

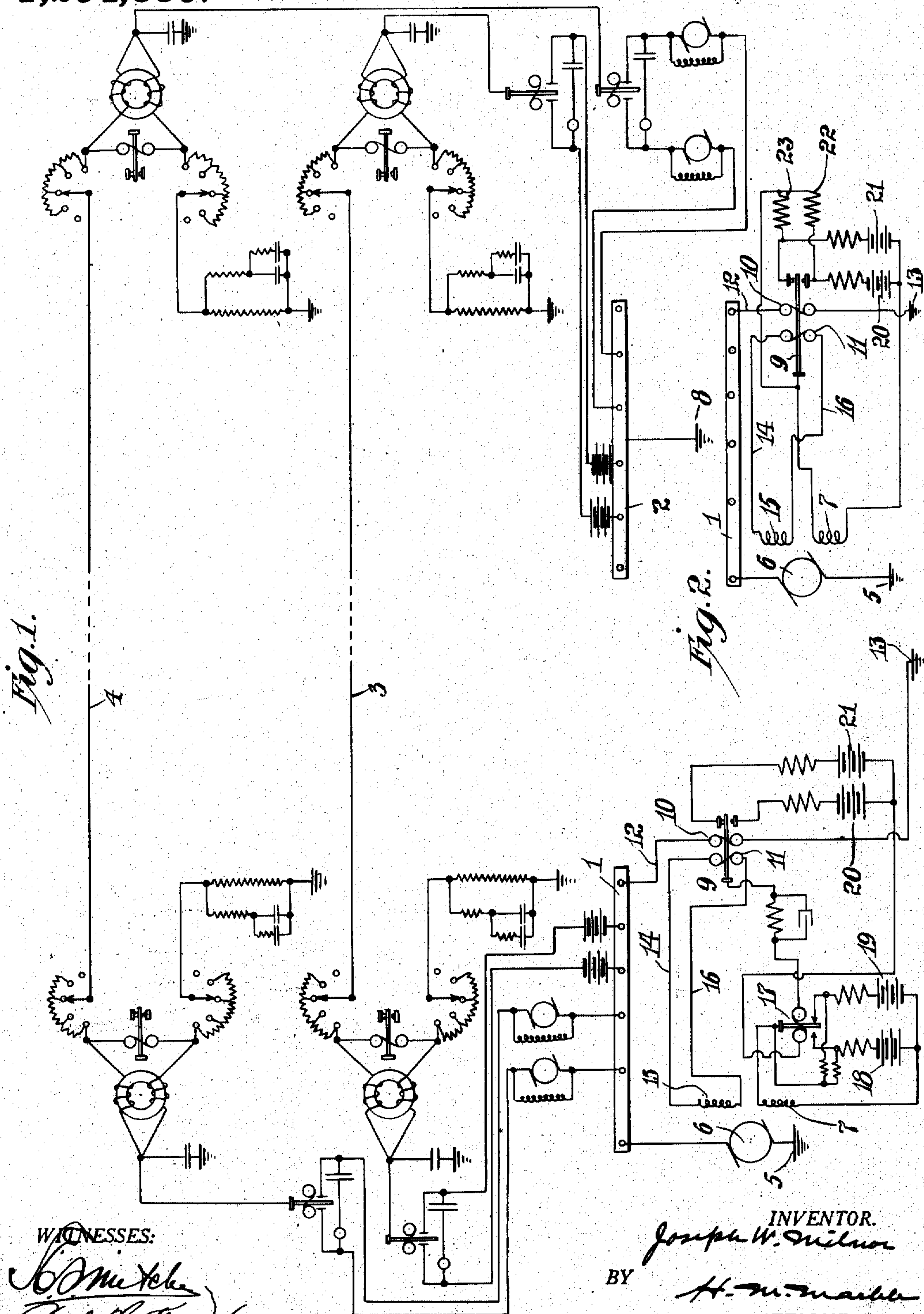
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MEANS FOR COMPENSATING FOR DISTURBANCES OF EARTH POTENTIAL.

