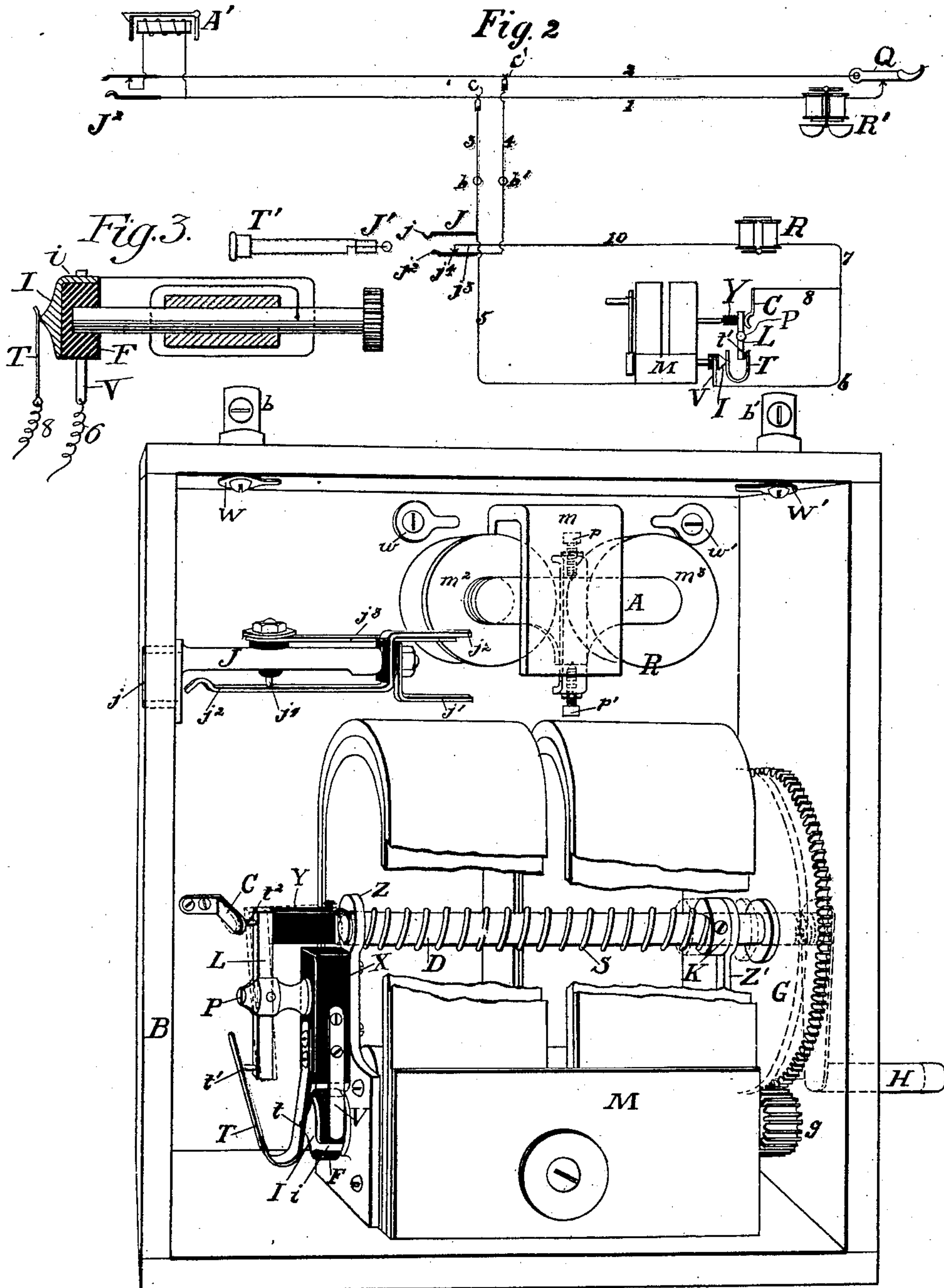


A. C. LUDINGTON.  
TELEPHONE TEST SET.  
(Application filed Jan. 18, 1900.)

(No Model.)



WITNESSES  
J. Edgar Allen  
Ellis Hillman

Fig. 1

INVENTOR  
A. C. Ludington,  
by Clement Sharty,  
Attys.



# UNITED STATES PATENT OFFICE.

ALBERT C. LUDINGTON, OF MARQUETTE, MICHIGAN, ASSIGNOR OF ONE-HALF TO NATHAN M. KAUFMAN, OF SAME PLACE.

