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TELEGRAPHIC REPEATING APPARATUS.

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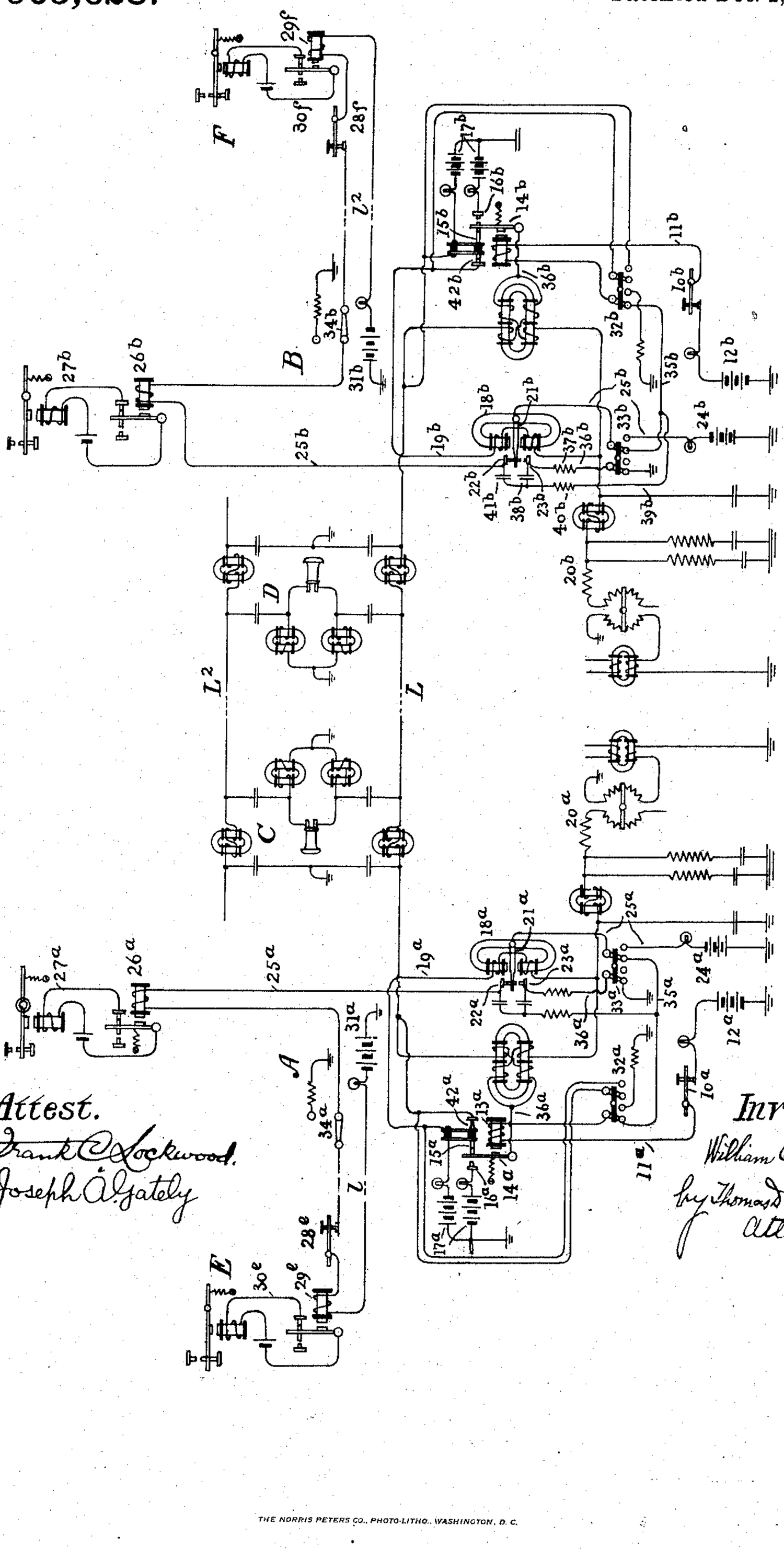

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TELEGRAPHIC REPEATING APPARATUS.

