51, 51' respectively and positioned to allow current to pass only in the same direction between the contact and common conductor, thereby to prevent feed back from one transfer contact to the other. A buzzer relay 55, 56 has its coil 55 interposed in said common conductor; and its movable element 56 is adapted to close a buzzer circuit 53, 56, 57, 58 including the buzzer 58. "In" and "out" signal lamps 59', 60 are connected by conductors 49'', 49''' between the back contacts 48', 48 of the "in" and "out" relays respectively and conductor 61, 53 connected to the second pole of the source.

When either trouble relay releases, the corresponding lamp 60, 60' lights and the buzzer sounds, until the corresponding silencing contact 51, 51' is set to off position in contact with contact 50, 50', thereupon the reenergization of the trouble relay magnet 35 or 36 as when the line is repaired, causes the buzzer again to sound until the silencing switch is turned to "on" position.

The alarm electromagnets 29 and 30 constitute part of "out" and "in" alarm relays respectively including front and back contacts 63', 64' and 63, 64 and transfer contacts 65', 65 normally engaging the respective back contacts. The transfer contact 65 of the "in" relay is connected through conductor 46 to said first pole, the transfer contact 65' of the "out" relay being connected to the back contact 64 of the "in" relay.

An annunciator 67, 68, 69 comprises a reset coil 67, a set coil 68 having one end connected to the front contacts and an indicator 69 attracted by either coil when energized. Conducting means 70, 71, 72, 73, 74, 75, 61, 53 connect the other end of the set coil to the second pole of the source 41, said conducting means including an operating relay coil 74 having its switch 75 in an alarm circuit 75, 76, 77, 78 including an alarm bell 78, whereby when either alarm relay coil 29 or 30 operates its switch, said annunciator is set and the alarm bell rings. A triple-pole alarm-silencing switch for silencing the alarm comprises a normally closed switch 71, 72 in said conducting means, a normally open switch 81, 82 interposed between the back contact 64' of the "out" relay and the common conductor 53, and a normally open reset switch 83, 84 all having their movable elements mechanically connected by the bar 85, whereby when the alarm silencing switch is shifted rightward to silence the alarm, the buzzer relay coil 55 is connected through switch 81, 82 in series with the back contacts, but will not sound if either back contact is disengaged. Therefore, when both alarm relays are at normal, the buzzer sounds until the alarm silencing switch is restored to normal.

The annunciator reset circuit 46, 67, 83, 84, 61, 53 includes the reset switch 83, 84 and coil 67 for automatically resetting the annunciator when the alarm is silenced.

It is noted that the alarm relay switches 64, 65 and 64', 65' are in series. Thus if line 5 or 6 be in broken condition, and one contact 65 or 65' consequently remains lowered, before and after an alarm signal, the lowering of the switch 14, 15 while the switch 81, 82 is closed, will silence

the trouble alarm, that was caused by the alarm.

The receiving station may be designed to receive from a number of sending stations, in which case the unit equipment within the enclosure 7 will be repeated for each sending station, while the common equipment within the enclosure 8 may be common to all subscribers, suitable means being provided for connecting the unit and common equipment near the points 86.

The arrangement of Fig. 2 is similar to that of Fig. 1. The branch conductors 25, 26 have each an end connected to the ground 27; but the alarm-signal-receiving electromagnets 29', 30' are of low resistance. Rectifiers 31 and 32 are interposed in series each branch conductor, the rectifiers pointing toward and from the ground respectively, as in Fig. 1. Separate branches are not provided for the trouble signal relays. On the contrary, high resistance trouble-signal-receiving electromagnets 35', 36 shunt the rectifiers 31 and 32 respectively. Lines 5 and 6 are connected to the ungrounded ends of said branch conductors 25, 26 and extend to the sending station as in Fig. 1. The electromagnets 25', 26', 35', 36' operate corresponding contacts 65, 65', 45, 45', as in Fig. 1. When the switch 14, 15 is in lower normal position it normally sends current in the direction most resisted by said rectifiers 31, 32, thereby normally forcing enough current through the high resistance electromagnets to energize them sufficiently to hold the trouble signal means against operation, but when either line 5 or 6 breaks the trouble buzzer is set in operation by the deenergization of either trouble signal magnet 35', 36'.

When the switch 14, 15 is in normal low position, the current which is forced to pass through coils 35', 36' is not enough to energize coils 29', 30' sufficiently to raise contacts 65, 65' to cause an alarm signal; but when the current is reversed by raising switch 14, 15, the rectifiers 31, 32 allow the passage of sufficient current through the coils 29', 30' operate the contacts 65', 65.

