

No. 680,880.

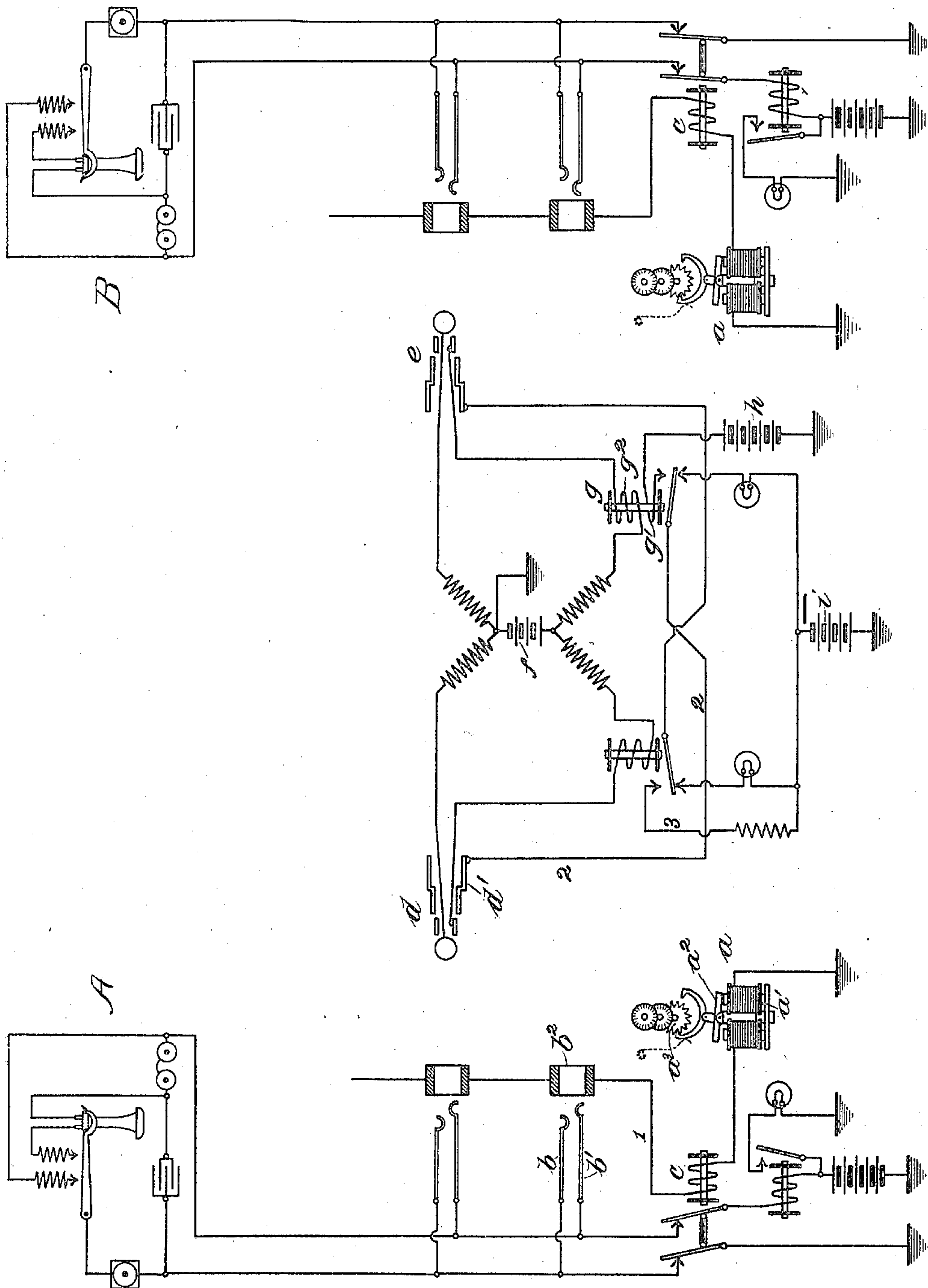
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F. R. McBERTY.

