(No Model.)

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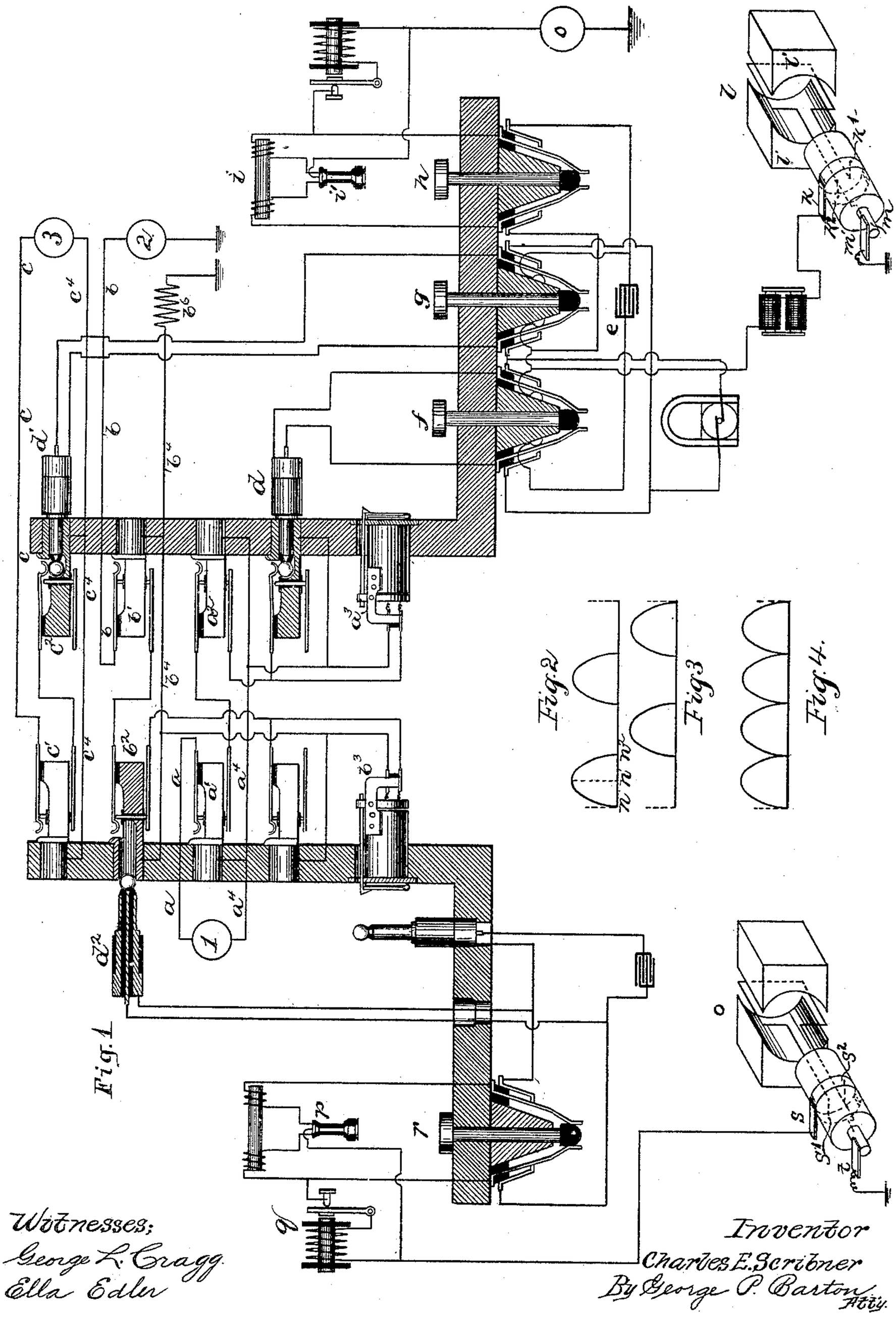
TEST CIRCUIT FOR MULTIPLE SWITCH BOARDS.

