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MEANS FOR ELIMINATING INTERFERENCE IN GROUNDED TELEGRAPH SYSTEMS

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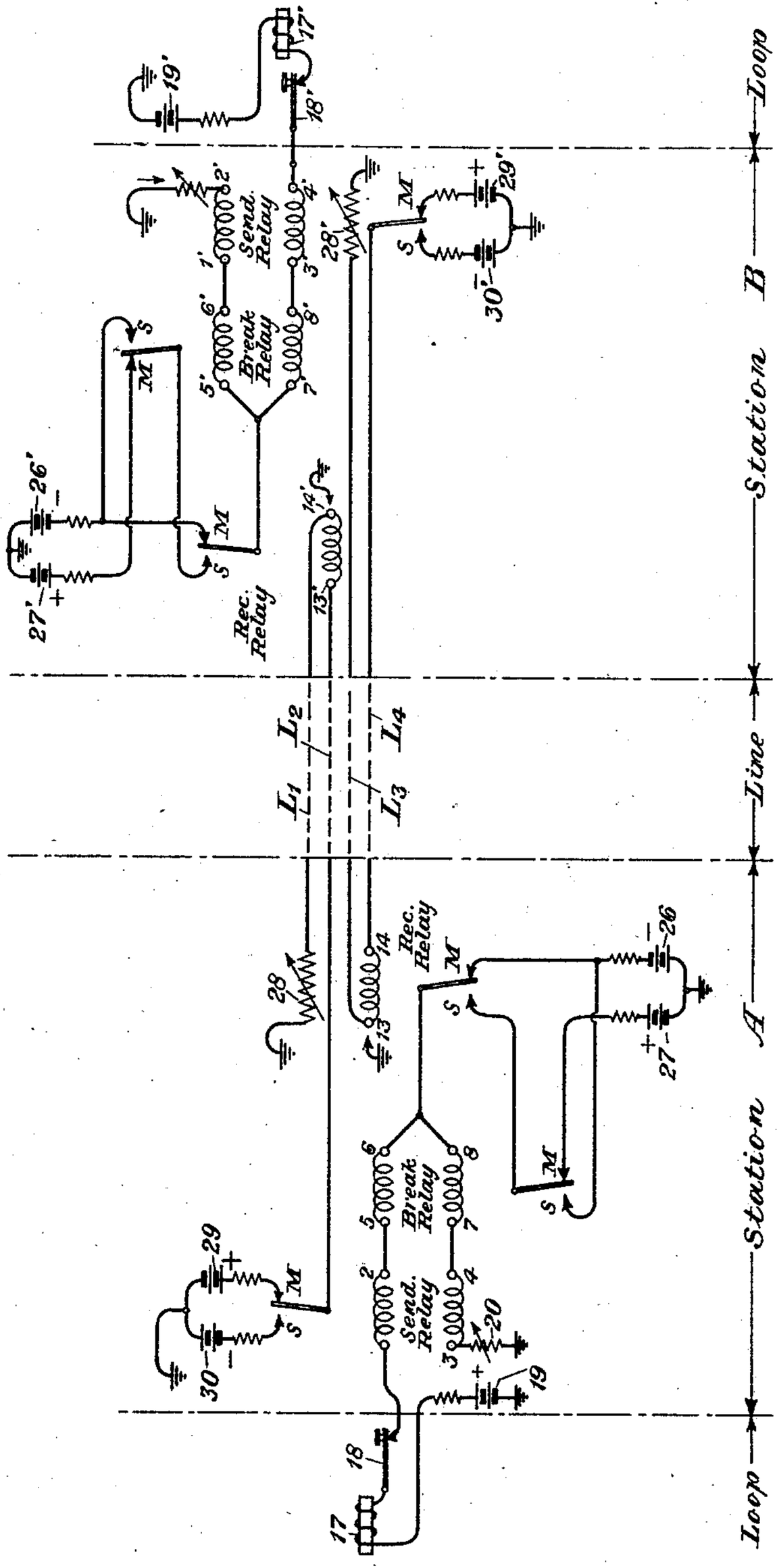

