(No Model.) 2 Sheets—Sheet 1.

C. E. SCRIBNER.

TESTING APPARATUS FOR MULTIPLE SWITCHBOARDS.

No. 489,099. Patented Jan. 3, 1893.

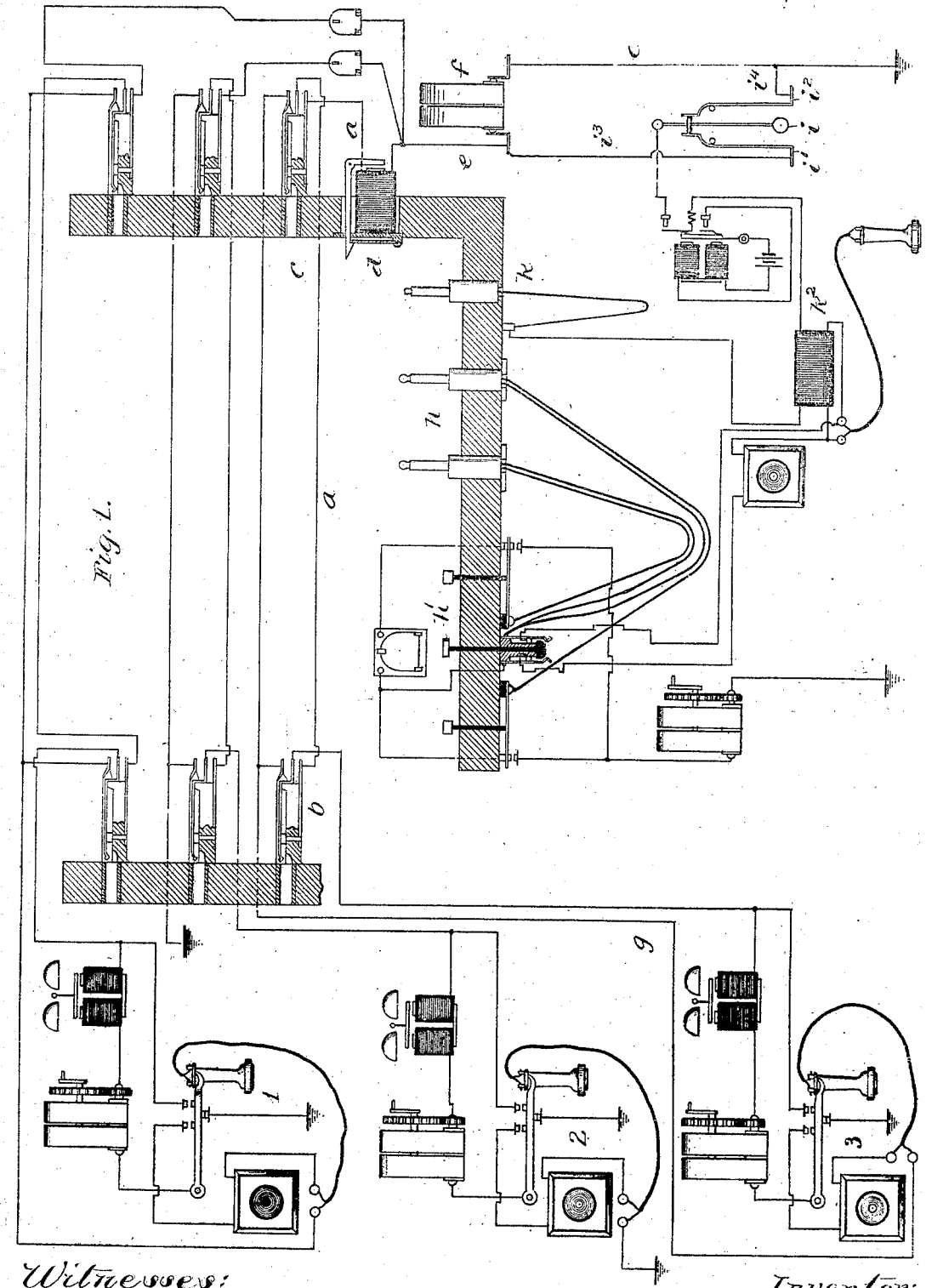

Fig. 1.

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(No Model.) 2 Sheets—Sheet 2.