No. 467,902. Patented Jan. 26, 1892.



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TEST-CIRCUIT FOR MULTIPLE SWITCH-BOARDS.

SPECIFICATION forming part of Letters Patent No. 467,902, dated January 26, 1892.

Application filed May 29, 1891. Serial No. 394,500. (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 Test-Circuits for Multiple Switch-Boards, (Case No. 262,) 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 relates to a testing system for multiple switch-boards.

Its object is to provide means whereby an operator at one switch-board may ascertain whether any line is in use at some other board or not.

Heretofore many circuits or test systems designed to enable an operator thus to determine whether a line called for was in use or not have been devised; but under certain unfavorable conditions which sometimes arise the sound or test-signal by which the condition of the line is indicated to a testing operator may be counterfeited by static discharges from a line, or by induced currents flowing in the lines escaping through the test-circuit to earth. Thus a false signal is produced, which misleads the operator and causes confusion and delay in establishing connection between subscribers.

My invention is designed to obviate this difficulty by providing a test-signal of such character as to be distinct and different from any such false signals.

My invention comprises circuits and apparatus whereby when a connection is made to a telephone-line the branch circuit is completed to earth, including a source of intermittent or pulsatory electro-motive force of such period and character that a current produced thereby is inaudible in a telephone; means for testing the electrical condition of the test-rings of a line, consisting of a test-plug connected to earth by a branch circuit including a second source of intermittent or pulsatory electro-motive force of the same period and general character as that from the first source, but whose periods of intermission coincide with the periods of activity of the first source; a vibrating circuit-breaker, and a telephone. When a test-circuit including these two sources of electricity is completed, as when a test-plug connected to the second source is applied to the test-ring of a telephone-line to which a branch circuit including the first source is attached, an undulatory current flows in the completed circuit, and is rendered audible in the telephone by the action of the vibrating circuit-breaker, and produces in the telephone a fluctuating musical tone characteristic of the apparatus employed. A similar sound could not be produced in the telephone by extraneous causes, since a static charge upon the line would result in only a momentary hum in the telephone, while an induced or foreign current would produce a continuous tone. When an idle line is tested, if the line be a metallic circuit no sound will be heard in the testing-telephone. If it be a grounded circuit, an intermittent tone is produced in the telephone, which is very distinct and different from the tone produced by the test of the line in use.

My invention will be more clearly understood by reference to the accompanying drawings, which are illustrative thereof, in which—

Figure 1 represents three sub-stations connected by lines to their respective spring-jacks and annunciators upon two sections of multiple switch-board. The switch-board at the right of the drawings is shown equipped with the well-known apparatus for connecting the different lines for calling and communicating with subscribers, and with my improved testing system. The switch-board at the left of the drawings is shown equipped with the testing system divested as far possible of its connections with the calling-keys and their apparatus not concerned in its operation. Fig. 2 is a graphical representation of the character of the electro-motive force impressed upon the circuit by one of the sources of current included in the test-circuit. Fig. 3 is a similar representation of the character of the electro-motive force of the other of the sources of current in the test-circuit. Fig. 4 is a representation of the composite current resulting from the coaction of the two sources of current in the test-circuit.

I will now proceed to describe in greater detail the system shown in Fig. 1, and my invention in connection therewith. Sub-stations 1, 2, and 3 are shown connected to their respect-

ive spring-jacks on the first and second sections of switch-board, 1 and 3 by metallic circuits and 2 by a grounded circuit. The circuit from sub-station 1, for example, may be traced through line a, through line-spring and contact of spring-jack a' at the first section of switch-board, thence to the line-spring and contact of jack a^2 at the second section of switch-board, thence through the annunciator a^3, thence returning by line-wire a^4 to station 1. The line-spring and frame of answering-jack a^5 are connected to lines a and a^4, respectively. The frames of jacks a' and a^2 are connected to line a^4. The line b from station 2 may likewise be traced through the line-spring and contact of spring-jack b', thence normally through the line-spring and contact of spring-jack b^2, through the annunciator b^3, returning by line b^4, resistance b^6, and earth to station 2. Line c from station 3 extends likewise through spring-jacks c' and c^2, returning by line c^4. The lines c c^4 are not shown connected to their annunciator and answering-jack.

