

No. 650,489.

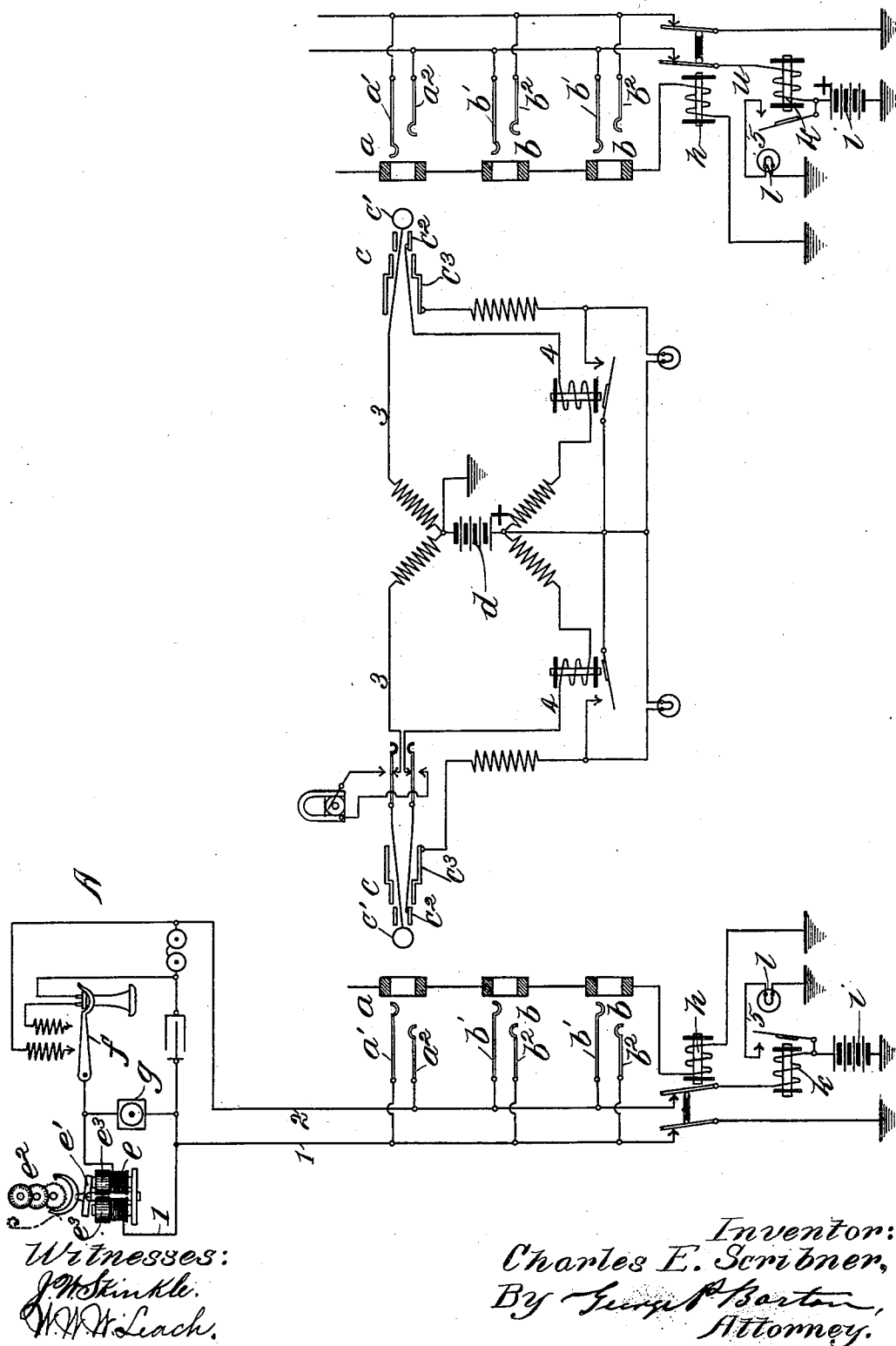
Patented May 29, 1900.

C. E. SCRIBNER.

CONNECTION COUNTER FOR TELEPHONE LINES.

(Application filed Oct. 21, 1899.)

(No Model.)



UNITED STATES PATENT OFFICE.

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CONNECTION-COUNTER FOR TELEPHONE-LINES.