APPLICATION FILED MAR. 10, 1917.

1,254,830.

Patented Jan. 29, 1918.



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# UNITED STATES PATENT OFFICE.

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MEANS FOR COMPENSATING FOR DISTURBANCES OF EARTH POTENTIAL.

1,254,830.

Specification of Letters Patent.

Patented Jan. 29, 1918.

Application filed March 10, 1917. Serial No. 153,824.

*To all whom it may concern:*

Be it known that I, JOSEPH W. MILNOR, a citizen of the United States of America, and a resident of New York, county of New York, and State of New York, have invented certain new and useful Means for Compensating for Disturbances of Earth Potential, of which the following is a specification.

This invention relates to means for compensating for differences of potential between the ground connections at the two ends of a system of electrical communication, such for example, as a telegraph system, and comprises a generator located in one of the ground connections of the system, together with novel control means for that generator, and other features all as hereinafter described and particularly pointed out in the appended claims.

The object of my invention is to provide simple and reliable means for compensating for differences of potential between the grounds at the two ends of a system of communication, and to avoid any periodic oscillation of potential due to the action of the compensating means itself.

I will now proceed to describe my invention with reference to the accompanying drawing, in which Figure 1 is a diagram illustrating diagrammatically a compensating arrangement embodying my invention, in connection with systems of communication extending between the points between which the differences of potential exist; and Fig. 2 is a fragmentary diagram illustrating an alternative arrangement.

In the operation of telegraph systems, telephone systems, and the like, much trouble is frequently experienced due to a difference of potential between the grounding points of the system, which difference of potential is commonly due to neighboring electric railways or electric power circuits or the like. This difference of potential, due to causes external to the system of communication, is frequently variable, which makes correction for such difference of potential by ordinary means, yet more difficult. By the present invention such difficulty is overcome.

In Fig. 1 of the accompanying drawings, 1 and 2 designate grounding bus-bars at the two points between which the difference of earth potential exists; and 3 and 4 designate the line wires of systems of communication

extending from the one bus-bar to the other. At the ends of these conductors 3 and 4 I have shown, diagrammatically, the transmitting and receiving arrangements of ordinary duplex telegraph systems, such transmitting and receiving arrangements being too well known to require description here. The systems of communication of wires 3 and 4 are entirely separate and distinct, and there may be as many of these systems between bus-bars 1 and 2, as desired; nor need these systems of communication be of the same nature; that is to say, one might be a telegraph system and the other or others telephone systems.

5 designates an earth connection for bus-bar 1, and 6 designates a generator interposed in that ground connection, 7 being the field windings of that generator. 8 designates the ground connection for bus-bar 2. It will be apparent that generator 6, if properly controlled and operated, will create a potential, equal and opposite to the earth potential existing between ground connections 5 and 8, so neutralizing, or compensating for, the actual difference in earth potential between points 5 and 8.

9 designates a polar relay having two magnet windings 10 and 11. For convenience in illustration, these two windings 10 and 11 are shown as on separate spools; but in practice, and as is well known, these windings will commonly be located on the same spools. Winding 10 is located in a conductor 12 leading from bus-bar 1 to some point 13, at which no potential disturbance exists. This point 13 is usually a point located laterally with respect to the conductors 3 and 4; that is to say it is not usually a point which is either in a direct line between points 1 and 2, or a point close to the line conductors 3 and 4. Winding 11 is in a circuit comprising a conductor 14 extending through a coil 15 in inductive relation with respect to the field coil 7 of generator 6; the circuit thence extending through conductor 16 back to winding 11. It will be apparent that continual reversal of the polarity of the current passing through field coil 7 will induce currents of opposite direction in coil 15 and circuit 14—16, so causing vibration of the armature of relay 9.

