

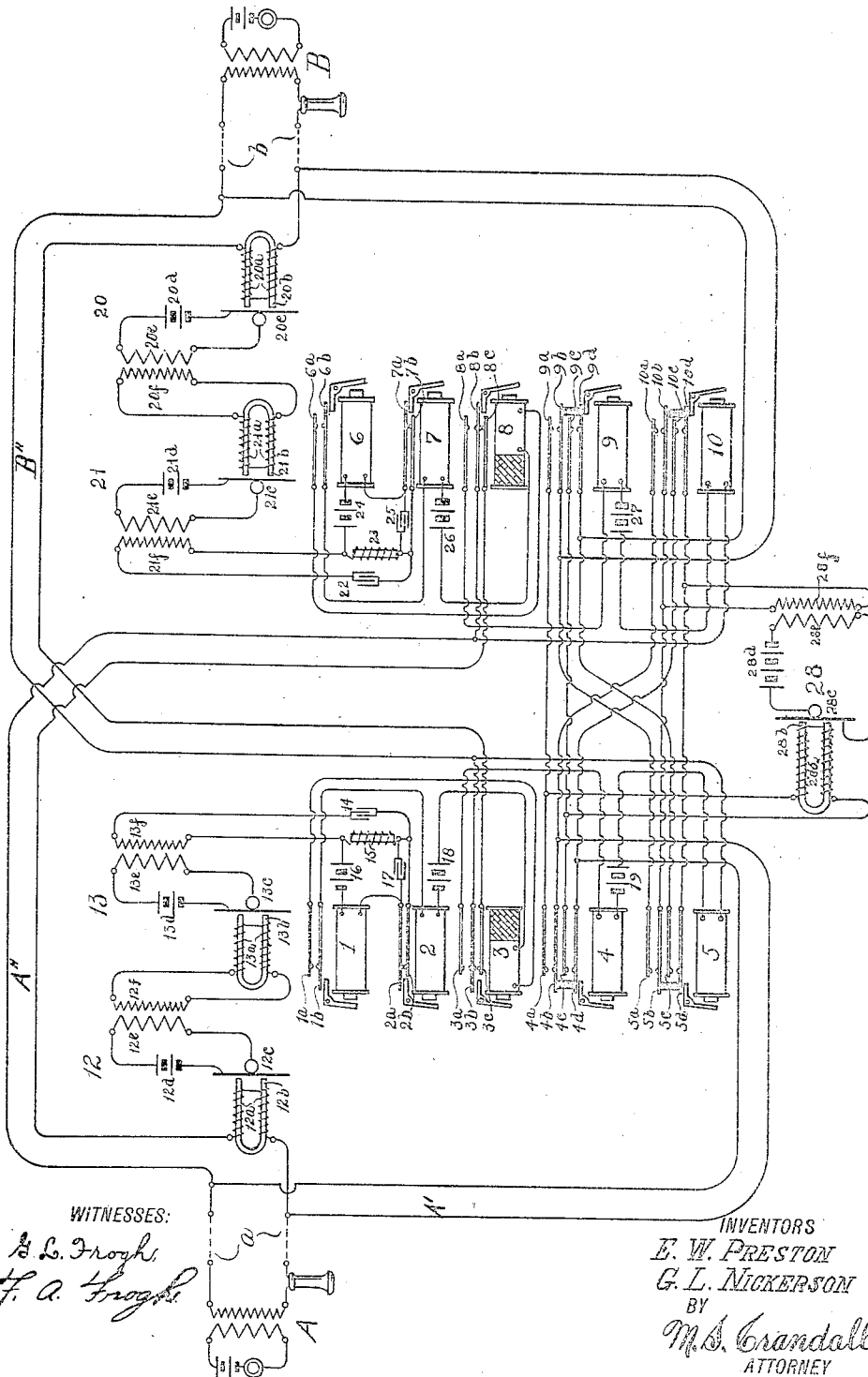
E. W. PRESTON & G. L. NICKERSON.

RELAY SYSTEM.

APPLICATION FILED JAN. 25, 1912.

1,056,300.

Patented Mar. 12, 1913.



