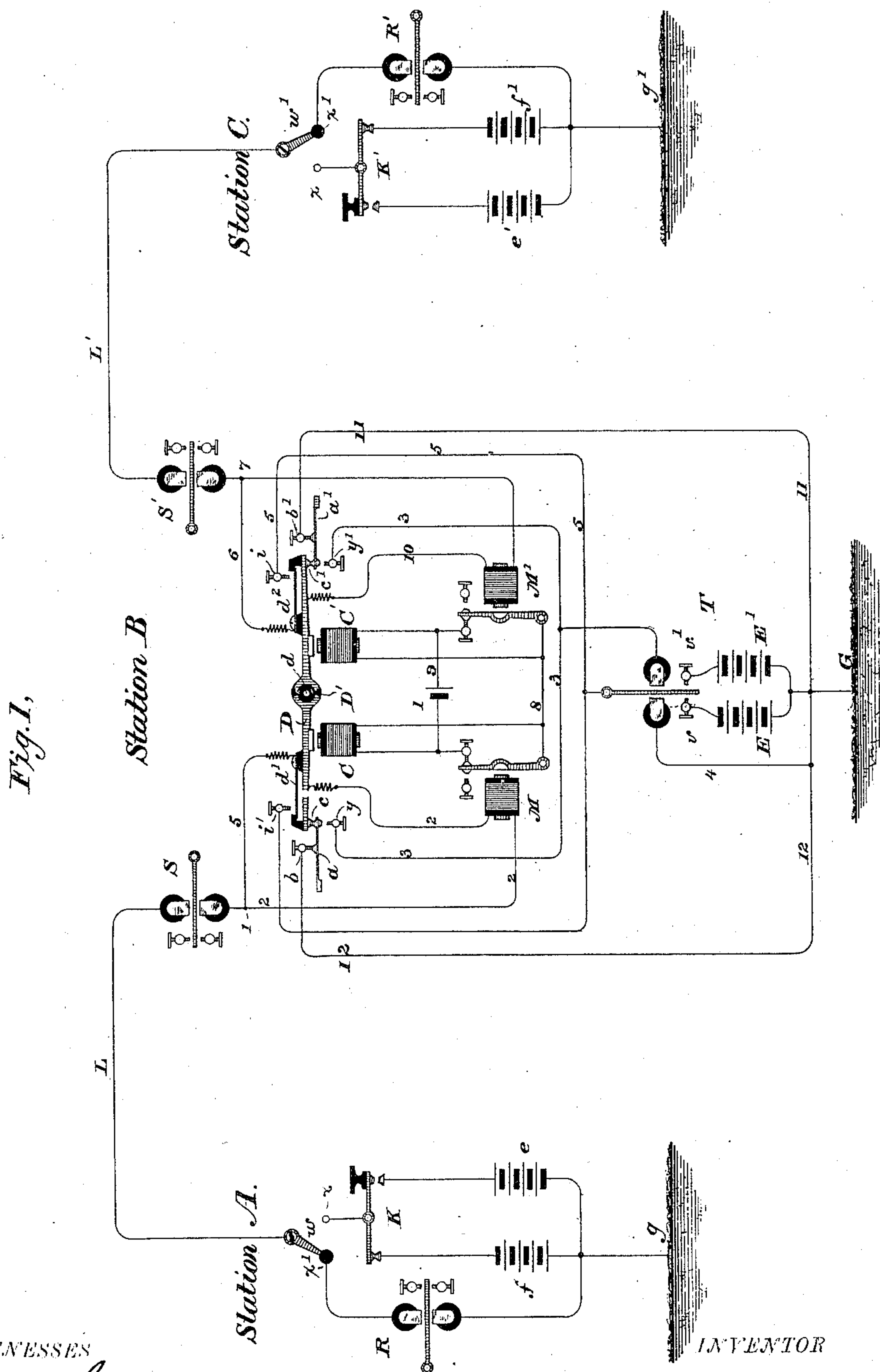


2 Sheets—Sheet 1.

Patented Oct. 2, 1883.

No. 286,107.



WITNESSES

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(No Model.)