No. 905,628. Specification of Letters Patent. Patented Dec. 1, 1908.

Application filed April 29, 1908. Serial No. 429,975.

To all whom it may concern:

Be it known that I, WILLIAM E. ATHEARN, residing at New York, borough of Brooklyn, in the county of Kings and State of New York, have invented certain Improvements in Telegraphic Repeating Apparatus, of which the following is a specification.

The present invention has reference to telegraph systems in which a multiplex circuit, or one where a plurality of messages may be transmitted simultaneously over a single line, is employed to connect a circuit adapted for the transmission of one message at a time with another circuit of the same character. The multiplex line under such circumstances operates at any instant in one direction only; it receiving impulses from one single-transmission line and repeating them into the other.

This invention, though obviously of more general application, is hereinafter described as especially useful in connection with organizations in which this intermediate or repeating circuit is a polar bridge duplex constituting one side of a composite telephone and telegraph system.

The invention aims to secure this repeating action in a simple and effective manner, with a minimum number of repetitions of each impulse and with the addition of but few moving parts to the ordinary duplex apparatus.

A further object of this invention is to render the repeating system independent of a condition of unbalance between the real and artificial lines, to which a composite circuit is peculiarly liable, on account of the wide variations in the grounded capacity of the real line.

With these and other objects in view, the invention consists in the features and combinations which will now be particularly described and pointed out in the claims.

The accompanying drawing is a diagrammatic illustration of one system to which my invention is applied.

There is shown at A and B, telegraph central stations joined by a line conductor L which is one limb of a composite circuit, the other side of which is furnished by a conductor L^2. At these stations, and others to be hereinafter mentioned, corresponding apparatus, with their elements and those of the local circuits, will be designated by the same numerals at both the home and distant stations, but distinguished from one another by superscripts indicating the particular station at which each is situated. Between the conductors L and L^2 are bridged telephone stations C and D. The arrangement of the telephone system and the manner in which the telephone and telegraph currents are separated form no part of this invention, and may be, for example, as described in the patent to William E. Athearn, No. 778,297, dated December 27, 1904. The conductor L^2 would usually furnish means for communication between a second pair of telegraph stations, but as this side of the system would not differ essentially from that including the conductor L, only the latter will be considered.

The stations A and B are arranged for multiple telegraphic transmission by the polar duplex method, this being chosen because of its simplicity and because working by reversals of polarity gives better results upon composite lines, which usually have a high capacity, than does operation by merely making and breaking the circuit. The apparatus for this purpose is shown as consisting of keys 10^a and 10^b included in local circuits 11^a, 11^b, each with a battery or other source of current 12^a, 12^b, and the winding of a pole changing transmitter 13^a and 13^b, respectively. These transmitters, by the coöperation of their armatures or movable contact members 14^a and 14^b with front and back contacts 15^a, 15^b and 16^a, 16^b under the control of the associated home key, connect the opposite poles of main batteries 17^a and 17^b to the line L. The resulting impulses are received at each distant station by polarized relays 18^a and 18^b, respectively, which are in bridges 19^a, 19^b from the line L to corresponding artificial lines 20^a, 20^b. The relay armatures 21^a, 21^b play between front and back stops 22^a, 22^b and 23^a, 23^b, contact with the former two of which applies current from batteries 24^a and 24^b to local circuits 25^a and 25^b including the winding of relays 26^a, 26^b which open and close sounder circuits 27^a, 27^b. The construction of this apparatus and the arrangement of the artificial lines and accessory apparatus, except as hereinafter pointed out, is in accordance with standard practice, and neither it nor the operation of the duplex system, as such, need be further considered.