## TELEPHONE-TEST SET.

SPECIFICATION forming part of Letters Patent No. 653,422, dated July 10, 1900.

Application filed January 18, 1900. Serial No. 1,851. (No model.)

*To all whom it may concern:*

Be it known that I, ALBERT C. LUDINGTON, a citizen of the United States, residing at Marquette, in the county of Marquette and State of Michigan, have invented a new and useful Telephone-Test Set, of which the following is a specification.

My invention relates to the test sets employed by linemen, particularly in locating troubles, such as grounds or crosses, in telephonic installations. It has for its object the production of a complete outfit of this general character which shall be compact, efficient, and when in use can be carried by the linemen without inconvenience such as results from the various terminals and attachments of many sets. To this end I provide a case containing a magneto-generator of a peculiar type to be described, a polarized buzzer or vibrator, and a spring-jack. These are all so connected that for their use only two projecting terminals are required on the exterior of the box, the handle of the generator being removable when not in use.

The form of generator which I employ, with certain switch attachments constituting part of my invention, enables a lineman by one movement of the hand to generate a current and alter its direction or character at will, rendering it possible thus to call either a subscriber or the central office on a given line, or, as a lineman would put it, to "ring in" or to "ring out."

My invention is fully illustrated in the accompanying drawings, wherein—

Figure 1 is a perspective view of the complete outfit, the front of the box and all circuit-wires being removed and parts of the generator-magnets being broken away. Fig. 2 is a diagram of a telephone-line and the circuits of my test set connected therewith. Fig. 3 shows in detail the generator-winding and its circuit connections.

Referring to the drawings, B is a box or casing of about the size of the ordinary "magneto-box" employed in telephone wall sets. Externally it is made smooth and without projections of any kind except the two binding-posts *b* and *b'*. In practice it is provided with a suitable carrying means, preferably a strap of some sort. Inclosed within the box

and firmly secured to the floor thereof is a magneto-generator M, of peculiar construction, to be described. Above the generator and fastened to the rear wall is a polarized vibrator R. To one side of this vibrator, secured to the side of the box, so as to present an opening *j* externally thereof, is a spring-jack J. The circuits of the box all terminate at tailed washers W and W', connected to the binding-posts *b* and *b'*. These circuits are omitted in Fig. 1 in order to avoid complication in the drawings.

Before proceeding to describe the parts of my invention in detail I wish to explain its general purpose and functions. In Fig. 2 is shown a subscriber's telephone-line, the two wires of which are marked 1 and 2, respectively. At the subscriber's station I have shown a switch-hook Q and a ringer or polarized bell R'. At the central station, connected to the other extremity of the line, I have shown an annunciator A' and a spring-jack J<sup>2</sup>. Now when it happens that a line does not work properly and the subscriber perhaps complains it becomes necessary to ascertain the location of the trouble as the first step toward its removal. There are a great many ways of testing for trouble, and whenever the trouble is found to be located outside of the switchboard at the central station it becomes linemen's work to find it and remove it. In prosecuting this work the lineman is of necessity provided with some sort of a testing outfit which can be connected to the line at divers points, and the present invention embodies such an outfit. The lineman of necessity finds himself in many situations where anything bulky in the way of a burden or any article which has numerous projections to be entangled in wires and the like is a nuisance, not to say dangerous. Consequently the present test set is reduced to the simplest form compatible with efficiency and has but two projections, (the binding-posts,) the handle H of the generator being removable by unscrewing in the ordinary way, as indicated in dotted lines in Fig. 1.

In ordinary testing with existing outfits it is frequently necessary for the lineman to cut the wire at some intermediate point, con-



nect his set first to one side of the break and then to the other, thus ascertaining in which direction the trouble lies. This cutting of the line is obnoxious for many reasons, principally because it introduces a source of possible trouble for every new splice. In the present invention the lineman can bridge his test set across the line by means of clips without cutting it and may still signal first one way and then the other to locate the trouble he is after. This is accomplished by giving him control of both alternating and continuous current, the subscriber's bell responding only to the former, while the central-office annunciator will respond to both. Thus in case of line trouble suppose the lineman to have attached his clips to the line, as shown in Fig. 2, and to have ascertained that he can call a subscriber, but not the central office. He then knows that the trouble is between him and the latter. By moving to a point nearer the central office and trying again he locates the trouble either between the second position and the first or the second position and the central office, and so on. As will appear from the description, he may also communicate with the central office at will over any line without calling the subscriber; but probably the most important use of the invention is in cases like the following: Suppose a lineman knows that there are one or more "dead" conductors in a cable or lines in a "lead" and he wants to find them. Suppose these lines are not all run "straight" and so that he knows where to put his hand on any line at any place, (and this is the condition of affairs in the majority of exchanges). The lineman can go to any place and test on all the lines or he can test from a cable-terminal, testing out all the conductors until he finds what he is looking for, and all this without once ringing any subscriber, cutting any wire, or disconnecting at any terminal. He can test out a subscriber's switchboard-circuit from the lightning-arresters or cross-connecting board without disconnecting the line or breaking the circuit at any place. Of course some of the effects obtained with this set can be produced with any direct-current machine; but such a machine, except as described in my specification, is not fitted for general testing or for linemen's use.