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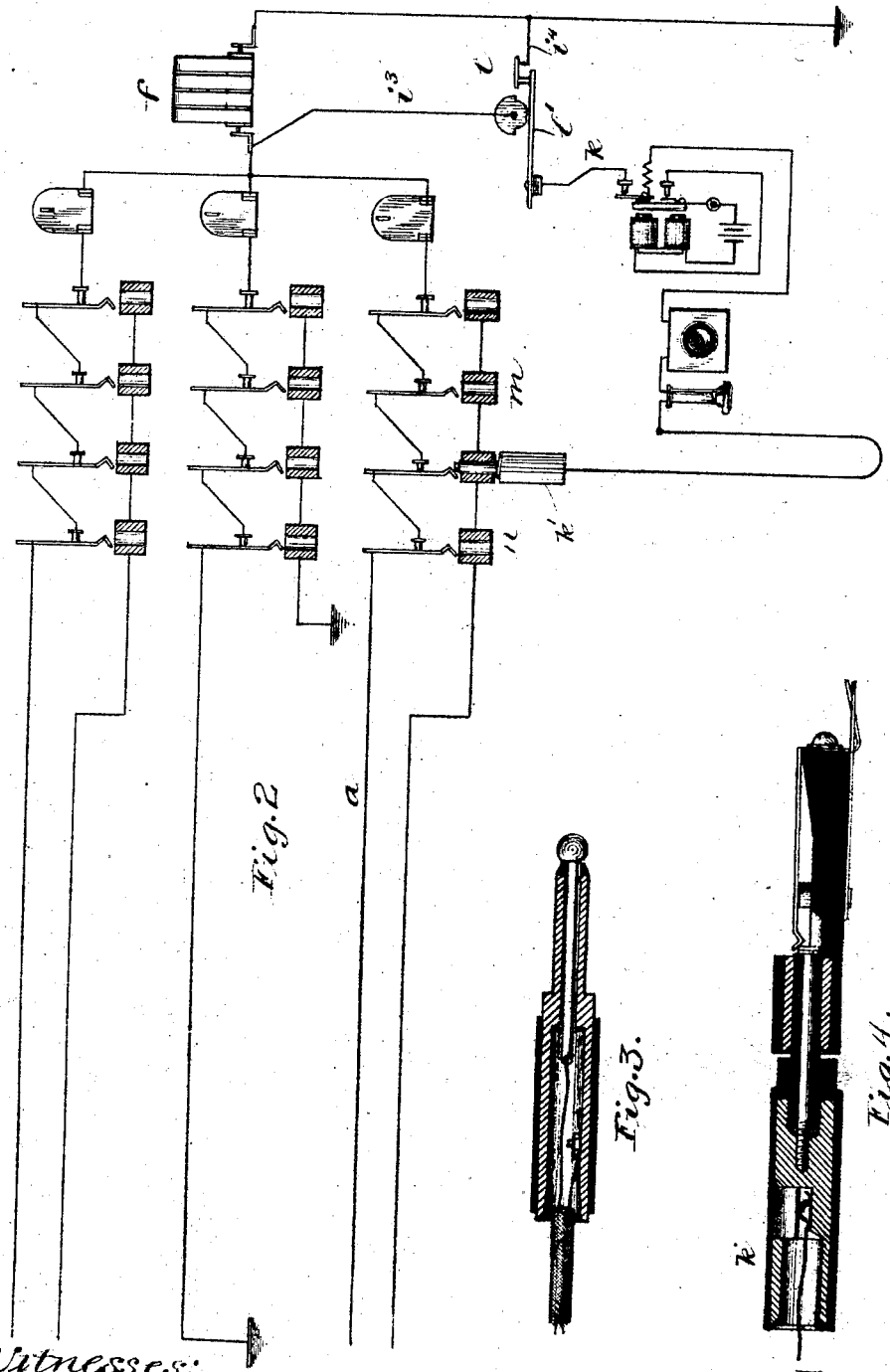

Fig. 2.

Fig. 3.

Fig. 4.

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UNITED STATES PATENT OFFICE.

CHARLES E. SCRIBNER, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE WESTERN ELECTRIC COMPANY, OF SAME PLACE.

TESTING APPARATUS FOR MULTIPLE SWITCHBOARDS.

SPECIFICATION forming part of Letters Patent No. 489,099, dated January 3, 1893.

Application filed June 19, 1888. Serial No. 277,559. (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 Testing Apparatus for Multiple Switchboards, (Case No. 173,) of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention is designed to provide ready and efficient means for determining at one board whether any given line is in use. This I accomplish by connecting the lines at the central office to a common line including a current generator, by means of which alternating or undulatory direct currents are sent in derived circuit over the telephone lines, and testing apparatus and circuits so arranged that when a connecting plug is inserted in any springjack of a line, the effect will be indicated to the operator on connecting the test plug of the testing apparatus with the spring of any other springjack switch of the line in use.