Joined to the stations A and B by lines *l*

and l^2, respectively, are telegraph substations E and F adapted for single transmission. Keys 28^e, 28^f and relays 29^e, 29^f governing local circuits 30^e, 30^f are situated at these substations, and serve to send and receive Morse impulses in the usual manner by opening and closing the circuits of batteries 31^a and 31^b. Switches 32^a, 32^b, 33^a, 33^b and 34^a, 34^b are in circuit at each of the stations A and B, and are associated, respectively, with the transmitters, polarized relays and substation lines. When these switches are thrown to the right they provide for the ordinary duplex operation of the system, excluding the substations, but when at the left, as illustrated in the drawing, the duplex circuit will be prepared for the carrying out of this invention; and this aspect of the system will now be described in detail.

The apparatus and circuits are so organized, that the key at the sending substation governs the pole changing transmitter at its home central station, which in turn operates the polarized relay at the distant central station, and this repeats directly into the line of and actuates the relay at the receiving substation. To accomplish this, the key and relay winding at each substation is placed in series with the winding of the home transmitter and front stop and armature of the home polarized relay. Considering E as the originating station, this transmitting portion of the circuit will be from the grounded battery 31^a through the line l, including the winding of relay 29^e, key 28^e and switch 34^a, conductor 25^a, including the winding of relay 26^a and the front or normal resting contact 22^a and armature 21^a of the polarized relay, switch 33^a conductor 35^a, switch 32^a and conductor 11^a, in which is the winding of the transmitter 13^a, key 10^a, and battery 12^a to ground. Therefore, when the key 28^e is manipulated it will send pulses of current through the winding of the transmitter 13^a at station A, causing the armature 14^a to act as a secondary key. The alternate contact of this armature with the stops 15^a and 16^a will send negative and positive currents from the grounded battery 17^a through the conductor 36^a to ground, by way of both the real line L and the artificial line 20^a. When these lines are approximately balanced, or possess the same electrical properties, the potentials at the ends of the bridge 19^a will be equal for these outgoing currents, and the winding of the home polarized relay 18^a will receive none of the transmitting current, so the armature will be retained in its normal position against the front stop 22^a by negative current applied by the distant transmitter 13^b, as in duplex operation. Consequently, the transmitting circuit just traced remains unbroken at the relay 18^a and is under the full control of the key 28^e. The greater part of the outgoing current over the line L finds its way to ground through the bridge 19^b at the distant central station B, including the winding of polarized relay 18^b, and through the artificial line 20^b. The armature 21^b of relay 18^b is thus caused to alternately leave and engage its front stop, opening and closing the receiving circuit, of which the substation line l^2 is a part, and repeating into this line the signals transmitted from the substation E, these being received by the relay 29^f at the substation F.

It will be seen that although the non-operation of the home polarized relay has been provided for, the transmitter 13^b at the distant central station, so far as yet described, would be actuated through the interruption and completion of its circuit by the armature 21^b. It thus becomes necessary to provide for the continuous energization of the transmitter during the operation of its associated relay. While the armature 21^b is resting against its front stop 22^b the winding of the transmitter 13^b will be traversed by the current which operates the receiving relay 29^f. When the armature 21^b is upon its back stop 23^b, a path to ground from battery 12^b is furnished through the winding of the transmitter 13^b by a connection 36^b and the switch 33^b. This ground connection contains a resistance 37^b approximating that of the circuit to ground through the line l^2, and it may therefore be considered as an artificial line. Thus, the battery 12^b and the transmitter winding are in circuit with both stops of the polarized relay through the ground, connecting from the stop 22^b through the line l^2 and from the stop 23^b through the path 36^b, both circuits being completed by the armature 21^b.