UNITED STATES PATENT OFFICE.

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RELAY SYSTEM.

1,056,800.

Specification of Letters Patent.

Patented Mar. 18, 1913.

Application filed January 25, 1912. Serial No. 673,442.

To all whom it may concern:

Be it known that we, EDWIN W. PRESTON and GEORGE L. NICKERSON, both citizens of the United States, residing at Sioux City, in the county of Woodbury and State of Iowa, have invented new and useful Improvements in Relay Systems, of which the following is a specification.

Our invention relates to a system of relays, the operation of which is automatically controlled by speech-currents from a telephone transmitter, or similar weak currents.

It is especially serviceable in long-distance telephony as commercially practised, for the purpose of connecting repeaters; yet is susceptible of use in wireless telegraphy for operating local sounders or it may be used in connection with telephone service meters.

We herein describe and illustrate our system in a duplicate symmetrical form for reversibly directing a repeating device; but, we would not be understood as, or limited to, practising our invention solely for this purpose.

The installation for the purpose above mentioned is preferably made as a portion of a cord-circuit of an exchange switch-board, yet it may be located at any point intermediate between two telephones which it is desirous to connect.

The repeater which we prefer to employ consists, on its receiving side, of a permanent magnet wound with helices of wire; and on its transmitting side, of a transmitter, controlled by the magnet and in circuit with a battery and the primary of an induction coil having two windings. This type of repeater is familiar to all versed in the art, and that its use amplifies transmission is conceded; but, heretofore it has been commercially impracticable chiefly because of its adaptability for one-way transmission only. This difficulty we have overcome.

In the installations presented by Randall in United States Patents 1,008,800, 1,008,801 and 1,008,802, apparatus are disclosed for reversing repeaters, but they seem impractical in-as-much as they are manually controlled. This defect we have eliminated. We have perfected a system which automatically directs a repeater with respect to two substations, according as the direction of transmission.

We utilize a plurality of the above-described repeaters, or reproducers, for the purpose of transforming the rather weak

currents generated in an induction coil to a potential sufficiently high to operate a relay, as will be presently made more clear; and one for the usual purpose of reproducing speech from one telephone to another. To simplify our description the former will hereinafter be called transformers. The other mechanical devices requisite for our installation are relays, batteries, condensers and impedance coils, all of well known types or of such specialized form as will be readily appreciated from the following description, reference being had to the accompanying drawing, which is a diagrammatic view of our invention, a substation being represented at each side thereof.

In the illustration the substations A and B are equipped as usual, each having a transmitter in local circuit with battery and the primary of an induction coil; their secondaries being associated, respectively, with metallic circuits *a* and *b* as customary. The circuit *a* is shown directly connected to a repeater circuit or link A', in multiple with a loop A'' and normally-open at its opposite end. The loop A'' terminates on normally-closed contact-springs 8^a and 8^b of what is commonly known as a slow-acting relay. Associated in series with said loop is the receiving side of a transformer 12, comprised of helices of wire 12^a upon a permanent magnet 12^b. The diaphragm of a carbon-cell transmitter 12^c is arranged toward and within the magnetic field of said magnet, and said transmitter is in local circuit with battery 12^d and an induction coil primary 12^e; a secondary winding thereof 12^f is directly connected to a similar transformer 13, consisting of a permanent magnet 13^b, with helices of wire wound thereon 13^a; a transmitter 13^c, similarly associated with said magnet and in series with battery 13^d and a primary of an induction coil 13^e. One terminal of the secondary winding 13^f of said induction coil is connected, through battery 13, with one side of a relay 1; and the opposite terminal of said secondary is connected, through a condenser 14, with a contact-spring 2^b of a relay 2, adapted to open the normally-closed contact of its two springs 2^a and 2^b, the former being connected with one side of the relay 1, (preferably highly wound that it may be very sensitive). Across the circuit leading from the secondary 13^f and including the condenser 14, is connected an impedance coil 15; thus providing a nor-

normally-closed circuit for flow of current from battery 16 through the relay 1. This current must be of only sufficient potential to only partially energize the relay 1, as it is not desired to attract the armature thereof only as current flows from the secondary 13^c. A condenser 17 is connected across the contact-springs 2^a and 2^b, designed to absorb the oscillations incident to the opening of said springs. The condenser 14 prevents the flow of current from battery 16 back through the secondary 13^c. The presence of the impedance coil 15 and the condenser 14 is, however, arbitrary; but their use seems more economical in-as-much as the resistance of the impedance coil is much greater than that of the induction coil secondary, and, therefore, draws less current. When associated with lines of comparatively low resistance, one or both of the transformers 12 and 13 may be omitted.