The operating outfit at the second board comprises the two loop-plugs d and d'. The tips of plugs d and d' are electrically connected by means of flexible cords and condenser e. The sleeves of plugs d and d' are connected directly. Included in circuit between the two plugs are the two ringing-keys f g, one on either side of condenser e, adapted when depressed to disconnect both tip and sleeve of one of the plugs from the corresponding portions of the other plug and to connect them to the two sides of a calling-generator. Branch connections are extended from the circuits joining the two connecting-plugs d d' to the contacts of a listening-key h, whereby upon depressing the key the telephone-set i is bridged in between the tip and sleeve of the plugs, and hence between the two sides of the circuit of two subscribers in communication. A second branch connection is extended from the wire joining the sleeves of the plugs d d' to the brush k of a dynamo l. The armature of dynamo l I have shown as a single coil revolving in the magnetic field produced by the pole-pieces l' l'. Of its two extremities one is connected to the segment k' of a special commutator and the other to the piece m. This piece m is connected to earth through the brush m'. The segment k' is of such length as to engage with the brush k during one half-revolution of the armature. A second commutator-segment k^2 is provided in a position to engage with the brush k during the remaining half-revolution and is in electrical connection with the piece m. Hence during one half-revolution of the armature the brush k receives current therefrom. During the other half-revolution the brush k is connected directly to earth through the segment k^2, piece m, and brush m'. Thus the electro-motive force impressed upon the circuit of which brush k is a terminal will be of the character graphically shown in Fig. 2. As the armature revolves the electro-motive force rises from zero at n, the beginning of a revolution, to a maximum at n' after one-fourth of a revolution, falling again to zero at n^2 after half a revolution. During the second half-revolution the brush k is upon the segment k^2, and hence there is no electro-motive force in the circuit. The period of fluctuation is such that separate pulsations of current through a telephone through which the circuit may be closed do not blend into a tone. I have found fifteen pulsations per second to be a suitable rate of pulsation for this purpose. The increase and decrease of the fluctuating current are so gradual as to be inaudible in a telephone, and the brush k is set at the proper point to leave or to enter upon the segment k' exactly at the points n n^2 when the electro-motive force is at zero. Hence no sound is heard in a telephone included in circuit with this dynamo.

In addition to the usual apparatus of an operator's telephone set in my invention I provide a connection from the middle of the coil of telephone i', a branch connection extending to earth through a dynamo o, similar to dynamo l, already described, giving pulsations of the same period and in the same direction as dynamo l, but coinciding with the periods of intermission of dynamo l. The character of the current from this dynamo is represented in Fig. 3. Pulsatory currents having the relation to each other described—that is, the pulsation of one coinciding with the intermission of the other—I choose to designate as "complementary" currents. At the second board, at the right of the drawings, I have represented this dynamo o by a circle. In connection with the testing outfit at the first board, however, it is represented as complete. In shunt around that half of the telephone-coil which is most directly connected to the tip of the test-plug, as d', I place a vibrating circuit-breaker, preferably adapted to be actuated by the current in the branch circuit from the telephone to earth. This method of connecting a circuit-breaker in shunt about a telephone-coil I have described in an application for Letters Patent, filed February 24, 1891, Serial No. 382,358, wherein the peculiar advantages of this method of producing a sonorous test-signal are set forth.