CONNECTION REGISTER FOR TELEPHONE EXCHANGES.

(Application filed Dec. 26, 1899.)

(No Model.)



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# UNITED STATES PATENT OFFICE.

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## CONNECTION-REGISTER FOR TELEPHONE-EXCHANGES.

SPECIFICATION forming part of Letters Patent No. 680,880, dated August 20, 1901.

Application filed December 26, 1899. Serial No. 741,578. (No model.)

*To all whom it may concern:*

Be it known that I, FRANK R. MCBERTY, a citizen of the United States, residing at Evanston, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Connection-Registers for Telephone-Exchanges, (Case No. 82,) of which the following is a full, clear, concise, and exact description.

My invention relates to the measurement of telephone service, and has for its object to provide a connection-register and circuits therefor associated with each telephone-line, whereby each call sent in from a substation of the line in response to which a connection has been completed to some other line and a response had to the call will automatically be registered.

In accordance with my invention I employ a connection-register consisting of a recording-train operated by the oscillating armature of a polarized electromagnet. The armature is normally positioned on a given side by any desired means, which may be a spring or the passage of suitably-directed electric current through the helix of the electromagnet. To operate the register, means controlled through the agency of a switch at the called station are provided for establishing in the register-circuit a final current impulse directed to throw over the armature of the polarized connection-register to the opposite side, whereby the connection is automatically registered when the called subscriber responds.

I further provide means whereby the connection-register is made independent of the called line after the connection has once been recorded.

The circuit including the connection-register may be formed in part by the usual grounded conductor from the test-ring of each jack, which includes the winding of the cut-off relay, and also in part by a third strand of the plug-circuit. This third strand has for one terminal the sleeve of the answering-plug, which engages with the test-ring of the spring-jack, and for the other terminal the armature of the supervisory relay associated with the connecting or calling plug. From the armature of the supervisory relay two

branches may then be led to ground, one from the front contact of the relay and one from the normal resting contact thereof. The branch from the back contact of the relay preferably includes a supervisory signal-lamp and a source of current of a given polarity, and the other branch preferably includes a winding of the supervisory relay and a second source of current oppositely directed. It will be seen, therefore, that when connection is made with the spring-jack of a calling-line there will be a circuit from the grounded battery connected with the back contact of the supervisory relay to the test-ring of the spring-jack of the calling-line and thence to ground through the winding of the cut-off relay and the connection-register. When, however, the called subscriber responds, the armature of his supervisory relay is attracted, cutting off the normal branch and substituting therefor the other branch containing the reversely-connected source of current. The current through the register is thus reversed and the connection recorded. The circuit will thereafter be independent of the called line, because the magnet of the supervisory relay will be energized by the current which is applied when the armature of the relay is drawn up.

I will describe my invention more particularly by reference to the accompanying drawing, which is a diagram illustrating by the aid of conventional symbols two telephone-lines extending from substations to a central office and a pair of plugs and their plug-circuit for uniting the lines, the system being equipped with the connection-register and circuits therefor of my invention.

In practicing my invention I preferably employ a polarized electromagnetic measuring or counting device  $a$ , which requires for its operation two successive oppositely-directed current impulses. Connection-registers constructed to operate on this plan are known in the art and consist, briefly, in a polarized electromagnet  $a'$ , having an oscillating armature  $a''$ , which is adapted to be attracted to one side or the other, according to the direction of current flowing through the windings of the magnet, and a counting or recording train driven by a star-wheel  $a^3$  and an actuating lever operated by the armature of the



electromagnet. As the armature is moved from one side to the other a step-by-step movement of the counting-train is thus produced, and it is evident that a full beat or  
 5 complete oscillation of the armature-lever is necessary in order to advance the counting-train the full distance from one figure of the dial to the next.