SPECIFICATION forming part of Letters Patent No. 650,489, dated May 29, 1900.

Application filed October 21, 1899. Serial No. 734,356. (No model.)

To all whom it may concern:

Be it known that I, CHARLES E. SCRIBNER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Connection-Counters for Telephone-Lines, (Case No. 478,) of which the following is a full, clear, concise, and exact description.

My invention relates to the measurement of telephone-service, and has for one object to provide a connection-counter and circuits therefor associated with each telephone-line, whereby all calls for connections sent in from the substation of the line and answered by the operator at the central office may be automatically registered.

A further object of my invention is to prevent the actuation of the counting or registering mechanism when a call transmitted from a substation is for any reason not responded to by the central-office operator or when a connection is made with the telephone-line merely in response to a call initiated at some other substation.

My invention is applicable to multiple switchboards wherein each line has a line spring-jack on each section of the board and in addition has on one of the sections an extra or answering spring-jack which is always made use of in responding to a call. The line-jacks, which are multiplied to the several sections of the switchboard, are plugged into only in completing a connection to the telephone-line in response to a call initiated at a substation of some other line.

In practicing my invention I preferably employ a polarized electromagnetic measuring or counting device which requires for its operation two successive impulses of current of opposite direction. Call-registers constructed to operate on this plan are known in the art and consist, briefly, in a polarized electromagnet having an armature which is adapted to be attracted to one side or the other, according to the direction of current flowing through the windings of the electromagnet, and a counting or multiplying train including a star-wheel which is adapted to be engaged by the pallets of an actuating-lever operated by the armature of the electromagnet. As the ar-

mature 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 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.

The modern type of switchboard, known among telephone engineers as a "relay-board," is equipped with a battery at the central office, which is connected in a normally-open bridge of each telephone-line through the back contacts of a cut-off relay associated with such line. A line-relay, which controls a local circuit, including a signal-lamp, is included in the circuit between the battery and the contacts of the cut-off relay, so that the signal is automatically displayed when the subscriber closes the telephone-line circuit by removing his telephone-receiver from its hook. When the central-office operator responds to a call thus made by inserting one of her plugs into the answering spring-jack of the calling line, a local circuit is closed through the windings of the cut-off relay, and the signaling apparatus is thereby removed from the line-circuit. When the centralized battery system is employed, the current for operating the subscriber's transmitter is supplied from a "talking-battery" included in a bridge of the cord strands of each pair of plugs.

My invention is particularly applicable to such a system, and the desired results are accomplished by making the polarized counting-magnet of high resistance and impedance and connecting the same in a bridge of the line by reversing the connection of the answering-jack of each line with relation to the line-jacks thereof and by adjusting the polarity of the talking-battery, which is included in a bridge of the cord strands of each pair of plugs, so that when a plug is inserted in an answering spring-jack current from the talking-battery will flow over the telephone-line in a reverse direction from that in which current from the line signal-battery previously flowed when the subscriber first removed his telephone from its hook. The current impulse, which is impressed upon the line when the subscriber removes his tele-

phone from its hook in initiating a call or when one of his line spring-jacks is plugged into in completing a connection ordered from some other substation, 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 movement of the armature in the opposite direction will register a call—that is to say, this first impulse of current brings about a half-registration of the counting mechanism, which is completed when a current impulse of opposite polarity is transmitted over the telephone-line. Of course two successive impulses of the same polarity would not effect a complete registration. In other words, the first current impulse acts merely to set or wind 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 line when the operator inserts one of her plugs into the answering-jack of the line, the connections of the answering-jack, as before stated, being reversed with relation to the line-jacks.

To avoid the possibility that the counter of the called station might be operated by the alternating ringing-current from the central office in case a subscriber should remove his telephone from its hook while ringing-current is being applied to his line, I make the polarized counting-magnet of high impedance, with the armature very sluggish in its action, so that it will be inert to the rapidly-alternating current. For this purpose the ends of the pole-pieces of the magnets may be encircled by heavy rings or sleeves of good conducting material, such as copper, and the armature of the magnet may consist of an extra-heavy steel bar.

I will describe my invention more particularly by reference to the accompanying drawing, which illustrates, diagrammatically, with the aid of conventional symbols, a telephone-line, with its substation and central-office apparatus constructed and equipped in accordance with my invention.