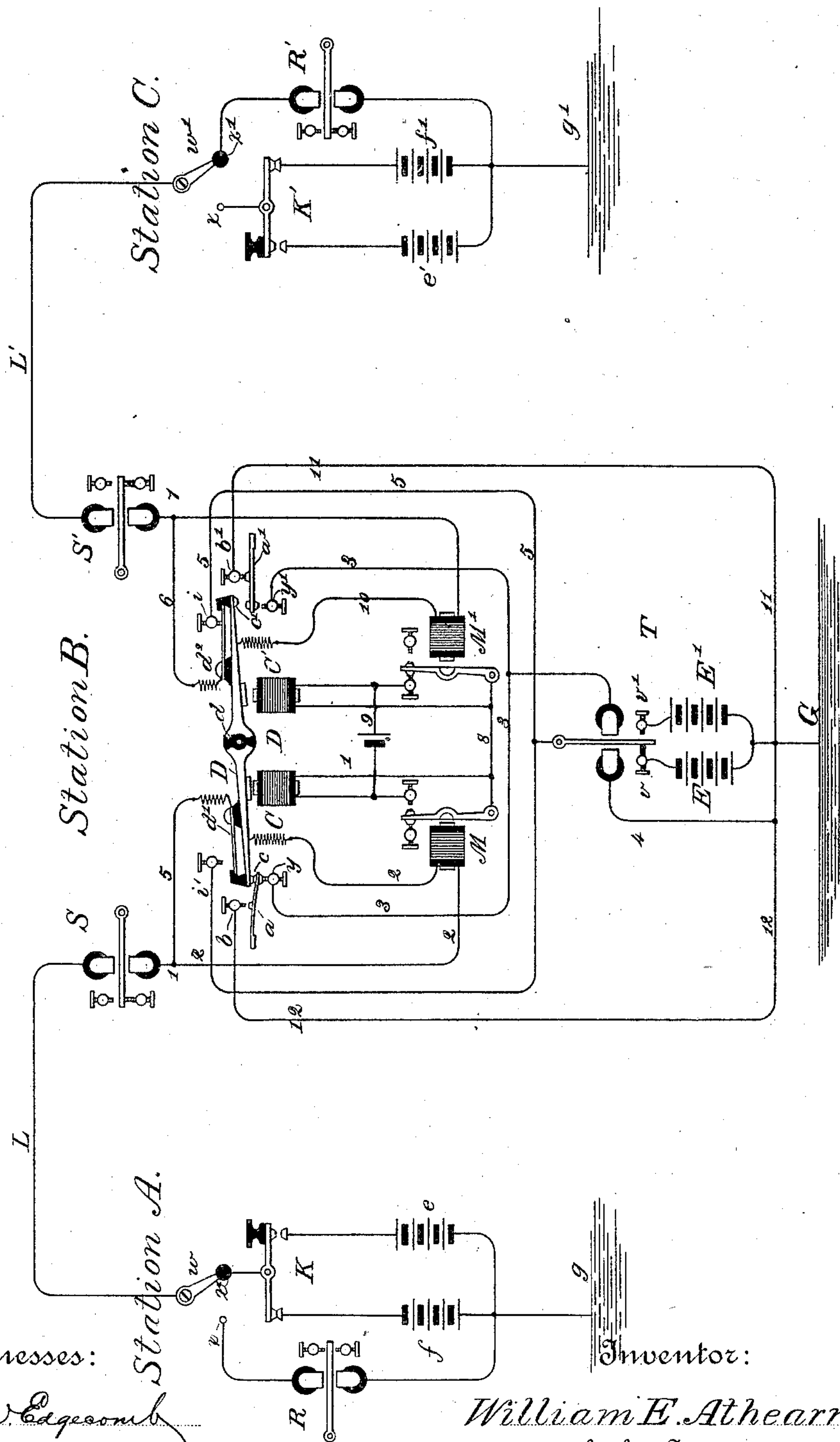
2 Sheets—Sheet 2.

W. E. ATHEARN.
TELEGRAPHIC REPEATER.

No. 286,107.

Patented Oct. 2, 1883.

Fig. 2.



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TELEGRAPHIC REPEATER.

SPECIFICATION forming part of Letters Patent No. 286,107, dated October 2, 1883.

Application filed October 25, 1882. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM E. ATHEARN, a citizen of the United States, residing in Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Automatic Telegraphic Repeaters, of which the following is a specification.