Referring now particularly to Fig. 2, *c* and *c'* are clips from which wires 3 4 lead to the binding-posts *b b'*. These posts are connected, respectively, to the two contacts *j* and *j'* of the spring-jack J. From the contact *j* a wire 5 is led to the generator M, and from the generator wires 6 and 8 pass to the vibrator R, which is connected by wire 10 to the contact *j'* through the spring *j''* of the spring-jack J. A rocking lever L is adapted to be moved by endwise movement of the main shaft D of the generator to cause either alternating or continuous current to be delivered through wire 7 from the junction-point of wires 6 and 8. The mechanism by which

this is accomplished is better shown in Fig. 1. Here X is a block of insulation secured by screws to the bearing-plate Z of the generator. Mounted upon this block are two springs T and V and a post P, in which is pivoted the lever L, the upper end of which carries a contact *t*, which is constantly pressed upon by the spring C, while its lower end carries a contact *t'*, normally in contact with the upturned outer end of the spring T, but adapted to be separated therefrom when the lever L is rocked. The end of the armature-shaft carries an insulating-button F, upon which is fixed a metal end cap I, having a pointed apex *t*, constantly in contact with the spring T, and a commutator-finger *i*, which in the rotation of the armature touches the spring V once for every revolution. The winding of the armature of the machine has one end connected in the usual way to the metal core or shaft and the other end to the insulated cap I. This is more clearly brought out in Fig. 3, where the insulating-button F and the cap I are shown in section. One end of the armature-winding, which is shown in diagram only, is connected to the shaft and the other end to the cap I through the commutator-finger *i*. Thus it will be evident that from the spring T alternating current may be taken off, while from the spring V intermittent current of only one polarity is obtainable.

Returning to Fig. 2, the parts are shown in their normal position, and it must be evident that with the lever L in contact with the spring T only alternating current can flow in the circuit, for the intermittent impulse through wire 6 will be the same that is already traveling by the other path through wire 8. On the other hand, if the handle of the generator is pushed in and then turned the contact *t'* is removed from spring T and only one path is complete—viz., that from spring V through wire 6—which will give intermittent direct current. In order that there may be no short-circuiting through the frame of the machine, a block of insulation Y is attached to the upper end of the lever L, and it is upon this block of insulation that the end of the shaft D bears when it is pressed in.

The shaft D is journaled in the end plates Z and Z' and is normally retracted into the position shown in full lines in Fig. 1 by a coiled spring S, working as a compression-spring between the plate Z and a collar K, secured to the shaft. The armature of the machine is rotated by means of the gear-wheel G and the pinion *g*, the latter having a broad enough face to permit of the sliding motion necessary in the shaft without disengagement of the gear-teeth.

The vibrator R consists of a pair of spools *m<sup>2</sup> m<sup>3</sup>*, mounted upon a yoke and secured to a permanent magnet *m*, which extends over the front of the spools. Secured in front of the cores of the magnets *m<sup>2</sup>* and *m<sup>3</sup>* and underlying the permanent magnet *m* is an arma-



ture A, carried upon pivots  $p$  and  $p'$ . Tailed washers W and W' are provided for the magnet-terminals.

The spring-jack J consists of a solid body 5 having a thimble  $j$  at one end perforated to receive a plug and fitted to a suitable orifice in the side of the box. Secured upon the body of the jack are the contact  $j^4$  and the spring  $j^2$ , with the terminal springs  $j'$  and  $j^3$ . 10 A plug J' is shown in Fig. 2 connected to a telephone-receiver T'. This plug and receiver are supposed to be kept in the lineman's coat-pocket when not in use, the insertion of the plug in the spring-jack raising the 15 spring  $j^2$  from the anvil  $j^4$ , and thus disconnecting the generator and vibrator, while it connects the telephone. Obviously as an equivalent of this series method of connecting the generator and vibrator they could 20 be bridged across the jack-terminals and would thus not have to be cut out. To do this, it is only necessary to connect the wire 5 to binding-post  $b$  and the wire 10 to  $b'$ .