The field coil 7 of generator 6 is connected to the armature of a polar relay 17, the cir-



cuit thence passing through said armature and the one contact stop or the other of the relay, and through one or the other of two opposed batteries 18 and 19, back to the coil 7. The magnet winding of relay 17 is in a circuit passing through the armature of one or the other of the opposed contact stops of relay 9, and thence through one or the other of opposed batteries 20 and 21, back to the magnet windings of said relay 17.

The action which results with the circuit arrangements thus described, is as follows:

Assume that there is no current in the windings 10 of relay 9. If at a given instant the tongue of relay 9 touches its upper contact there will be a current through battery 21 and the magnet windings of relay 17 tending, we will say, to move the armature of relay 17 to the right. As soon as this armature touches its right hand contact point current will pass in one direction through field coil 7 of the generator 6; and the consequent energization of field coil 7 will induce a current flow in the inductively-associated coil 15; which current, transmitted through conductors 14 and 16, will act through magnet coil 11 of relay 9 to reverse the armature of that relay, thereby in turn reversing the magnetization of the coil of relay 17 and so in turn reversing the position of the armature of that relay, thereby inducing a current in the opposite direction in coil 15 and so reversing the position of the armature of relay 9. It will be apparent that, with no current passing through coil 10 of relay 9, the armatures of the two relays vibrate continually. Since, due to the large self inductance of generator field winding 7, a comparatively long time (perhaps one second or more) is required to effect a considerable change in the current flowing through it, it is evident that the rapid vibrations of the relays can cause only exceedingly small oscillations of the current in those field windings 7.

If there be a current in winding 10 of relay 9, due to difference of potential between the "corrected" bus-bar 1 and the true earth potential at 13, the armature or tongue of relay 9 will tend to rest against its one contact or the other (according to the direction of current in conductor 12) a greater length of time than it does against the other contact of that relay. As a result, the tongue of relay 17 will also tend to rest against one contact a greater length of time than against the other, thus enabling the current in generator field winding 7 to build up to a value sufficient to cause the generator to compensate for the difference in potential between bus-bar 1 and ground 13.

Heretofore a system for equalizing the potentials of grounding points has been devised, wherein a generator is interposed between one terminal bus-bar and the ground

for that bus-bar, such generator being intended to compensate for difference of potential existing between the two terminal bus-bars of the systems, such for example as bus-bars 1 and 2; a special line conductor being employed to connect these two terminal bus-bars, and there being in such line conductor the field magnets of a polar relay, the armature contacts of which relay control two opposing batteries, which are connected in circuit (through the contact points of the relay) with the field coils of the said generator. In practical use of this former system referred to it has been found that the potential of the "corrected" bus-bar oscillates about the mean potential, instead of being steady. In one case the oscillation was found to be equivalent to an alternating current potential of about ten volts with a frequency of about fifteen cycles per second; the potential being between the corrected bus-bar and the true earth. The cause of this oscillation of potential is undoubtedly the inductance of the field circuit of the generator, giving to that field circuit a certain time factor, and the time factor of the relay determined in part by its adjustment. By the present invention, this existence of a normal period of the field circuit producing a potential oscillation such as described, is avoided; the relay 9 being self-vibratory (except as its normal vibrations are checked by current through the circuit 12 and windings 10) has a relatively high rate, so that the batteries 16 and 17 affect the field windings 7 of the generator 6 not at all, practically, unless there be a distinct current flow in conductor 12 and windings 10 tending to cause the armature of relay 9 to linger against one stop or the other, and so causing the armature of relay 17 to correspondingly linger.