In Figure 1 I have shown three subscribers' stations and their lines connected with two multiple switchboards, the connecting and testing apparatus being shown at the second board in detail. Fig. 2 is a diagram illustrating the circuits of the telephone lines at the central office more in detail, a rotary circuit changing device being shown as a part of the testing apparatus in place of the pendulum circuit changing device shown in Fig. 1. Fig. 3 is a sectional view of an ordinary loop plug. Fig. 4 is a detailed view of the test plug inserted in a springjack switch so as to bring its tip only in contact with the spring of the switch without lifting said spring from its normal ground contact.

Like parts are indicated by similar letters and numerals of reference throughout the different figures.

The metallic circuits of stations 1 and 3 consist each of two branches, one branch extending normally from ground at the subscriber's station through the spring and contact of each of the switches of the line, and thence through an annunciator to the common ground line including the generator, the other branch being normally open at both ends extending from the subscriber's station to the insulated frame or test piece of each of the springjack switches of the line.

The circuit of station 2 consists of a line grounded at the subscriber's station and extending through the spring and contact of each of the switches of the line at the central office and through an annunciator to the ground line containing the generator. The insulated frames or test pieces of the springjacks of the line connected with station 2 are simply connected together by a line grounded at the central office.

The only practical difference between a grounded circuit, as the circuit of station 2, and a metallic circuit, as the circuit of station 3, is that in one case the circuit is completed through the ground a portion of the way, while in the other the entire circuit is metallic.

I will now describe the circuit of station 3 as illustrated in detail in Fig. 1. Beginning at the ground contact of the telephone switch of station 3, circuit may be traced through the generator and bell over limb *a* through the spring and contact of switch *b* upon the first board; thence through the spring and contact of switch *c* of the second board and thence through an annunciator *d* to the common line *e* including the generator *f*. The other limb *g* of the metallic circuit of station 3 extends from a contact near an upper contact point of the telephone switch, through the telephone and thence to the insulated frames or test pieces of switches *b*, *c*. This limb *g*, it will be observed, is normally open at both ends. On the second switchboard I have shown an ordinary pair of loop plugs *h* and their double stranded flexible cords, in connection with a listening key *h'* of well-known construction. Any two lines may be connected together in the ordinary manner by inserting the plugs into the springjacks of the line. The line *a*, as above stated, is connected to a generator *f* included in a common ground wire *e*. From different sides of this generator I provide branch circuits to different parts of the commutator or circuit changer of the testing apparatus. In Fig. 1

this circuit changer is designed to be operated by a pendulum i which swings between the terminals i' and i^2 of the branches i^3 and i^4 from the different sides of the generator. The pendulum i is connected with the circuit k which includes a rheotome and a telephone, the other terminal of circuit k being a test plug k' (for detailed view of test plug k' see Fig. 4). In Fig. 1 the circuit k is connected with the telephone by means of an induction coil or converter k^2. As the pendulum vibrates the branches i^3 and i^4 are alternately connected with circuit k.

In Fig. 2, in place of the pendulum, I have shown the eccentric l which is driven constantly by any suitable means. When in the position shown, branch i^3 is open and circuit k is connected directly with branch i^4 through spring l'. The eccentric l may be in vertical cross section of the form shown, cut away so that only about one half of its circumference will come against spring l' as the eccentric rotates. Thus during one half the rotation of the eccentric l, connection is made between circuit k and branch i^3 through the spring l' which is, during this time, separated from the contact of branch i^4. During the remaining portion of its revolution the cut away portion being opposite the spring l' allows spring l' to close upon the contact of branch i^4 while branch i^3 is disconnected from spring l'. Thus the branches i^3 and i^4 are alternatively connected with the circuit k as the eccentric l is turned.

In practice the generator f will be constructed to send alternating or undulatory direct currents over many lines. The current sent over any one line is, therefore, necessarily of low electro-motive force and would not operate a telephone placed directly in the circuit of one of the lines. While the currents sent over the lines by the generator are alternating or undulatory direct the changes in strength or direction are, comparatively speaking, gradual as distinguished from abrupt, and these changes take place so slowly that although acting upon the telephone included in circuit even to the extent of causing movements of the diaphragm of the telephone I have discovered that these movements will be of such character as not to cause any sound to one listening. I therefore provide a rheotome or vibrator in the test circuit k so that the character of the current present may be indicated by the telephone included in said circuit k.