In the drawing two substations A B are  
 10 illustrated, with the usual telephone apparatus, connected by the two limbs of a metallic-circuit telephone-line with spring-jacks and the usual call-indicating apparatus at the central office. Each spring-jack consists of a  
 15 pair of line-springs  $b b'$ , connected with the limbs of the line, and a third contact-piece or test-ring  $b^2$ , which is connected to ground by a conductor 1, including the winding of the cut-off relay  $c$  and also including the  
 20 winding of the polarized magnet of the connection-register. A pair of plugs and their plug-circuit is illustrated for making a connection between the spring-jack of one line and the spring-jack of another in response to  
 25 a call. The plug which is used first in making connection with the line of the calling subscriber is called the "answering-plug" and is designated on the drawing by the letter  $d$ . The other plug of the pair is used in completing a connection to the line of the station  
 30 called for and is called the "connecting-plug" or "calling-plug." This is designated on the drawing by the letter  $e$ . Each plug has the usual ring and tip contacts, which make connection with the long and short line springs,  
 35 respectively, of the spring-jack, and so with the limbs of the telephone-line, and also has a third contact piece or sleeve which engages the test-ring  $b^2$  of the spring-jack. A centralized battery  $f$  is bridged across the tip and ring strands of the plug-circuit between  
 40 the windings of the repeating-coil in the usual manner, and the ring-strand of the plug-circuit includes the supervisory relays, one between each plug and the battery  $f$ . These  
 45 relays are controlled by the flow of current in the telephone-lines to which the plugs are connected. The supervisory relay  $g$ , which is associated with the connecting-plug, is provided with a winding  $g'$ , which is included in  
 50 a conductor extending from the front contact of the relay to ground through a source of current  $h$ . This source of current is connected in circuit with its negative side toward earth. The winding  $g'$  is provided in  
 55 addition to the usual winding  $g^2$ , which is included in the ring-strand of the plug-circuit. The armature of the supervisory relay  $g$  is connected by a conductor 2 with the sleeve or  
 60 third contact  $d'$  of the answering-plug  $d$ . The normal resting contacts of both supervisory relays are connected to earth through supervisory signal-lamps and a battery  $i$ . This battery is connected with its positive side  
 65 toward the earth oppositely to the battery  $h$ . A conductor 3 connects the battery  $i$  with the front contact of the supervisory relay,

which is associated with the answering-plug. The circuit of the connection-register of the calling-line thus extends from ground  
 70 through the windings of the polarized magnet  $a'$  of the register, through the cut-off relay  $c$  to the test-ring  $b^2$  of the spring-jack, to the sleeve  $d'$  of the answering-plug, and thence by way of the conductor 2 to the armature of the supervisory relay  $g$ , which is controlled by the flow of current in the called line. From the armature of the supervisory  
 75 relay two paths are provided, one by way of the normal resting contact of the relay-armature through the supervisory signal-lamp and to earth through the battery  $i$  and the other by way of the front contact, against which the armature is drawn when the relay is energized, through the retaining-winding  $g'$  of  
 80 the relay, and to earth through the battery  $h$ . Since the batteries  $i$  and  $h$  are reversely connected, it will be seen that when the armature of the supervisory relay  $g$  is drawn up the current flowing in the circuit of the connection-register will be reversed, causing the  
 85 register to be operated.

The current impulse which is impressed upon the register-circuit when an answering  
 90 plug is inserted in the spring-jack of the line, is the first of the successive opposing impulses which are requisite for the operation of the polarized connection-register, and its effect upon the mechanism of the register is to bring it into position where a second single  
 95 movement of the armature in the opposite direction will complete the registration—that is to say, this first impulse of current brings about a half-registration of the counting mechanism, which is completed when a  
 100 current impulse of opposite polarity is established in the circuit. Of course two impulses of the same polarity would not effect a complete registration. In other words, the first current impulse acts merely to set or wind  
 105 up the counting mechanism, bringing it into a condition where it is capable of responding to a second and reversely-directed current impulse, which completes the registration. This second current impulse of opposite direction is impressed upon the circuit when  
 110 the called subscriber responds, the energization of his supervisory relay-magnet causing the battery  $h$  to be substituted in the circuit for the battery  $i$ , so that the connection is reversed. The current flowing in the circuit  
 115 through the retaining-winding  $g'$  of the supervisory relay serves to cause the armature of the relay to be held up even though the current in the main winding  $g^2$  of the relay should cease. This makes the register-circuit independent of the called line after the  
 120 called subscriber has once answered.