Fig. 1

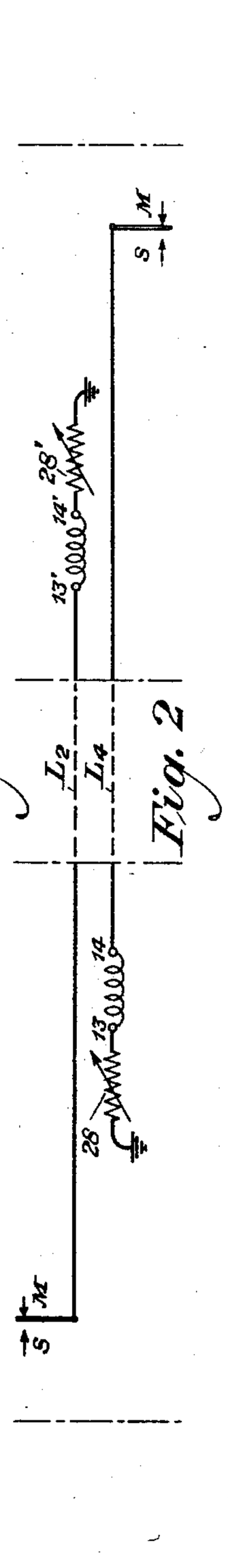

Fig. 2

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UNITED STATES PATENT OFFICE

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MEANS FOR ELIMINATING INTERFERENCE IN GROUNDED TELEGRAPH SYSTEMS

Application filed June 24, 1931. Serial No. 546,656.

This invention relates to grounded telegraph systems, and particularly to a method and means for eliminating from such systems the effects of interfering currents created by earth potential differences, power line induction and other similar sources.

In the operation of grounded telegraph systems difficulty is sometimes experienced due to the presence in such systems of interfering currents created by sources external to the system itself, such as differences of earth potential or power line induction. Those currents created by the sources of interference affect the receiving relays of the telegraph system and produce a distortion of the telegraph signals being transmitted between stations of the said system.

In the copending application of W. H. Kline, Serial No. 546,655, filed June 24, 1931, is described a two-wire grounded system in which neutralization of interfering currents is effected by opposing in the windings of the receiving relays the currents set up in the two wires of the said system by the source of interference. In that system there is a tendency that changes in battery voltages, line resistance or line leakage, may produce bias in the signals that would necessitate readjustment of the biasing current in the receiving relay in order to overcome the bias of the signals.

The present invention involves an arrangement for eliminating the effect of interfering currents produced by differences of earth potential or power line induction, which system is not subject to bias of signals due to changes of battery voltage or the characteristics of the line itself.

This invention will be clearly understood from the following description when read in connection with the attached drawing of which Figure 1 shows a simple form of embodiment of the invention adapted to neutralize the effects of both power line induction and those produced by differences of ground potential; and Fig. 2 shows an alternative arrangement that may be employed where differences of ground potential do not exist.

In Fig. 1, L_1 and L_2 represent conductors of a pair connecting the sending relay at station A to the receiving relay at station B; and conductors L_3 and L_4 connect the sending relay at station B to the receiving relay at station A. The loop at station A comprises a sounder 17 and the key 18. The said loop is connected to terminal 1 of winding 1—2 of the sending relay and also to a source of potential 19. The sending relay has two windings 1—2 and 3—4 and similarly, the break relay has two windings 5—6 and 7—8. Terminals 6 and 8 of the break relay are connected together to the armature of the receiving relay. The marking contact of the said receiving relay is connected to the negative battery 26, and the spacing contact is connected to the armature of the break relay. The spacing contact of the break relay is connected to the negative battery 26 and the marking contact of the break relay is connected to the positive battery 27. The marking and spacing contacts of the sending relay are connected to positive and negative batteries respectively, and the armature of the relay is connected to conductor L_2. That conductor is also connected to the terminal 13′ of the winding 13′—14′ of the receiving relay at station B. Terminal 14′ is connected to the conductor L_1 which is grounded at station A through an adjustable artificial line 28. If the telegraph circuits between stations A and B were not exposed to interference from external sources such as differences of earth potential between stations or inductive interference, it would be unnecessary to employ the lines L_1 and L_3 to terminate the line circuits at stations A and B, respectively. In that event, the terminals 13 and 14′ of the windings of the receiving relays at stations A and B, respectively, may be connected directly to ground, as indicated by the grounded arrow heads shown in connection with the terminals of the said windings.