The substation A is provided with the usual telephone and calling apparatus for use in connection with a relay-switchboard and common battery system. The limbs 1 2 of the telephone-line terminate at the central office in the long and short line-springs a' a'' of the answering spring-jack a and are multiplied to the line spring-jacks b b at the several sections of the multiple switchboard. The connections at the line-jacks, however, are reversed relatively to the connections of the answering-jack—that is to say, at each line-jack the limb 1 is connected with the short spring b^2 and the limb 2 is connected with the long spring b' , while at the answering-

jack the limb 2 is connected with the long spring b' .

An ordinary pair of plugs is illustrated for making connections between the spring-jacks of different telephone-lines at the switchboard, the tip c' of each plug being adapted when inserted in a spring-jack to make contact with the shorter line-spring thereof. Similarly the ring c^2 of the plug makes contact with the longer line-spring of the jack, and the sleeve or shank c^3 engages the testing thereof. The tip and ring contacts of each pair of plugs are united by cord strands 3 4, respectively, through the windings of a repeating-coil in the usual manner, and the centralized talking-battery d is connected in a bridge of the cord strands between the windings of the repeating-coil, the rings c^2 of the plugs being connected with the positive side of the battery, while the tips c' are connected with the negative side thereof.

At the substation A the polarized electromagnet e , the armature whereof actuates the counting-train e^2 , is connected with the limb 1 of the telephone-line and with the telephone switch-hook f , so that when the telephone is in use the magnet will be in a bridge of the line in shunt with the telephone-transmitter g . The magnet e is of high impedance and is very sluggish in its action, having its armature e' made of steel and comparatively massive and having the ends of its pole-pieces encircled by heavy copper rings or jackets e^3 e^3 . The polarized magnet of the counter is very similar to the magnet of an ordinary polarized signal-bell, and its centrally-pivoted armature e' is connected with an operating-lever of the escapement-train and is adapted to be thrown to one side or the other, according to the direction of the current flowing through the magnet-windings.

To effect a complete registration of the counting mechanism, it is necessary that the armature of the polarized magnet shall make a complete oscillation—that is, a movement in one direction followed by a movement in the opposite direction. For this purpose a light "bias" spring may be attached to the armature, as indicated by dotted lines, to keep the armature normally to the side to which it would be thrown by negative current from the limb 1 of the telephone-line, the registration being effected when an impulse of current in a direction to throw the armature to the other side is impressed upon the line, the armature being returned to its normal position by the spring after the cessation of the actuating-current; but with the relay-board, as above described, it is evident that the two batteries which are connected successively with the polarized counter—that is, first the line signal-battery when the subscriber removes his telephone from its hook, and later the battery of the cord-circuit, which is connected in a reverse manner when the answering spring-jack is plugged into—will furnish

the necessary reversely-directed impulses of current to operate the counter positively. With such an arrangement the spring would be superfluous.

5 The two limbs 1 2 of the telephone-line are grounded at the central office by way of the back contacts of the cut-off relay *h*, the limb 2 between the cut-off relay and ground including a centralized line signal-battery *i* 10 and the winding of a relay *k*. A local circuit 5, including the line signal-lamp *l*, is controlled by the relay *k*. The line signal-battery *i* is thus connected in a bridge of the line at the central office, and the signal-lamp *l* is there- 15 fore lighted when the circuit of the telephone-line is closed at the substation by the removal of the telephone-receiver from its switch-hook. When a call is thus initiated, current from the battery *i* will flow through 20 the windings of the polarized counting-magnet *e*, which is included in the normally-open bridge of the line at the substation, and this current is of suitable direction to throw the armature of the polarized magnet to a given 25 position. This movement of the armature we may consider as a preliminary one, "setting" the mechanism so that it will be in condition to respond to the positive counting impulse, which will later be applied when the 30 answering-jack is plugged into.

Of course sometimes the armature of the counting device will already have been thrown or set to this preliminary position by a previous impulse of negative current which may 35 have been thrown on the line from the talking-battery of a cord-circuit at a previous connection with the line-jack in response to a call initiated at some other station. In such a case the subsequent impulse of negative 40 current from the line-battery at the initiation of a call would produce no movement of the armature, since the latter is already in the position to which such current would tend to move it.