It is evident that during the movement of the armature of the polar relay 18^b between its contact stops, there is an interval of no current through the magnet coils of the pole changing transmitter 13^b, and a consequent liability to produce a false signal, which, however, in a well known way may be lessened by such a close adjustment of the contact stops of the said polar relay that the time required for the armature movement is very brief. It is, however, found that the difficulty is not wholly met by thus shortening the travel of the armature, and that the exigencies of practice require that an energizing current shall be available and protracted through the pole changer magnet coils during the movement period of the relay armature 21^b. This is supplied by a condenser 38^b contained in a bridge 39^f between the back stop 23^b and conductor 35^b. When the armature 21^b leaves the front stop 22^b, the battery 12^b, severed from its ground connection through the line l^2, increases the charge of this condenser, and the consequent rush of current through the winding of the transmitter 13^b prolongs its

magnetism, holding its armature 14^b until the relay armature reaches its back stop. At this time the condenser is discharged through the conductors 25^b, 35^b and 39^b, the latter including sufficient resistance 40^b to prevent the condenser from being short circuited and from producing a spark at the contact 23^b. The succeeding break of the relay armature with its back stop causes the condenser to be charged in a similar manner, bridging the interval required for said armature to again reach the front stop; whereupon, the cycle is repeated. As a result of this organization, the winding of the transmitter 13^b is never long enough without current to cause it to open this receiving portion of the repeating circuit. A condenser 41^b may be connected between the front stop 22^b and the conductor 39^b to absorb the extra current, which would otherwise produce a spark when the circuit of the substation line is broken at said front contact. Convenient values for the capacity of the condensers 38^b and 41^b are four microfarads and three-tenths of a microfarad, respectively. The resistance 40^b may be three hundred ohms.

It will be understood that all that has been said regarding transmission from substation E to substation F applies equally to the operation of the system in the opposite direction, the transmitting portion of the repeating circuit in the latter case being at the central station B and the receiving portion at the central station A.

A difficulty arises in the operation of the system which it has been found desirable to remedy, and the means employed for this purpose has another function which is of considerable importance. Suppose the operators at the substations E and F were to simultaneously open their keys 28^e and 28^f. From what has already been stated, it will be evident that both transmitters 13^a, 13^b would release their armatures, and this would reverse the current through the windings of the polarized relays 18^b, 18^a, respectively. When the armatures of the relays reach their back stops under the influence of this reversal, they would close the circuits of the windings of both transmitters through ground connections 36^b and 36^a; which transmitters, attracting their armatures, would send out reversed currents and again bring the armatures of the polarized relays to their front stops, this continuing as long as both keys 28^e, 28^f are open, and causing all the relays and sounders of the system to chatter until one of the keys is closed. To overcome this, the transmitters 13^a and 13^b have a pair of extra contacts 42^a and 42^b, respectively, one of each pair being movable with the front contacts 15^a and 15^b, said front and extra contacts being mounted upon springs insulated from one another but adapting the elements for movement together. The contacts 42^a and 42^b are included in the bridges 19^a and 19^b with the windings of the polarized relays, and when the transmitters are energized are closed by the pressure of the armatures 14^a, 14^b. Upon the release of the armatures, however, the springs separate these extra or bridge contacts, opening the circuits of the relay windings and rendering them temporarily inoperative. As a consequence of this, each polarized relay responds to current impulses from the distant station only when the home transmitter, and therefore the associated substation line, is closed, and the reactive effect between the ends of the repeating system is impossible. Furthermore, since the winding of each polarized relay is disconnected from the circuit when the associated transmitter applies reversals of polarity to the line L, the system will not be dependent upon a correct balance between this line and the artificial lines 20^a, 20^b to prevent the passage of outgoing currents through the relay windings and the maintenance at the relay armatures of the continuity of the sending portion of the repeating system.

Having thus described my invention, I claim:

1. A telegraph repeating system comprising a circuit having at each of two stations a current reversing transmitter and a polarized relay, and a single-transmission circuit arranged to control the transmitter at one station and being itself directly controlled by the relay at the same station.

2. The combination with telegraph stations, of a multiplex line connecting the stations and being provided thereat with an electromagnetic transmitter and with a relay, and a line for single transmission extending to one of the stations and including the winding of the transmitter and contacts of the relay thereat.