I will now proceed to describe the various operations involved in establishing communication between two sub-stations by means of the system shown and to point out more particularly the use of my testing system in connection therewith. Suppose, for example, that the subscriber at station 1 desires to communicate with subscriber at station 3. Upon operating his calling-generator the shutter of annunciator a^3 is caused to fall. The operator at the second board inserts answering-plug d into the answering-jack a^5 of line 1 and depresses the listening-key h, whereby the lines a and a^4 are extended through the contacts of the listening-key to her telephone i'. Hav-

ing ascertained the number of the line with which subscriber at station 1 desires connection the operator proceeds to test to determine whether lines from station 3 are already in use at some other switch-board or not. This she does by applying the tip of her testing-plug d' to the test-ring of the spring-jack of lines from station 3 at her board. The operation of testing will be more readily followed by reference to the testing outfit at the first board. Here the testing-plug d^2 is shown applied to the test-ring of spring-jack b^2 as in the act of testing the condition of that line. The lines from station 2 are not in use; but since the line b^4 is grounded a pulsatory current (represented in Fig. 3) will flow from the dynamo o through one-half the coil of telephone p and through the coil and contacts of the vibrating circuit-breaker q, thence through the contacts at one side of the listening-key r to the tip of the test-plug d^2, thence through the line b^4, resistance b^6 to earth, and returning to dynamo o. The vibrating circuit-breaker q will be at once thrown into vibration and an intermittent musical tone will be heard in the telephone p, which indicates to the operator that the line tested is not in use. If the operator had tested a metallic circuit-line which was idle, no current would have flowed from dynamo o, since the circuit would be nowhere closed to earth, and the silence in the telephone would similarly indicate the idleness of the line. Suppose, however, that the operator applies the tip of the test-plug d^2 to the test-ring of a line which is in use, as test-ring of jack a' of line from station 1. During one-half of the revolution of the armature of dynamo o the current will flow, as before traced, to the test-ring of jack a', thence through line a^4, through the sleeve of plug d to the brush k of dynamo l, thence through the segment k^2, against which it bears at that instant, and brush m' to earth. During the next half-revolution of the two dynamos, a current will flow from the armature of dynamo l through the segment k', brush k, sleeve of plug d, fragment of line a^4 to test-ring of jack a', thence through tip of plug d^2, one-half of telephone-coil p, and vibrating circuit-breaker q, thence through the brush s, segment s^2 of dynamo o, through the brush t to earth, and thence returning to dynamo l. Thus a pulsatory current made up of the alternate pulsations of current from dynamos o and l flows in the test-circuit. The character of this composite current is represented in Fig. 4. The tone produced in telephone p will be of a correspondingly fluctuating character and will be very different and distinct from the tone produced by any accidentally-induced current through the test-circuit, which may exist occasionally.

It is obvious that the vibrating circuit-breaker q might be included directly in the earth branch from telephone p; but I find the arrangement shown to be preferable.

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

1. In a test-circuit for multiple switch-boards, the combination of several electrically-connected test-rings of spring-jacks, with a branch connection from one of the test-rings to earth, including a source of intermittent or pulsatory electro-motive force, a second branch connection from another of the test-rings to earth, including a telephone and a vibrating circuit-breaker in shunt thereof, and a second source of intermittent electro-motive force whose pulsations are complementary to and in the same direction in the test-circuit as those from the first source, substantially in the manner and for the purpose specified.

2. In combination with spring-jacks connected by telephone-lines with a sub-station and furnished with test-rings electrically connected together, a branch circuit extending from one of the test-rings through a source of intermittent or pulsatory electro-motive force to earth, and another branch connection from another of the test-rings extending through the coil of the telephone and through the contact points of a vibrating circuit-breaker, and a second source of intermittent electro-motive force whose pulsations are in the same direction relative to the test-circuit as but complementary to the pulsations from the first source to earth, substantially in the manner and for the purpose specified.

3. In an electrical circuit, the combination of a source of intermittent electro-motive force of constant direction relative to the electrical circuit, a second source of intermittent electro-motive force whose pulsations are complementary to and in the same direction in the circuit as those from the first source, a telephone, and a vibrating circuit-breaker in shunt of the telephone, substantially as and for the purpose specified.

In witness whereof I hereunto subscribe my name this 27th day of April, A. D. 1891.

CHARLES E. SCRIBNER.

Witnesses:
ELLA EDLER,
FRANK R. MCBERTY.