My invention relates to a certain class of telegraphic apparatus known as "automatic repeaters" or "translators," the function of which is to receive the signals which have been telegraphically transmitted over a line from a distant station, to retransmit the said signals over a second line, and also to perform the reverse operation of retransmitting and repeating similar signals from the second line into the first without the intervention of an attendant. The apparatus hitherto in use for this purpose has been designed for the reception and retransmission of telegraphic signals formed by alternately interrupting and restoring an electric current of unchanged polarity, but is not adapted to the requirements of telegraphic systems in which the signals are formed by transmitting electric currents of alternating polarity.

The object of my invention is to receive and retransmit in either direction telegraphic signals of alternating polarity; and to this end I make use of a pole-changing or alternating current-transmitter, which is adapted to be operated by the agency of currents of like character received upon one line and to retransmit corresponding currents upon another line; and it also comprises an automatic switch, whereby the receiving and transmitting device may be automatically interchanged between one line and the other, so that retransmission in either direction may be effected without the aid of an attendant.

The subject-matter claimed as new will be hereinafter more specifically described and pointed out.

In the accompanying drawings, Figure 1 is a theoretical plan illustrating my invention, in which I have shown the apparatus at an intermediate or repeating station in connection with the sending and receiving apparatus of two terminal stations, the latter being indicated in outline. The intermediate station is

designated as station B, and the terminals as stations A and C, respectively. Fig. 2 represents the same apparatus in the position which it assumes during the act of transmitting from station A to station C.

The apparatus at station A comprises a key, K, the lever of which may be connected to the line L at pleasure by means of a switch or button, *w*. The front contact of the key K is connected with the positive pole of a main battery, *e*, and the rear contact with the negative pole of another similar battery, *f*, the opposite poles of said batteries being united with each other and with the earth at *g*. It will be understood, therefore, that when the key K is manipulated by the operator in the usual manner of transmitting arbitrary telegraphic signals alternate positive and negative currents will be transmitted through the switch *w* over the line L to station B, the switch being in contact with *x*. When signals are to be received over the line L from station B, the switch *w* is removed from the contact *x* and placed upon the contact *x'*. The signals will then pass through the receiving-instrument R, which consists of an electro-magnet provided with a polarized armature of well-known construction, and thence to the earth at *g*.

The several parts of the apparatus at station C are constructed and arranged in the same manner as at station A, and are designated in the drawings by similar letters of reference having the numeral 1 affixed thereto. Thus K' represents the key, R' the receiving-instrument, and so on.

The apparatus at the intermediate station, B, comprises a pole-changing transmitter, T, consisting, essentially, of an electro-magnet having a polarized armature which is caused to oscillate to and fro between two contact points or stops, *v* and *v'*, which latter are respectively connected to the unlike or opposite poles of two batteries or other suitable sources of electricity, E and E'.

The automatic switch or circuit-changer comprises a horizontal metallic lever, D, poised upon an axis, *d*, at the center of its length, and separated into two parts by insulating material at D'. Beneath this lever, at equal distances from its axis, are placed two electro-magnets, C and C', which act upon correspond-

ing soft-iron armatures placed above and opposite their respective poles, and attached to the automatic switch D in a well-known manner, as shown in the figure. Two insulated springs, d' and d'' , are mounted upon the upper side of the respective arms of the automatic switch D, and make electric contact with the stops i' and i , respectively, when it is oscillated.

10 Near one end of the automatic switch D is mounted an insulated spring, a , which, when the lever is at rest in an intermediate position, as represented in the drawings, is in contact both with an adjustable fixed stop, b , which is
15 connected with the earth by wire 12, and with a contact, c , formed upon the end of the automatic switch D. When this end of the lever is depressed, the spring a remains in contact with the stop c , and at the same instant is
20 separated from the fixed stop b . When the same end of the automatic switch is raised, the spring a is separated from the contact c . A similar device is placed at the opposite end of the automatic switch D, as shown in the
25 drawings, the spring being designated as a' , the fixed stop as b' , and so on. The springs a and a' also make alternate contact with the fixed stops v and v' at each extremity of the
30 D, which switch is normally maintained in its intermediate position, when no current is passing, by the action of the springs a and a' .

The main-line wire L coming from station A divides at the point 1 into two branches, the branch 2 being connected to the left-hand
35 portion of the automatic switch D and the branch 5 to the contact-spring d' . A non-polarized or neutral relay, M, of well-known construction, is placed in the branch 2, and I
40 prefer, also, for reasons hereinafter set forth, to include in the main line L a receiving-instrument, S, provided with a polarized armature responding to changes in the polarity in the actuating-current. The other main-line
45 wire, L', extending from station B to station C, in like manner proceeds from the point of union at 7 of two branches, one extending from the contact-spring d'' and the other from the corresponding arm of the automatic switch
50 D. The stops v and v' are connected by conductors 3 and 3' with one terminal of the electro-magnet of the pole-changing transmitter T, and the other terminal thereof is connected with the earth by the conductor 4.