The resistance of the trouble signal coils is so high that the current passing therethrough has not enough effect on the alarm signal coils to cause an alarm signal.

The operation of the system of Fig. 2 is the same as that of Fig. 1. If the switch 14, 15 be raised, the current will be reversed and can then pass through the rectifier, and cause an alarm signal.

If a line 5 or 6 breaks the corresponding trouble magnet will be deenergized, causing a trouble signal. If a line 5 or 6 breaks, the corresponding alarm signal coil will fail to respond to an alarm signal, but the other alarm coil will respond as in Fig. 1 since the associated trouble signal coil in no way retards current passing the rectifier.

In practice, if the batteries 10 and 11 are of 6 volts each, coils 29', 30' are conveniently 20 ohm coils, and coils 35', 36' are conveniently 600 ohm coils.

At the subscribers sending station there may be various circuits or devices to be supervised. These may be so connected in local circuit with a local magnet coil 99 of a relay 19', 99, so that abnormal condition energizes the coil 99, opens the switch 19', deenergizes coil 35, thereby causing a trouble signal at the receiving station.

I claim as my invention:

1. In combination, a pair of lines; a receiving station; a receiving station ground; a pair of alarm branch conductors and a pair of supervisory branch conductors each conductor of each pair having an end connected to the ground and the other end connected to the lines respectively; a signal receiving electromagnet and a rectifier interposed in each branch conductor; the rectifiers in the alarm conductors being conductive toward and from the ground respectively; the rectifiers in branch conductors connected to the same line being conductive toward and from the ground respectively; a sending station; an intermediately grounded source of current at the sending station; a pole changing means associated with said source for selectively sending positive current thereof from said sending station into one of said lines and negative current to the other and thence through one or the other pair of said branch conductors; and signal means operated by said electromagnets.

2. In combination, a sending station; a receiving station; a pair of conducting lines extending from the receiving station to the sending station; a source of direct current; a pole changer at the sending station comprising a double pole transfer switch having its transfer elements connected to the respective lines, and contacts so connected to the end terminals of said source that the shifting of the transfer element may send positive and negative current into said lines and vice versa; an alarm branch conductor and a supervisory branch conductor each having an end connected to one line and the other end connected to the other line; a signal-receiving electromagnet and a rectifier interposed in each branch conductor, the rectifiers being conductive in opposite directions respectively; said switch having a normal closed position and an alarm position; the rectifier of the supervisory branch being connected to receive current when the switch is normally closed; the alarm rectifier being connected to receive current when the switch is in alarm position.

3. In combination, a pair of lines; a pair of alarm branch conductors and a pair of supervisory branch conductors each conductor of each pair having an end connected to a ground and the other end connected to the lines respecively; a signal receiving electromagnet and a rectifier interposed in each branch conductor; the rectifiers in the alarm conductors being conductive toward and from the ground respectively; the rectifiers in branch conductors connected to the same line being conductive toward and from the ground respectively; a source of current; and means associated with said source and ground for selectively sending positive or negative current through one or the other pair of said branch conductors.

4. In combination, a pair of lines; a neutral conductor; a pair of branch conductors each having an end connected to the neutral conductor and the other to one of the respective lines; a low-resistance, alarm-signal-receiving electromagnet and a rectifier interposed in series each branch conductor; the rectifiers being conductive toward and from the neutral conductor respectively; a sending station; a high resistance trouble-signal-receiving electromagnet shunting each rectifier; and relay elements moved by said electromagnets when they become energized.

5. In combination, a pair of lines; a neutral conductor; a pair of branch conductors each having one end connected to one of the lines and the other to the neutral conductor; a signal-receiving electromagnet and a rectifier interposed in series in each branch conductor; the rectifiers

being conductive toward and from the neutral conductor respectively; a source of current intermediately connected to the neutral conductor; and means associated with said source normally sending current in one direction through said lines to energize said magnets, and settable to send current in the opposite direction to de-energize said magnets.

6. A combination as in claim 5 in which said last named means is normally set to send current in the direction most resisted by said rectifiers; and in which said electromagnets respectively constitute part of first and second alarm relays each including front and back contacts and a transfer contact normally engaging the back contact; said combination including also a local source of current; the transfer contact of the first relay being connected to the first pole of said local source; the transfer contact of the second relay being connected to the back contact of the first relay; an annunciator comprising a set coil having one end connected to said contacts; conducting means for connecting the other end of the set coil to the second pole of the local source, and having alarm means interposed therein; an alarm silencing switch comprising a normally closed switch in said conducting means, a normally open switch interposed between said second pole and the back contact of the second relay.