It is not necessary that two cooperating relays, such as relays 9 and 17, be employed for effecting the rapidly recurring reversal of the field circuit 7 of generator 6. In Fig. 2 I illustrate an arrangement wherein a single relay 9 is employed for this purpose. In this figure, as in Fig. 1, 1 designates a correcting bus-bar of the system, 6 the correcting generator, 7 and 15 cooperating field coils of the generator, 9 the relay referred to having magnet coils 10 and 11; 20 and 21 designate opposing batteries or other generators, and 12 designates a control circuit leading from the bus-bar 1 to a point of neutral potential 13. In this arrangement the circuit of magnet coils 11 includes the field coil 15, and as, by the vibratory action of the armature of relay 9, the current in field coil 7 is reversed, the current induced in field coil 15, as a result of such reversal, acts through magnet coil 11 upon the armature of relay 9 to maintain such vibration. The action of the con-



trol circuit 12 on the relay is the same as in Fig. 1. Resistance shunts 22 and 23 connect field coil 7 with batteries 20 and 21 respectively.

5 In a companion application, Serial No. 153,822, I have claimed the method of compensating for earth potential disturbance, and the method of preventing oscillation of potential due to the resonance of the field  
10 circuit of the generator itself, carried out by the apparatus above described; and in such other application I have also claimed means, alternative to the means herein illustrated and described, for effecting correction of  
15 earth potential and for preventing cyclic disturbance of potential by the correcting generator itself. In still another companion application, Serial No. 153,823, I have claimed  
20 still other means for correcting for disturbance of earth potential and for preventing cyclic disturbance of potential due to the correcting generator itself. The claims generic to the said various embodiments of  
25 my invention are included in application Serial No. 153,822.

The means for preventing the "hunting" of the correcting generator, i. e., the impressing of a voltage oscillation by the correcting generator itself, above described, is  
30 not confined to the prevention of, or correction or compensation for, direct current ground potential disturbance, but is applicable also to the prevention of such "hunting" action in the case of correction for al-  
35 ternating current electro-magnetic induction, or alternating current ground potential; and in my companion application, Serial No. 153,825, I have shown means for preventing the "hunting" action of my com-  
40 panion application, Serial No. 153,822, employed for correction for alternating current disturbances. The substitution of the means for preventing hunting action, herein de-  
45 scribed, for the particular means for the purpose shown in my said application, Serial No. 153,825, is obvious in view of the relations between the disclosures of the present application and that of my applica-  
50 tion Serial No. 153,822. In such use of the present invention for correction of alternating current disturbance, a control circuit, like the control circuit 12, herein illustrated and described, will be employed, such a control circuit being exposed to the influence of  
55 the alternating current disturbance, just as, in the present application, the control circuit 12 is exposed to the ground potential.

What I claim is:

1. A ground connection for a system of communication comprising a connection  
60 from one point of such system to a grounding point at which disturbances of earth potential may exist; a generator in such ground connection having a controlling field cir-  
65 cuit, a source of current supply therefor, two relays, one of said relays arranged by its vibration to reverse the current in said field circuit, a coil inductively associated  
70 with respect to said generator field circuit and connected operatively with a magnet circuit of the second relay, to cause such second relay to vibrate, said second relay pro-  
75 vided with means for causing said first mentioned relay to vibrate, said second relay having a magnet coil in addition to that magnet coil by which it is caused to vibrate,  
80 and another ground connection for such system of communication passing through such second magnet coil of such second relay.

2. In a system of communication comprising a correcting generator, the combination  
85 with a correcting generator having a controlling field circuit, relay means arranged by vibration to reverse the current in said field circuit; a coil inductively associated  
90 with respect to said generator field circuit, and arranged to maintain said relay means in vibration, said relay means having a controlling magnet in addition to that coil by which it is caused to vibrate.

3. In a system of communication comprising a correcting generator arranged to correct for external disturbances imparted to the system, the combination with a correct-  
95 ing generator having a controlling field circuit, relay means arranged by its vibration to reverse the current in said field circuit, said relay means having an operating mag-  
100 net, a coil inductively associated with said generator field circuit, and connected operatively with said magnet to cause the vibration of such relay means, such relay means having also another control magnet, and a control circuit subjected, like such system of communication, to the disturbance, and pass-  
105 ing through such controlling magnet.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

JOSEPH W. MILNOR.

Witnesses:

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PAUL H. FRANKE.