The relay 1 controls the normally-open contact of springs 1^a and 1^b, the former being connected to one terminal of a slow-acting relay 3 and the latter connected to one side of the relay 2, the opposite sides of said relays being interconnected through battery shown at 18. The slow-acting relay 3 controls the contacts of three springs,—3^a, 3^b and 3^c, the latter two being normally-closed and so adjusted as to open the loop B'', connected therewith, when said relay is actuated. Relays 4 and 5 and battery 19 are connected in a series circuit terminating on the normally-open contact-springs 3^a and 3^b. Each of said relays has four springs, respectively, 4^a, 4^b, 4^c and 4^d; and 5^a, 5^b, 5^c, and 5^d, all the contacts of which are normally-open. The contact-springs 4^a and 4^c are directly connected with the receiving helices 28^a of a repeater 28, and in multiple with similar contact-springs 9^a and 9^c of a relay 9 in the companion circuit. The contact-springs 4^b and 4^d are movable and are the terminals of the repeater link A', and multiple with contact-springs 10^a and 10^c of a relay 10 in the corresponding circuit. To the contact-springs 5^a and 5^c are connected the lines of the opposite repeater link B' and the contact-springs 9^b and 9^d of a relay 9 in the opposite circuit. The movable contact-springs 5^b and 5^d are connected with contact-springs 10^b and 10^d of the relay 10, and in multiple with a circuit leading to the secondary, or transmitting side, 28^c of the repeater 28.

The repeater represented at 28 is constructed substantially the same as the transformers, as hereinbefore mentioned, having a permanent magnet 28^b, helices of wire thereon, controlling a variable resistance 28^e in local circuit with battery 28^d and an induction primary 28^e, a second winding being shown at 28^f.

We have described the construction of

one half the system shown and the companion circuit is a replica thereof, the operation of which is as follows: The rising and falling speech currents flowing from substation B over loop B'', (normally-closed at relay 3), and through the windings 20^a of the transformer 20, will vary the attraction of the permanent magnet 20^b and accordingly cause vibration of the diaphragm of the transmitter 20^c; thus causing a variation of the resistance of said transmitter, and a corresponding variation in the current flow from battery 20^d through the induction primary 20^e associated therewith. This disturbance in the primary circuit causes an intensified alternating current to flow from the secondary 20^f through the helices 21^a of the second transformer 21; and in similar fashion the magnet 21^b acts upon the transmitter 21^c, causing undulating currents to flow in the primary 21^e from battery 21^d; the current generated thereby in the secondary 21^f passes through the condenser 22, the contact-springs 7^a and 7^b, and, augmented by the battery 24, (shown in circuit with the impedance coil 23), actuates the relay 6, closes the contact-springs 6^a and 6^b, thus energizing simultaneously relays 7 and 8, in local circuit with battery 26, the former relay opening the contact-springs 7^a and 7^b, thereby deenergizing the relay 6. It is now clear that the relays 6 and 7 alternately interrupt one another continuously as current flows from the secondary 21^f. The relay 8, being slow-acting, cannot follow the rapid interruptions of relays 6 and 7, and, therefore, its armature remains attracted during such interruptions and holds open the loop A'', leading from the companion circuit and terminating on contact-springs 8^b and 8^c; and holds closed the contact-springs 8^a and 8^b and the circuit associated therewith, (thereby actuating the relays 9 and 10, shown in series with battery at 27). The relay 9, by closing the contact-springs 9^a and 9^b, and 9^c and 9^d, directly connects the link B' with the receiving side, or windings 28^a, of the repeater 28. The relay 10, by closing the contact-springs 10^a and 10^b, and 10^c and 10^d, directly connects the transmitting side, or secondary 28^c of said repeater with the link A' of the companion circuit. In a similar manner the speech waves emanating from the substation A direct the repeater 28 in the opposite direction, inductively linking together the two substations, and rendering inoperative the corresponding apparatus by holding open the loop B''.