7. A combination as in claim 5 in which said last named means is normally set to send current in the direction least resisted by said rectifiers, and in which said electromagnets respectively constitute part of relays each including, a transfer contact adapted to be attracted by the magnet and front and back contacts adapted to be engaged by each transfer contact, the transfer contact normally engaging the front contact; said combination including a local source of current having one pole connected to said transfer contacts; a silencing switch associated with each relay, each comprising fixed contacts connected to said back and front contacts respectively, and a silencing transfer contact engageable with said fixed contacts; a common conductor connected to the second pole of said source; trouble signal means operated by current in the common conductor; and rectifier valves connected between said common conductor and said silencing transfer contacts respectively and positioned to allow current to pass in the same direction between the contact and common conductor.

8. In combination, first and second alarm relays each including front and back contacts and a transfer contact normally engaging the back contact; a source of current; the transfer contact of the first relay being connected to one pole of the source; the transfer contact of the second relay being connected to the back contact of the first relay; an annunciator comprising a set coil having one end connected to said front contacts; conducting means for connecting the other end of the set coil to the second pole of the source, and having alarm means interposed therein; and an alarm silencing switch comprising a normally closed switch in said conducting means, a normally open switch interposed between the second pole and the back contact of the second relay.

9. In combination, "out" and "in" alarm relays each including an alarm electromagnet; front and back contacts and a transfer contact normally engaging the back contact; a source of current; the transfer contact of the "in" relay being connected to a pole of said source; the transfer contact of the "out" relay being connected to the back contact of the "in" relay; an annunciator comprising a set coil having one end connected to the front contacts, and an indicator attracted by the coil when energized; conducting means for connecting the other end of the set coil to the second pole of said source; an alarm circuit including an alarm bell; said conducting means including an operating relay having its switch in said circuit and its coil in said conducting means; whereby when either alarm relay operates, said annunciator is set and the alarm bell rings; a common conductor connected to said second pole; and a double pole alarm silencing switch comprising a normally closed switch in said conducting means, a normally open switch interposed between the back contact of the out relay and the common conductor having their movable elements mechanically connected.

10. A combination as in claim 9 including a reset coil adapted to attract said indicator; a reset circuit including a reset switch and said reset coil for resetting the annunciator when the alarm is silenced; the movable element of the reset switch being mechanically connected to said movable elements of the alarm silencing switch.

11. In combination, a pair of lines; a neutral conductor; two branch conductors connecting the respective lines to the neutral conductor; an electromagnet and a rectifier in series in each branch conductor; the rectifiers being conductive toward and from the neutral conductor respectively; a source of current intermediately connected to the neutral conductor and sending means normally conducting current from said source into said lines in opposition to said rectifiers and settable to reverse the current to energize said electromagnets; alarm relays each including a normally closed switch and one of said electromagnets respectively; a signal alarm means operated by either or both of said electromagnets when energized; a signal alarm silencing means including a normally open switch; a trouble alarm; and conducting means connecting the three switches and said trouble alarm in series circuit; whereby after said normally opened switch is closed during signal alarm silencing, the restoration of said sending means to normal will operate the trouble alarm while either of said lines is broken; the arrangement of said relay switches in series preventing the operation of the trouble alarm as a result of closure of one of the relay switches during alarm sending while one line is broken or both are intact.

12. In combination, a pair of lines; a neutral conductor; supervising means and two branch conductors connecting the respective lines to the neutral conductor; an electromagnet and a rectifier in series in each branch conductor; the rectifiers being conductive toward and from the neutral conductor respectively; the supervising means being conductive only in the opposite direction to the rectifiers; a source of current intermediately connected to the neutral conductor; and sending means normally conducting current from said source into said lines in opposition to said rectifiers to supervise the line, and settable to reverse the current; first and second alarm relays each including one of said electromagnets respectively, front and back contacts, and a transfer contact normally engaging the back contact; a local source of current having a first pole connected to the transfer contact of

the first relay; the transfer contact of the second relay being connected to the back contact of the first relay; alarm means connected between the second pole of the local source and the front contacts; whereby if said sending means be operated when either line is broken or both are intact, the alarm means will be operated; a silencing assembly comprising a normally closed switch interposed between the alarm means and front contacts, and a normally open switch connected to the back contact of the second relay; and a trouble alarm between the normally open switch and said second pole.