In Fig. 2 the plug k' is shown connected with a spring of a switch of line a as in the act of testing. As all the other switches included in the line a are closed, current will be sent from generator f to the tip of test plug k', thence through the telephone and rheotome included in circuit k to spring l' and thence by branch i^4 to the generator when the eccentric l is in the position shown. When, however, the eccentric l is electrically connected with spring l' and lifts said spring l from contact with branch i^4, the current will be sent from generator f through branch i^3 to eccentric l and spring l'; thence through circuit k to the tip of plug k'; thence to the spring of the springjack in which test plug k' is inserted and thence over line a to ground at station 3. The operator listening at the telephone will thus hear a constant hum or buzz in the telephone included in circuit k. In case telephone line a were connected with another line at a spring jack switch either in front or back of the switch in which test plug k' is inserted, the circuit of the generator f through circuit k would be interrupted at each turn of the eccentric l or at each stroke of the pendulum i. Thus, suppose the spring of switch m lifted from its contact. The circuit of generator f will be found open at said spring of switch m and also at the spring l' when the eccentric is in the position shown. Therefore, during half the revolution of eccentric l, no current will be sent through circuit k. When, however, contact is formed between eccentric l and spring l', the circuit from generator f may be traced through branch i^3 to circuit k; thence to the test plug k' and thence over line a to ground at station 3. With the line a open thus at switch m back of the switch in which the test plug k' is inserted, the derived circuit from generator f will be closed intermittently through the rheotome and telephone in circuit k and the operator listening at the telephone will hear the hum intermittently instead of continuously, as is the case when the line a is free. The same effect will be produced in the telephone when a springjack n in front of the one in which the test plug is inserted is open, but by means of different connections; that is to say, suppose the spring of switch n separated from its back contact; current from the generator f would then be sent through the cut off portion of line a to the tip of test plug k'; thence through circuit k to spring l'; thence to branch i^4 and thence to the generator with the eccentric in the position shown. When the spring l' is lifted from its contact with branch i^4, no current would be sent through the circuit k, since though the contact would be complete between branch i^3 and the spring l', still the circuit would be found open at the back contact of switch n. Thus as the eccentric rotates, the circuit of the generator through the rheotome and telephone would be closed intermittently and the operator listening at the telephone would hear an intermittent hum or buzz. Therefore the operator would know that the line was in use whenever the hum in the telephone should be intermittent, the constant hum or continuous hum, as before described, both indicating that the line was free. The rate of revolution of the eccentric and of oscillation of the pendulum are such that the intermittent hum or buzz caused when the

subscriber's telephone is in communication with another, may be heard several times by the operator during the time that the telephone receiver would be held to the ear for the test. The currents are slowly changing, alternating or undulatory direct.

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

1. The combination with a telephone line extending through a series of switches, of a current generator connected with said line for sending an undulatory direct or alternating current of low electromotive force upon said line, a test circuit including a telephone and rheotome and a circuit changing device for alternately connecting said test circuit with different sides of said generator; whereby, on closing said test circuit with any springjack switch of the series the operator listening at the telephone may make a test to determine whether the line is in use.

2. The combination with the circuit including the rheotome and telephone connected at one end with the spring of one of the springjack switches in a telephone line and with a circuit changing device at the other end, of a generator current connected with said telephone line to send undulatory direct or alternating currents thereon and branch circuits from different sides of said generator to the circuit changing device; whereby it may be determined whether the telephone line is connected or in use, substantially as and for the purpose specified.

3. The combination with several telephone lines connected each through a different series of springjack switches to a common ground line including a generator, of a testing apparatus which is alternatively connected to different sides of said generator at one end and provided with a test plug at the other end for connecting with a springjack switch of any one of the lines; whereby it may be determined by listening at the telephone of the testing apparatus when the test plug is connected with a spring of any telephone line, whether said line is open at any other of its series of springjack switches, substantially as and for the purpose specified.

4. The combination with a telephone line extending through a series of switches, of a current generator connected with said line for sending slowly changing alternating or undulatory direct currents over said lines, a rheotome, a circuit changing device, and a telephone, whereby the presence of said currents will be indicated only when the rheotome is connected in circuit with said telephone.

In witness whereof I hereunto subscribe my name this 13th day of June, A. D. 1888.

CHARLES E. SCRIBNER.

Witnesses:

GEORGE P. BARTON,

CHAS. C. WOODWORTH.