The apparatus employed at station B and in the loop connected thereto, is similar to that employed at station A and in its loop, and has been designated by the same numerals primed.

The manner in which the system operates for the transmission of signals is as follows: Assuming that it is desired to transmit a

marking impulse from the loop at station A to the loop at station B, the key 18 is closed. That causes current to flow from the battery 19 over a circuit that includes the sounder 17, key 18, windings 1—2 and 5—6, the marking contact of the receiving relay and the negative battery 26. Current will also flow from ground through the artificial line 20, windings 3—4 and 7—8, the marking contact of the receiving relay and the negative battery 26. The effect of the current through the last-mentioned pair of windings opposes that through windings 1—2 and 5—6, but since the current through the latter pair of windings is greater than that through windings 3—4 and 7—8 the armatures of the sending relay and the break relay will be moved to their marking contacts. Current will accordingly flow from the positive battery 29 over the line L_2 through the winding 13′—14′, thence over the line L_1 and through the artificial line 28 to ground. The direction of flow of current through the winding of 13′—14′ causes the armature of the receiving relay at station B to move to its marking contact. That connects the negative battery 26′ to the windings of the break relay and the sending relay at station B. Since the polarity of battery 26′ is opposite that of battery 19′ current will flow through windings 7′—8′ and 3′—4′. Current will also flow from battery 26′ through windings 1′—2′ and 5′—6′. Since the current through windings 7′—8′ and 3′—4′ is twice as large as that through the other windings of the said relays (assuming that batteries 26′ and 19′ are of equal voltage), the armatures of the sending relay and of the break relay will remain upon their marking contacts. The flow of current through the sounder 17′ energizes it and completes the transmission of the marking impulse.

If the key 18 is then opened to transmit a spacing impulse, current will cease to flow through windings 1—2 and 5—6. Current will continue to flow from battery 26 through windings 3—4 and 7—8. The direction of flow will be such as to move the armatures of the sending relay and break relay to their spacing contacts. Accordingly, the negative battery 30 will be connected to the line L_2 and current will flow therefrom over the said line through the winding 13′—14′ of the receiving relay at station B, thence, over the line L_1 and through the resistance 28 to ground. The armature of the receiving relay at station B will be moved to its spacing contact thereby connecting the positive battery 27′ to the windings of the break relay and of the sending relay at that station. Since batteries 27′ and 19′ are connected in opposition current will not flow through the windings 7′—8′ and 3′—4′, and furthermore, current ceases to flow through the sounder 17′. That releases the latter and effects the transmission of the spacing impulse to the operator at station B. Since the positive battery 27′ is connected so as to send current through the windings 5′—6′ and 1′—2′ in opposite direction to that in which current flowed from battery 26′, the armatures of the sending relay and of the break relay will be held upon their marking contacts.