13. In combination, a pair of lines; a neutral conductor; two conductors connecting the respective lines to the neutral conductor; an electromagnet and a rectifier interposed in series in each branch conductor; the rectifiers being conductive toward and from the neutral conductor respectively; a source of current intermediately connected to the neutral conductor; and sending means for normally sending current from said source through said lines and rectifiers, and setable to send current in the opposite direction; alarm means responsive to said current in the opposite direction; a local current source; relays each including one of said electromagnets, front and back contacts, and a transfer contact connected to one pole of said source and normally engaging the front contact; a silencing switch for each relay comprising "on" and "off" contacts connected to said back and front contacts respectively, and a silencing transfer contact normally engaging the "on" contact; a common conductor, having trouble signal means therein, connected to the second pole of the local source; valves between said common conductor and said silencing contacts allowing current to pass in the same direction; signal lamps connected between said back contacts and said second pole; whereby during alarm both lamps will operate, and when either line breaks the corresponding signal lamp will operate until the break is repaired, and said trouble signal means will operate until the corresponding transfer contact is shifted to an "off" contact; the valves preventing a break in one line from operating the lamp corresponding to the other line.

14. In combination, a pair of lines; a conductor connected between the lines; a low-resistance, alarm-signal-receiving electromagnet and a rectifier interposed in series in said conductor; a high resistance trouble-signal-receiving electromagnet shunting the rectifier; and relay elements moved by said electromagnets when they become energized.

15. In combination, a pair of lines; a conductor connected between the lines; a low-resistance alarm-signal-receiving electromagnet and a rectifier interposed in series in said conductor; a sending station; a high resistance trouble-signal-receiving electromagnet shunting the rectifier; a source of current; means associated with said source for selectively sending current thereof from said station in either direction into said lines and thence through said conductors; said means normally sending current in the direction most resisted by said rectifier, thereby normally maintaining the high resistance electromagnets energized; trouble signal means held against operation by the trouble signal magnet when energized and set in operation by the deenergization of the trouble signal magnet; and alarm means set in operation by the alarm electromagnet when energized.

16. In combination a circuit including a current source; a trouble switch, supervisory means and alarm means connected to the circuit; a sending means settable to alarm and normal positions; said switch, source and means being so connected to the circuit that when the sending means is in normal position current passes through the switch and energizes the supervisory means, and when the settable means is in alarm position, the switch is shorted out and the alarm means is energized.

17. In combination, a pair of lines; a neutral conductor; pairs of branch conductors connecting the respective lines to the neutral conductor; a supervisory electro-sensitive means in one branch conductor connected to each line; alarm electro-sensitive means connected in the other branch conductors respectively; a source of current intermediately connected to the neutral conductor; a normally closed trouble switch; sending means normally conducting current from said source through said switch and into said lines in a manner normally to energize the supervisory means, whereby opening of said switch will deenergize the supervisory means; said sending means being setable in a manner to short out said switch and deenergize the supervisory means and operate the alarm means, whereby the opening of the switch cannot prevent operation of the alarm.

18. In combination, a pair of lines; a pair of alarm electro-sensitive means; a source of current; a sending means having normal and alarm positions; said source and means being so connected to said lines that when the sending means is in normal position the sensitive means are normally deenergized and when the sending means is in alarm position both alarm sensitive means are energized if both lines are intact and only one is energized if only one line is intact; normally closed switches adapted to be opened by the alarm electro-sensitive means respectively when operated; a signal alarm means operated by either or both of said alarm sensitive means when operated; a signal alarm silencing means including a normally open switch; a trouble alarm; and conducting means connecting the three switches and said trouble alarm in series circuit; whereby after said normally opened switch of the silencing means is closed during signal alarm silencing, the restoration of said sending means to normal will operate the trouble alarm as a result of said restoration while either of said lines is broken; the arrangement of said switches in series preventing the operation of the trouble alarm during alarm sending, as a result of closure of one of said normally closed switches resulting from a broken line.

19. In combination, a pair of lines; a neutral conductor; branch conductors connecting the respective lines to the neutral conductor; an alarm electro-sensitive means in each branch conductor; a source of current intermediately connected to the neutral conductor; sending means normally conducting current from said source into said lines in a manner normally to energize the supervisory means; normally closed switches adapted to be opened by the alarm electro-sensitive means respectively when operated; a signal alarm means operated by either or both of said alarm sensitive means when operated; a signal alarm silencing means including a normally open switch; a trouble alarm; and conducting means connecting the three switches and said trouble alarm in series circuit; whereby after said normally opened switch of the silencing means is closed during

signal alarm silencing, the restoration of said sending means to normal will operate the trouble alarm as a result of said restoration while either of said lines is broken; the arrangement of said switches in series preventing the operation of the trouble alarm during alarm sending and silencing, as a result of closure of one of said normally closed switches resulting from a broken line.