3. The combination with two polar duplex telegraph stations connected by a line circuit and each provided with a pole changing transmitter and a polarized relay, of a single-transmission line extending to each station, each of said lines being adapted to control the transmitter at its home duplex station and being controlled in the contacts of the polarized relay at said station through the transmitter at the distant duplex station.

4. A telegraph repeating system comprising a transmitting apparatus and a receiving apparatus connected in circuit at each of a plurality of stations, and means effective upon the operation of the transmitting apparatus for rendering the receiving apparatus at the same station temporarily inoperative.

5. A telegraph repeating system comprising a current reversing transmitting apparatus and a polarized receiving apparatus connected in circuit at each of two stations, and

means controlled in contacts of the transmitting apparatus for opening the circuit of the receiving apparatus at the same station.

6. A telegraph repeating system comprising a transmitter and a relay connected in circuit at each of two stations, the transmitter having contacts controlling the relays at both the home and distant stations.

7. The combination with two duplex telegraph stations having a line extending between them and each being connected to an artificial line, of a polarized relay at each station bridged between the connecting line and the artificial line thereat, a transmitter at each station having contacts for controlling the relay at the distant station and for opening and closing the bridge of the relay at the home station, and a single transmission line joined to both the relay and transmitter at each station.

8. A telegraph repeating system comprising a transmitting apparatus and a receiving apparatus each provided with a magnetizing winding and with a movable contact member, the contact member of the receiving apparatus completing a circuit for the winding of the transmitting apparatus at its opposite extremes of movement.

9. A telegraph repeating system comprising a transmitting apparatus and a receiving apparatus each provided with a magnetizing winding and with a movable contact member, the contact member of the receiving apparatus normally completing the energizing circuit for the transmitting apparatus, and means for supplying current to the winding of the transmitting apparatus during the movement of the contact member of the receiving apparatus.

10. A telegraph repeating system comprising a transmitting apparatus and a receiving apparatus each provided with a magnetizing winding and with a movable contact member, the contact member of the receiving apparatus completing a circuit for the winding of transmitting apparatus at its opposite extremes of movement, and means for supplying current to said winding during the movement of the contact member.

11. In a repeating system, the combination with telegraph lines, of a relay provided with a winding and with an armature movable between opposed stops, said winding being connected to one line and one of the stops to another line, a transmitter having a winding in series with the relay armature, and a source of current connected to the transmitter winding and being in circuit with both stops of the relay.

12. In a repeating system, the combination with telegraph lines, of a relay provided with a winding and with an armature movable between opposed stops, said winding being connected to one line and one of the stops to another line, a transmitter having a winding in series with the relay armature, a source of current connected to the transmitter winding and being in circuit with both stops of the relay, and a condenser adapted to be charged from the source of current through the transmitter winding.

13. The combination with a polar bridge duplex telegraph line having the usual polarized relay and electro-magnetic transmitter, of a single-transmission line connected to the front stop of said relay and an artificial line joined to the back stop of said relay, both of the lines being grounded, a grounded battery in circuit with the lever of the relay and the winding of the transmitter, and a condenser bridged between the back stop and the lever.

14. In a telegraphic system the combination of a main circuit extending between central terminal stations and operating by current reversals; branch circuits extending from the said central stations respectively to substations, and operating by current intermittences; a receiving instrument at each central station responsive to the current reversals of said main circuit produced at the other central station, and adapted to itself produce corresponding current intermittences in the associated branch circuit; a transmitting instrument at each central station responsive to the current intermittences of the associated branch circuit and organized to produce corresponding reversals in said main circuit; and means controlled by the said transmitting instrument for rendering the receiving instrument at the same station inoperative during each intermittence of the associated branch circuit, substantially as set forth.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses, this 23rd day of April 1908.

WILLIAM E. ATHEARN.

Witnesses:

ROBERT FOSTER JANES,

SYLVANUS H. COBB.