If during the transmission of a spacing impulse from station A to station B the operator opened the key 18′ in order to get control of the circuit, there would be no indication produced at station A of the attempt of the operator at station B to get such control. That will be apparent when it is realized that during the transmission of a spacing impulse from station A to station B current ceases to flow through the path that includes the windings 7′—8′ and 3′—4′, the key 18′ and the sounder 17′. If, however, the key 18′ is maintained open when the operator at station A closes the key 18 for the transmission of a marking impulse, he will receive an indication of the attempt of the operator at station B to get control of the circuit. Thus, if key 18 is closed the armatures of the sending relay and of the break relay will move to their marking contacts. The flow of current from battery 29 through winding 13′—14′ will move the armature of the receiving relay at station B to its marking contact. That connects the negative battery 26′ to the windings of the sending relay and of the break relay, but since the key 18′ is open current will not flow through the windings 7′—8′ and 3′—4′. Current will flow from ground through windings 1′—2′ and 5′—6′, and as a result thereof the armatures will be moved to their spacing contacts. The movement of the armature of the sending relay to its spacing contact connects the battery 30′ to the line L_3 and causes current to flow through the winding 13—14 in such direction as to move the armature of the receiving relay at station A to its spacing contact. That connects the positive battery 27 to the windings of the break relay and the sending relay, and since that battery opposes, in polarity, battery 19 connected to the loop at that station, current will not flow through the winding of the sounder 17. Consequently, no sound will be produced by that instrument, and since that represents an abnormal condition during the transmission of a marking impulse the operator at station A realizes that the other operator is attempting to get control of the circuit.

The system described hereinbefore is rendered immune to the effects of differences of earth potential by employing four conductors beween stations, using separate pairs for transmission in each direction and grounding both ends of each pair at the same station. Thus, pair L_1—L_2 has its ends grounded at station A and pair L_3—L_4 has its ends grounded at station B. Since both ends of a

pair are grounded at the same place no difference of potential can exist between these ends, and accordingly, there will be no flow of current due to earth potential differences through the winding of the relay connected with the conductors of each pair.

The manner in which the system is rendered free from power line induction will be understood from the following description. Let it be assumed that a source of inductive disturbance sets up in the conductors L_1 and L_2 a voltage to ground. Current will accordingly flow over the conductor L_1 to ground through the variable resistance 28, and also over the conductor L_2 to ground through the resistance of the battery connection at station A. By adjustment of the resistance 28 those currents may be equalized, and accordingly no difference of potential will exist between L_1 and L_2; consequently, current will not flow through the winding 13′—14′. In similar manner the winding 13—14 of the receiving relay at station A is rendered free from the effect of inductive interference set up in the conductors L_3 and L_4.

The arrangement shown in Fig. 2 is one that may be employed wherever freedom from inductive disturbances and from interference due to differences of earth potential already exist. In the arrangement of Fig. 2 the circuit extending from the sending relay at station A to the receiving relay at station B is terminated at the latter station by connecting the winding 13′—14′ to ground at that station, the connection including the variable resistance 28′. In like manner, the winding 13—14 is connected to ground at station A, the connection including the variable resistance 28.

While the invention has been described as embodied in a particular form, it is to be understood that it is capable of embodiment in other and different froms without departing from the spirit and scope of the appended claims.

What is claimed is:

1. In a telegraph signaling system, the combination with a sending relay at one station of a receiving relay at another station, a line wire connecting the armature of the said sending relay to one terminal of the winding of the said receiving relay, another line wire connecting the other terminal of said winding of said receiving relay to ground at the first mentioned station, and means connected with the said other line wire to render the impedance to ground of the said other line wire substantially equal to the impedance to ground of the said first mentioned line wire.

2. In a telegraph signaling system, the combination with a pair of line wires substantially parallel so as to be equally affected by a source of external interference, of a sending relay having an armature and grounded sources of potential of opposite polarities connected to its contacts, one of said line wires being connected to said armature and also to one terminal of the winding of said receiving relay, and the other line wire extending from the other terminal of the receiving relay winding to ground at the point where the said sending relay is located, the said line wires having substantially equal impedance to ground.

3. In a telegraph signaling system, the combination with one station having a sending relay and a receiving relay of a second station also having a sending relay and receiving relay, two pairs of line conductors extending between said stations, one pair connecting the sending relay at the first station to the receiving relay at the second station, and also connecting the latter receiving relay to ground at the first station, and the other pair of line wires connecting the sending relay at the second station to the receiving relay at the first station and also connecting the last mentioned relay to ground at said second station, the impedance to ground of the conductors of each pair being substantially equalized.

In testimony whereof, I have signed my name to this specification this 22nd day of June, 1931.

FRED J. SINGER.