20. In combination, a pair of lines; a neutral conductor; pairs of branch conductors connecting the respective lines to the neutral conductor; a supervisory electro-sensitive means in one branch conductor connected to each line; alarm electro-sensitive means connected in the other branch conductors respectively; a source of current intermediately connected to the neutral conductor; sending means normally conducting current from said source into said lines in a manner normally to energize the supervisory means and settable in a manner to operate the alarm means; normally closed switches adapted to be opened by the alarm electro-sensitive means respectively when operated; a signal alarm means operated by either or both of said alarm sensitive means when operated; a signal alarm silencing means including a normally open switch; a trouble alarm; means operated by deenergization of either supervisory means for operating the trouble alarm; trouble alarm silencing means for preventing operation of the trouble alarm by said deenergization; and conducting means connecting the three switches and said trouble alarm in series circuit; whereby after said normally opened switch of the silencing means is closed during signal alarm silencing, the restoration of said sending means to normal will operate the trouble alarm as a result of said restoration while either of said lines is broken; the arrangement of said switches in series preventing the operation of the trouble alarm during alarm sending, as a result of a broken line, when the trouble alarm silencing means is operated for silencing the trouble means.

21. In combination, a pair of lines; a neutral conductor; supervisory means and two branch conductors connecting the respective lines to the neutral conductor; an alarm electro-sensitive means in each branch conductor; a source of current intermediately connected to the neutral conductor; sending means normally conducting current from said source into said lines in a manner normally to energize the supervisory means and settable in a manner to cause the current to operate the alarm means; first and second alarm switch assemblies associated with the sensitive means respectively, each including front and back contacts, and a transfer contact normally engaging the back contact and operated to engage the front contact by operation of the sensitive means; a local source of current having a first pole connected to the transfer contact of the first relay; the transfer contact of the second relay being connected to the back contact of the first relay; alarm means connected between the second pole of the local source and the front contacts; whereby if said sending means be operated when either line is broken or both are intact, the alarm means will be operated; a silencing assembly comprising a normally closed switch interposed between the alarm means and front contacts, and a normally open switch connected to the back contact of the second assembly; and a trouble alarm between the normally open switch and said second pole.

22. In combination, a pair of lines; a pair of supervisory electro-sensitive means; a source of current; a sending means having normal and alarm positions; said source and means being so connected to said lines that when the sending means is in normal position the supervisory means are normally to be energized and when a line breaks one sensitive means will be deenergized and when the sending means is in alarm position both supervisory means are deenergized and both alarm sensitive means are operated; a local current source; switch assemblies associated with the supervisory sensitive means respectively and each including a back contact, and a transfer contact connected to one pole of said source and operated by the deenergization of the sensitive means to engage the back contact; a common conductor, having trouble signal means therein, connected to the second pole of the local source; valves between said common conductor and said back contacts allowing current to pass in the same direction; signal lamps connected between said back contacts and said second pole; whereby during alarm both lamps will operate to visually indicate alarm, and when either line breaks a single signal lamp and said trouble signal means will operate, the valves preventing a break in one line from indicating alarm by operating both lamps.

23. In combination, a pair of lines; a neutral conductor; pairs of branch conductors connecting the respective lines to the neutral conductor; a supervisory electro-sensitive means in one branch conductor connected to each line; alarm electro-sensitive means connected in the other branch conductors respectively; a source of current intermediately connected to the neutral conductor; sending means normally conducting current from said source into said lines in a manner normally to energize the supervisory means and settable in a manner to deenergize the supervisory means and operate the alarm means; alarm means responsive to operate one or both of said alarm sensitive means; a local current source; switch assemblies associated with the supervisory sensitive means respectively and each including front and back contacts, and a transfer contact connected to one pole of said source and normally engaging the front contact and operated by the associated sensitive means when deenergized to engage the back contact; a silencing switch for each assembly comprising "on" and "off" contacts connected to said back and front contacts respectively, and a silencing transfer contact normally engaging the "on" contact; a common conductor, having trouble signal means therein, connected to the second pole of the local source; valves between said common conductor and said silencing contacts allowing current to pass in the same direction; signal lamps connected between said back contacts and said second pole; whereby during alarm both lamps will operate to visually indicate alarm, and when either line breaks the corresponding signal lamp will operate until the break is repaired and said trouble signal means will operate until the corresponding transfer contact is shifted to an "off" contact; the valves preventing a break in one line from indicating alarm by operating both lamps.

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