If desired, a light bias spring may be attached to the armature of the polarized connection-register, as indicated in dotted lines,  
 130 to keep said armature normally to the side to which it would be thrown by negative current from the test-ring of the jack. The reg-



istration is thus effected when an impulse of current in a direction to throw the armature to the other side is impressed upon the circuit, the armature being returned to its normal position by the spring when the circuit is broken and the actuating-current ceases; but with the batteries *i* and *h*, as above described, it is evident that the reversely-directed impulses of current, which are necessary to operate the counter positively, will be impressed upon the circuit in succession—that is, first, the battery *i* when the answering-jack is plugged into, and, later, the battery *h* when the called subscriber responds. With such an arrangement the spring would be superfluous.

To recapitulate, the polarized register is responsive for the recording of a connection to two successive oppositely-directed current impulses and is included in a circuit with a source of current to establish the required preliminary current impulse when the answering-plug of a pair is inserted in the spring-jack of the line with which the register is associated. When the connecting-plug is inserted in the spring-jack of the called line, the register-circuit is thus brought under the control of the telephone-switch at the called subscriber's station. When the called subscriber responds by removing his telephone from its hook and closing the bridge of the line through his telephone apparatus, the current from battery *f*, flowing through the winding *g*<sup>2</sup> of the supervisory relay *g*, energizes the relay-magnet and causes the armature thereof to be drawn up. This disconnects from the register-circuit the ground branch, including the battery *i*, and substitutes therefor the grounded branch, including the reversely-connected battery *h*. The impulse of positive current now impressed upon the register-circuit by the battery *h*, following the impulse of negative current previously established in the circuit by the battery *i*, causes the armature of the polarized register-magnet to oscillate, thus advancing the measuring-train one step. Since the circuit of the battery *h* includes the retaining-winding *g*<sup>1</sup> of the supervisory relay, the armature of the relay will be held up until the circuit is broken by the withdrawal of the answering-plug from the spring-jack of the calling-line. The connection-register is thus rendered independent of the called line after the called subscriber has responded. When a connection is made with the spring-jack of any line in completing a connection ordered from some other line, the connection-register of the called line is not operated, because only negative current is impressed upon the circuit thereof.

Having now described my invention, I claim as new, and desire to secure by Letters Patent, the following:

1. The combination with two telephone-lines extending from substations to a central office, of means at the central office for unit-

ing the lines in response to a call from one of them, a polarized connection-register responsive for the registration of a connection to two successive oppositely-directed current impulses, a supervisory relay at the central office controlled through the agency of a switch at the called station, a circuit including said connection-register established upon connection at the central office with the calling-line, said register-circuit being controlled by the supervisory relay of the called line, a source of current adapted to establish the required initial current impulse to actuate said register, normally connected in said circuit by way of the normal resting contact of the relay-armature, and a second source of current adapted to establish in said circuit the required final current impulse, said second source of current being connected by way of the front contact of said relay when the relay is energized, as set forth.

2. The combination with two telephone-lines extending from substations to a central office, of means at the central office for uniting the lines in response to a call from one of them, a polarized connection-register associated with the calling-line, responsive for the registration of a connection to two successive oppositely-directed current impulses, a circuit including said register, means, controlled by connection with the calling-line at the central office for establishing in said register-circuit the required initial current impulse, and means, controlled through the agency of a switch at the called station, for establishing in said register-circuit the final oppositely-directed current impulse, whereby the connection is automatically registered when the called subscriber answers the call, as set forth.