Having thus described our invention, what we claim as new and desire to secure by United States Letters Patent, is:

1. The combination with two telephone lines, normally inductively and conductively isolated each from the other, of a sym-

metrical relay system, each half comprised of the following elements:—a circuit, closed when the other half is inactive; receiving helices, connected to one of said lines, by said circuit; a variable resistance, controlled by said helices; a circuit for said variable resistance; a source of electrical energy and an inductive primary contained in said circuit; an inductive secondary, related to said primary; receiving helices, connected with said secondary; a variable resistance, controlled by said helices; a source of electrical energy and an inductive primary, both connected with said variable resistance; an inductive secondary, related to said primary; a sensitive relay; a circuit connecting said relay and secondary; an impedance coil across said circuit; a condensing means in series therewith; a source of direct current in series with the impedance coil and sensitive relay; a circuit controlled by the sensitive relay; an interrupting relay, a slow-acting relay and a source of direct current in said circuit; the interrupting relay adapted to alternately open and close the circuit containing the sensitive relay; a condenser as a shunt across the circuit portion opened; means for preventing the operation of the other half of the system, controlled by the slow-acting relay; means governed by the slow acting relay for connecting a repeating device with and between the said two telephone lines, said repeating device being oppositely directed, with respect to the half of the system operating.

2. The combination with two telephone lines, normally conductively and inductively isolated each from the other, of a relay system of two halves, each half comprising:—a sensitive relay; an inductive link associating said relay with one of said lines; an auxiliary circuit for said relay; a source of direct current in said auxiliary circuit; a local circuit controlled by the sensitive relay; two relays and a source of direct current in the latter circuit; one of said relays adapted to interrupt the circuit containing the sensitive relay; a condensing means across the point of interruption; the other of said two relays adapted to render inoperative the other half of the system; a local circuit governed by the last named relay and controlling means for inductively linking together the two telephone lines.

3. The combination with two portions of a telephone line, said portions being normally directly out of conductive or inductive relation each to the other, of a symmetrical

relay system, either half inoperative while the other is active, and each half associated with a different one of said line portions and comprising:—an inductive link; an electro-magnet identified with one of said line portions by means of said link; an auxiliary circuit for the electro-magnet; a source of energy and impedance means in said circuit; means controlled by the electro-magnet adapted to intermittently open the circuit in which the said magnet is connected; condensing means as a shunt across the circuit portion opened; and switching means controlled by said electro-magnet for governing another circuit.

4. The combination with two telephone circuits and a repeater, said circuits being normally conductively and inductively isolated each from the other, of a switching system of two halves, each half comprising:—apparatus adapted to connect the receiving circuit of the repeating telephone with one of the telephone lines and the transmitting circuit of the repeating telephone with the other telephone line; a relay adapted to control said apparatus and to prevent the reversal of the repeating telephone; an electro-magnet adapted to govern said relay; an inductive link joining the electro-magnet and the telephone circuit with which it is identified; an auxiliary circuit for the electro-magnet; a source of current and an impedance therein; a relay governed by said electro-magnet and adapted to intermittently break said circuit.

5. The combination with a source of induced current, of a sensitive relay; a source of direct current as an auxiliary to the induced current for energizing said relay; means for intermittently deenergizing said relay; and local electromagnets controlled by said relay.

6. The combination with local electromagnets, of a sensitive relay adapted to govern said electromagnets; a source of induced current for the control thereof; a source of direct current as an auxiliary to the induced current for energizing said relay; and means for intermittently deenergizing the relay.

Signed at Sioux City, county of Woodbury, and State of Iowa, this fifteenth day of January, 1912, in the presence of two witnesses.

EDWIN W. PRESTON.
GEORGE L. NICKERSON.

Witnesses:

W. L. SEDGWICK,
C. C. SEDGWICK.