55 The electro-magnets C and C', which alternately actuate the automatic switch D and its attachments, are themselves actuated by the local battery l , which is connected with them and with the neutral relays upon each side of
60 the apparatus in the following manner: The armature-levers of the neutral relays M and M' are electrically united by a conductor, 8, and the rear contact-stops of these relays are in like manner united by the conductor 9. The
65 terminals of the electro-magnets C and C' are attached by means of short branches to the

conductors 8 and 9, respectively, as shown in the figure, and a local battery, l , is included in the wire 9 at a point between the point of attachment of the terminals of the electro-
70 magnets. By inspecting this organization of circuits it will be observed that when the armature of the neutral relay M' falls on its back contact, the current of the local battery l will
75 be diverted from the electro-magnet C' by way of the shunt formed by its armature, and hence the latter will be rendered inoperative, while the other electro-magnet, C, will remain in action. This operation will be reversed as to
80 the electro-magnets C and C' by the breaking of the shunt at M' and the closing of the shunt at M. In Fig. 1 the various parts are represented in the position which they respectively occupy when both lines are at rest.

If we suppose a communication is to be
85 transmitted from station A over the line L to station B, and at the same time automatically retransmitted from station B over the line L' to the station C, the operation of the apparatus will be as follows: By chang-
90 ing the switch w (see Fig. 2) from the contact stop x' to the contact-stop x , and by manipulating the key K at station A in a well-known manner, alternate positive and negative currents of equal strength, constituting
95 telegraphic signals, are transmitted over the line L from the batteries e and f . These alternate currents, reaching the point 1 at station B, pass through the coils of the neutral relay M, and thence by wire 2 to contact
100 spring a , stop b , and wire 12 to the earth at G. The neutral relay M, responding equally to currents of either polarity, now holds its armature away from its back contact. This interruption of the shunt renders the local electro-magnet C active, thereby pulling down and
105 holding the left-hand end of the automatic switch D. By this means the connection of the wire 2 with the earth is interrupted and a new contact is established between the wires 2 and 3 at the stop y , and also between the spring d'' and the stop i . The polarized armature of the pole-changing transmitter T now
110 responds to the alternate positive and negative currents transmitted through its coils by way of the wire 3, and is thus brought into alternate contact with the stops v and v' , which constitute the terminals, respectively, of the positive and negative batteries E and E'. The
115 armature of the electro-magnetic transmitter T thus forms a key, by means of which alternate positive and negative currents are sent through the connecting-wire 5, stop i , and wire 6 to the point 7, and thence over the
120 line L' to station C, and finally through the receiving-instrument R' at that station to the earth at g' . The incoming current at station B preferably passes through the coils of a sounder or other receiving-instrument, S, provided with a polarized armature and placed
125 in the wire L, whereby the attendant may ascertain at any time whether or not communi-

cations are passing. When the transmission from station A has been completed, the switch or button *w* at that station is turned on the point *x'*, thus placing the line L to ground through the receiving-instrument R and leaving no current on the line. If, now, the operator at station C should desire to transmit a communication in the opposite direction to station A, he first changes the switch *w'* so as to place the key K' in connection with the line L'. The initial current transmitted over the line, on arriving at the point 7, passes through the neutral relay M' and by the wire 10 to the contact *c'* and the contact-spring *a'*, and thence through the stop *b'* and wire 11 to the earth. It cannot pass from the point 7 through the branch 6, for the reason that the spring *d'* is held in an intermediate position by the position of the automatic switch D, thus leaving the circuit disconnected at that point. The passage of the initial current through the neutral relay M' interrupts the shunt around the electro-magnet C' in the manner hereinbefore explained, and thus brings the latter into action, depressing its own end of the automatic switch D and elevating the opposite end, the effect of which is to break the connection between the spring *a'* and stop *b'*, and to put the line L' to earth through the electro-magnet of the pole-changing transmitter T, and also at the same time to connect the armature of the transmitter T with the line L by bringing the spring *d'* into contact with the stop *i'*. The position of the several parts is now precisely the same as in the former case, except that they are arranged to operate in the reverse direction. Thus it will be understood that the transmission of the initial electrical impulse from either terminal station by its automatic action through the neutral relay upon the circuit-changing mechanism establishes the necessary conditions to insure the proper retransmission of the communication over the second line without the intervention of an attendant, and in this way the operators at station A and station C are enabled to correspond with each other in precisely the same manner as if there were no intermediate station, by which means direct communication may be maintained over a far greater distance than would be possible by the direct transmission of the current.