3. The combination with two telephone-lines extending from substations to a central office, of spring-jacks for the lines at the central office and a pair of plugs and their plug-circuit for uniting the lines in response to a call from one of them, a polarized connection-register responsive for the registration of a call to two successive oppositely-directed current impulses, a circuit including said register established by the insertion of the answering-plug into the spring-jack of the calling-line, and a source of current in said circuit adapted normally to maintain therein current in a given direction, and means, controlled through the agency of a switch at the called station, for establishing in the register-circuit the required final oppositely-directed current impulse, as set forth.

4. The combination with two telephone-lines extending from substations to a central office, of spring-jacks for the lines at the central office and a pair of plugs and their plug-circuit for uniting the lines in response to a call from one of them, a polarized connection-register responsive for the registration of a call to two successive oppositely-directed current impulses, a circuit including said regis-



ter established by the insertion of the answering-plug into the spring-jack of the calling-line, and a source of current in said circuit adapted normally to maintain therein current in a given direction, means, controlled  
5 through the agency of a switch at the called station, for establishing in the register-circuit the required final oppositely-directed current impulse, and means for thereupon  
10 rendering the register-circuit independent of the called line, as set forth.

5. The combination with two telephone-lines and means at a central office for uniting them, of a connection-register associated with  
15 one of the lines and a polarized electromagnet for operating said register, a circuit including said polarized magnet and a responsive device *c*, a source of current in the register-circuit adapted to affect said responsive  
20 device but not suitable to operate the connection-register, and means controlled through the agency of a switch at the substation of the called line for establishing in the register-circuit a current impulse of definite direc-  
25 tion adapted to operate the register, substantially as set forth.

6. The combination with two telephone-lines extending from substations to a central office, of means at the central office for unit-  
30 ing the lines, a polarized electromagnet and a connection-registering train operated by the armature thereof, said registering-train requiring two successively-opposite movements of said armature to complete a registration, means for positioning the armature  
35 normally at one side, a circuit including said electromagnet, a relay controlled through the agency of a switch at the called station, controlling said circuit, a branch from said cir-  
40 cuit controlled by said relay, a retaining-winding *g'* for the relay and a source of current *h* included in said branch circuit, whereby when the relay is operated a suitably-directed current impulse to throw the armature of the  
45 polarized electromagnet to the opposite side, is produced in the registering-circuit and the circuit is simultaneously rendered independent of the called line, substantially as set forth.

50 7. The combination with telephone-lines

and switches at the stations thereof for determining the flow of current in the lines in the use of the telephones, spring-jacks for the lines, plugs and a plug-circuit for uniting  
55 them, and normal grounded extensions of each line, of an electromagnetic switch for each line, controlling the said grounded extensions, a polarized connection-register, a local circuit including the magnet of the switch to-  
60 gether with the polarized connection-register, said local circuit comprising a portion terminating in a contact-piece of the spring-jack including said magnet and register and a por-  
65 tion terminating in a registering-contact portion of the plug, and a switch in said last-mentioned portion adapted to apply current of either polarity in said portion; whereby  
70 the switch-magnet is excited during connection with the line, while the register may be operated at will, substantially as described.

8. The combination with a telephone-line extending from a substation to a central office, of a spring-jack for the line at the central office adapted for the insertion of a connecting-plug therein, said spring-jack having  
75 a contact-piece *b*<sup>2</sup>, call-indicating apparatus for the line at the central office and a cut-off relay *c* controlling the connection of said indicating apparatus with the line and adapted to respond indifferently to current of either  
80 polarity, a branch circuit *l* from said contact-piece *b*<sup>2</sup> of the spring-jack, including the magnet of the cut-off relay, a polarized connection-register included in said branch circuit, responsive for the registration of a call to two  
85 successive oppositely-directed current impulses, a connecting-plug adapted to be inserted in the spring-jack of the line, oppositely-directed sources of current, and means for alternately connecting said sources of cur-  
90 rent with the plug and so with the contact-piece *b*<sup>2</sup> of the jack, whereby the connection-register is operated, substantially as set forth.

In witness whereof I hereunto subscribe my name this 22d day of September, A. D. 1899. 95

FRANK R. McBERTY.

Witnesses:

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