45 When the operator at the central office in response to a call from the substation inserts one of the plugs *c* into the answering-jack *a* of the calling line, positive direct current flows from the centralized battery *d* over the 50 conductor 4 of the cord-circuit to ring *c*² of the plug, to the longer line-spring *a'* of the answering spring-jack, and out over the limb 1 of the telephone-line, energizing the counting-magnet *e*, and flowing back to battery 55 over the other limb 2 of the telephone-line. This impulse of positive current follows the impulse of negative current, which was previously thrown on the line through the line signal-battery *i*, causing the armature to move 60 to its alternative position, thus advancing the counting-train and registering the connection. When, however, a plug is inserted in the line-jack, as in making a connection with the telephone-line in response to a call 65 from some other substation, negative current from the centralized battery *d* will flow over the limb 1 of the telephone-line; but since

negative current has previously been thrown on this limb from the line signal-battery *i* it will be evident that no further actuation of 70 the counting mechanism will result.

The counter will not be actuated if the called subscriber removes his telephone from its hook while ringing-current is being applied to his line, because the polarized elec- 75 tromagnet is too sluggish to respond to the rapidly - alternating ringing - current. The counting device of a given substation is therefore operated only when a connection is made with its line at the central office in response 80 to a call initiated at that station.

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

1. The combination with a telephone-line 85 having limbs 1 2 extending from a substation to a central office, of a counting device at the substation and an electromagnet of high impedance for operating the same, connected with the limb 1 of the telephone-line, said 90 electromagnet being polarized to respond only to direct current flowing in one direction over the line, an answering spring-jack *a* and line spring-jacks *b* forming terminals for the telephone-line at the central office, 95 the connections of the line-jacks being reversed relatively to the connections of the answering-jack, a switch-plug having a contact-piece adapted to make connection with the limb 1 of the telephone-line when inserted 100 in the answering-jack, said contact-piece being adapted to make connection with the other limb 2 of the telephone-line when the plug is inserted in a line-jack, and a source of direct current connected with the contact- 105 piece of the switch-plug, whereby said source of current is connected with the limb 1 of the telephone-line to operate the counting device, when the switch-plug is inserted in the answering-jack, substantially as set forth. 110

2. The combination with a telephone-line having limbs 1 2 extending from a substation to a central office, of a counting device at the substation and a polarized electromagnet 115 for operating the same, connected with the limb 1 of the telephone-line, an answering spring-jack *a* and a line spring-jack *b* at the central office, a switch-plug for insertion in a spring-jack to make connection with the telephone-line, and a source of direct current 120 *d* associated with a cord strand connected with a contact-piece of the plug, whereby said source of current is connected with the limb 1 of the telephone-line to operate the counting device, when connection is made 125 with the answering spring-jack of the line, substantially as set forth.

3. The combination with a telephone-line extending from a substation to a central office, of a polarized magnet connected in a 130 bridge of the line at the substation, counting mechanism operated by said magnet, a line spring-jack and an answering spring-jack for the telephone-line at the central office, the

connections of said spring-jacks being reversed relatively to one another, a switch-plug at the central office and a source of current *d* connected with a contact-piece of the plug, whereby current from said source will be directed over the line when the plug is inserted in a spring-jack, the current flowing in a direction to actuate the polarized counting device at the substation when connection is made with one of the spring-jacks, and flowing in a reverse direction, so that the counting device will not be actuated, when the plug is inserted in the other jack having reverse connections, substantially as set forth.

4. The combination with a telephone-line extending from a substation to a central office, of a high-impedance polarized electromagnet connected in a bridge of the line, counting mechanism actuated by said magnet, a spring-jack for the line at the central office, a switch-plug adapted to be inserted in said spring-jack to make connection with

the line, and a source of current adapted to be connected with the line to operate the counting device, such connection being controlled by the insertion of the switch-plug in the spring-jack, substantially as described.

5. A connection-register for telephone-lines, comprising a measuring-train, a polarized electromagnet provided with a magnetic ring *e*³ of high conducting material, as copper, and a heavy steel armature for said electromagnet connected with and adapted to operate the measuring-train, whereby said electromagnet, while adapted to respond to continuous current of a given direction, is made inert to rapidly-alternating current, substantially as set forth.

In witness whereof I hereunto subscribe my name this 2d day of October, A. D. 1899.

CHARLES E. SCRIBNER.

Witnesses:

ELLA EDLER,

FLORENCE E. SUMMER.