I claim as my invention—

1. The combination, substantially as hereinbefore set forth, of a polarized armature, an electro-magnet for actuating said armature by the influence of alternate positive and negative currents traversing its coils, a line-wire electrically connected with said armature and extending to earth at a distant terminal station, and a positive and a negative source of electricity with which said armature is alternately placed in connection when moved to and fro by alternating currents traversing the coils of its actuating electro-magnet.

2. The combination, substantially as here-

inbefore set forth, of a polarized armature, an electro-magnet for actuating said armature by the influence of alternate positive and negative currents traversing its coils, a line-wire extending to earth at a distant terminal station temporarily connected with said armature, a positive and a negative source of electricity with which said armature is alternately placed in connection when moved to and fro by alternating currents traversing the coils of its actuating electro-magnet, and means for maintaining said armature out of connection with said main line when no current is traversing the coils of its electro-magnet.

3. The combination, substantially as hereinbefore set forth, of a polarized armature, an electro-magnet for actuating said armature by the influence of alternate positive and negative currents traversing its coils, two independent line-wires extending to earth at different terminal stations, an automatic switch for electrically connecting said armature with one or the other of said line-wires, and a positive and a negative source of electricity with which said polarized armature is alternately placed in connection when moved to and fro by alternating currents traversing the coils of its actuating electro-magnet.

4. The combination, substantially as hereinbefore set forth, of a polarized armature, an electro-magnet for actuating said armature by the influence of alternating positive and negative currents traversing its coils, two independent line-wires extending to earth at different terminal stations, an automatic switch acting through the influence of an incoming current traversing either line-wire to place that line-wire in electric connection with the earth through the coils of said electro-magnet, and to place the other line-wire in electrical connection with said polarized armature, and a positive and a negative source of electricity with which said polarized armature is alternately placed in connection.

5. The combination, substantially as hereinbefore set forth, of a positive and a negative source of electricity, a pole-changing transmitter for placing said sources of electricity alternately in connection with an automatic switch, two independent line-wires extending to earth at different terminal stations, two independent electro-magnets acting upon said switch, to thereby place the pole-changing transmitter in connection with one or the other of said lines respectively, and two relays for controlling the action of said electro-magnets.

6. The combination, substantially as hereinbefore set forth, of a positive and a negative source of electricity, two insulated contact-points, a pole-changer transmitter for placing said sources of electricity alternately in connection with said insulated contact-points, two insulated contact-springs, one or the other of which may be placed in connection with one or the other of said contact-points, two independent line-wires extending to the earth at

different terminal stations, each line-wire proceeding from the junction of two branches, one of which branches extends from one of said contact-springs and the other normally from the earth, and two electro-magnets, one being included in each of said earth-branches, and means, substantially such as described, for placing the one or the other of said contact-springs in connection with the corresponding contact-point through the instrumentality of said electro-magnets.

7. The combination, substantially as hereinafore set forth, of a pole-changing transmitter, two independent line-wires extending to different terminal stations, an automatic switch for alternately placing said transmitter in connection with one or the other of said lines, two electro-magnets for alternately reversing the position of said automatic switch, a local battery and neutral relays actuated alternately by the incoming currents from said line-wires, respectively, for controlling the action of said local battery upon the electro-magnets by which the automatic switch is reversed.

8. The combination, substantially as hereinafore set forth, of a positive and a negative source of electricity, a pole-changing transmitter actuated by an electro-magnet for placing said source of electricity alternately in connection with one of two independent line-wires extending to the earth at different terminal stations, and an automatic switch constructed substantially as described, whereby both said lines are normally connected to the earth and disconnected from the transmitter, but either of said lines may be transferred from the earth to the transmitter, while the other line is simultaneously transferred from the earth to the electro-magnet which actuates said transmitter.

In testimony whereof I have hereunto subscribed my name this 21st day of October, A. D. 1882.

WM. E. ATHEARN.

Witnesses:

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BENJ. R. BRAISTED.