In using this set the lineman first attaches 25 his clips and then pushing the handle of his generator all the way in turns it. By so doing he has removed the contact  $t'$  from the spring T and current will pass of one polarity and intermittently from the generator M 30 through the spring V, wires 6 and 7, vibrator R, wire 10, and so to line. This current will pass both ways over the line; but it will not operate the subscriber's bell, as that is polarized. On the other hand, if the line is intact 35 to the central office it will energize the annunciator A' and the operator will insert a plug in the jack J<sup>2</sup> and respond. As soon as the lineman has called he will remove his plug and receiver from his pocket and insert 40 the plug in the jack J, whereby he may converse with the operator. If no response is made from the central office, the lineman may permit the handle H to return from the position shown in dotted to the position shown 45 in full lines, and by turning the handle he will produce alternating current through the following box-circuit: from binding-post  $b$  by wire 5 to generator M, cap I, spring T, contact  $t'$ , lever L, spring C, wire 8, wire 7, vibrator R, wire 10, contact  $j^4$ , spring  $j^2$ , to binding-post  $b'$ . 50

I am aware that it is not new to derive current having different characteristics from the same machine and that it is not new to use 55 differences in polarity or other characteristics of current for signaling purposes. I do not claim these nor the method of testing the line. My claims are intended to cover the apparatus described, by virtue of which the 60 above ends can be attained without any skilled manipulation. The only instructions that a lineman needs for the use of my apparatus are to use his clips before ever cutting the line and to press in the handle before 65 turning if he wishes to get central without calling the subscriber.

What I claim, and desire to secure by Letters Patent of the United States, is—

1. In a lineman's test set, the combination of the following instrumentalities: a vibrator 70 responsive to alternating current, a magneto-generator included in circuit with said vibrator, a commutator for said generator constantly connected to deliver intermittent direct current; a terminal spring connected to 75 take off alternating current from the generator, included in a normally-closed branch around the commutator, and means operated at will, by the working shaft of the generator, to open and close said branch, substantially as described. 80

2. A lineman's test set consisting of the following instrumentalities: a vibrator responsive to alternating current, a generator having its armature constantly connected to a 85 collector-spring to deliver alternating current, and to a commutator for delivering direct current of one polarity, a normally-closed circuit including a spring-brush, from said commutator to the vibrator, a normally-open 90 circuit or branch around the commutator and including the collector-spring, a shaft for driving the generator geared to the armature thereof and having endwise movement in its bearings, and a switch included in the collector-spring circuit adapted to make or break 95 the same, and controlled by the endwise movement of the shaft, substantially as described.

3. In a testing-generator the combination of the following instrumentalities: a driving-shaft having endwise movement in its bearings, an armature geared to said shaft, terminal contacts connected to the armature-winding, and adapted to rotate with the armature, a collector-spring constantly pressing 100 against one of said contacts, and a commutator-spring intermittently engaging with the other of said contacts, constantly-closed circuit connections from said commutator-spring and the other end of the armature-winding to circuit-terminals; a switch-lever 105 mounted in proximity to the extremity of the generator-shaft and carrying an insulating-button for engagement therewith, the lower end of the switch-lever carrying a contact for 110 engagement with the collector-spring, and a branch circuit connection from such switch-lever around the commutator-spring to the same terminal, substantially as described.

4. In a lineman's test set, a vibrator, and a 120 generator, a driving-shaft for the generator having endwise movement in its bearing, armature-terminals for the generator connected to deliver alternating or intermittent direct current respectively, and means controlled 125 by the endwise movement of a shaft for rendering operative one set or the other of armature-terminals, at will, substantially as described.

5. In a lineman's test set the combination 130 of the following instrumentalities: a containing-case, a generator therein adapted to de-



liver alternating or direct current, means  
controlled through the handle of said gener-  
ator to determine what current shall be de-  
livered, a vibrator responsive to alternating  
5 current only, a spring-jack included in the  
circuit of the generator and vibrator and nor-  
mally completing the same, a telephone-re-  
ceiver and a plug connected thereto and  
adapted to be inserted into the spring-jack to

cut out the generator and vibrator and cut in to  
the telephone, substantially as described.

In testimony whereof I have hereunto set  
my hand, in the presence of two subscribing  
witnesses, this 15th day of December, 1899.

ALBERT C. LUDINGTON.

Witnesses:

JOSEPH P. SHEPARD,  
ROBT. MCCARTHY.