

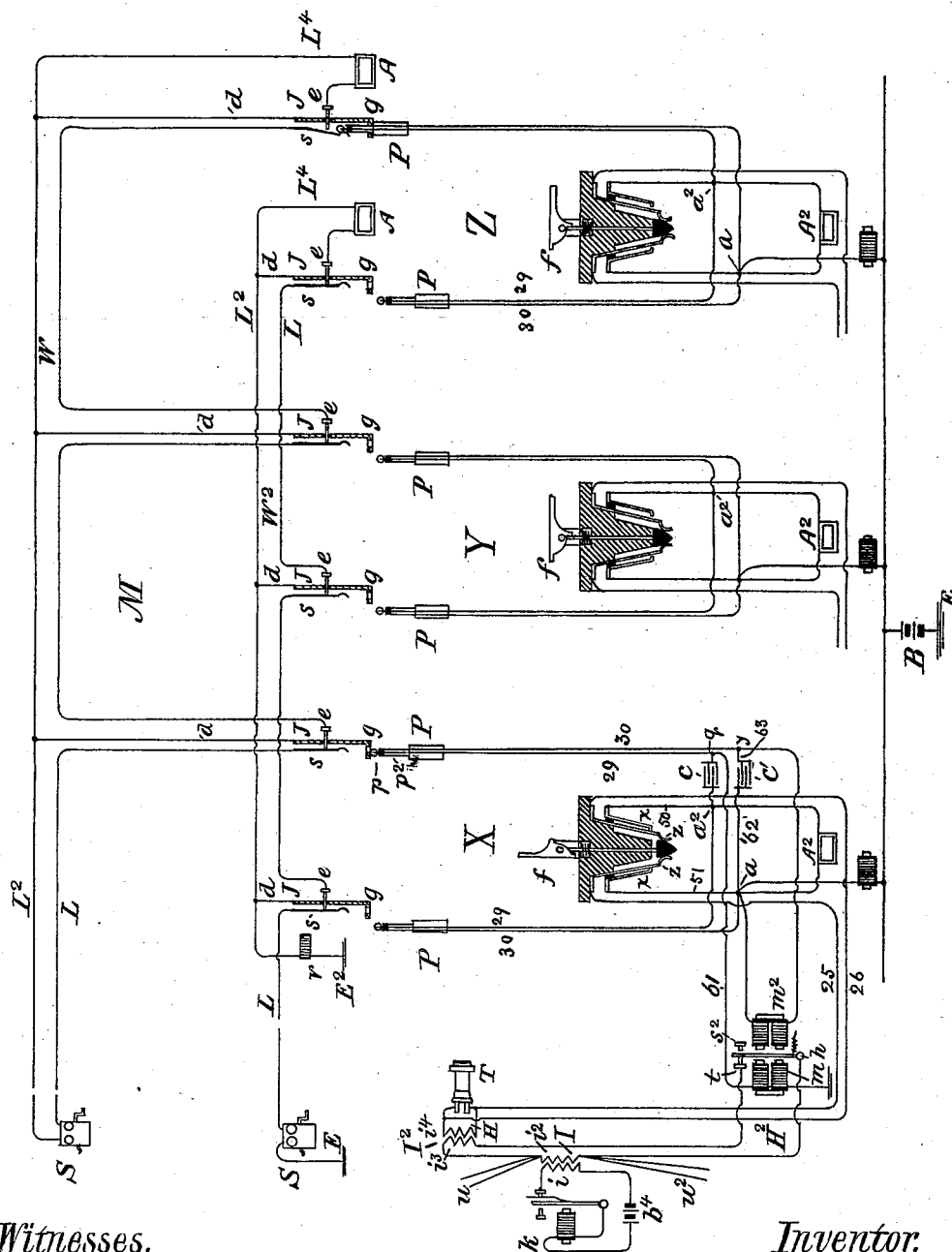
(No Model.)

J. L. McQUARRIE.

BUSY TEST APPARATUS FOR MULTIPLE SWITCHBOARDS.

No. 487,854.

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Witnesses.

Spencer Lockwood
Geo. Willis Pierce

Inventor.

James L. McQuarrie

UNITED STATES PATENT OFFICE.

JAMES L. MCQUARRIE, OF BOSTON, MASSACHUSETTS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE WESTERN ELECTRIC COMPANY, OF ILLINOIS.

BUSY-TEST APPARATUS FOR MULTIPLE SWITCHBOARDS.

SPECIFICATION forming part of Letters Patent No. 487,854, dated December 13, 1892.

Application filed April 7, 1892. Serial No. 428,206. (No model.)

To all whom it may concern:

Be it known that I, JAMES L. MCQUARRIE, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented certain Improvements in Busy-Test Apparatus for Multiple Switchboards, of which the following is a specification.

This invention relates to busy-test apparatus for multiple telephone-switchboards.

Its object is to provide an efficient system of testing a line at any one section of a multiple switchboard to ascertain whether the said line may not already be in use at another section, which system shall not be liable to give false signals by reason of discharges from metallic circuits or from extraneous currents circulating in earth-completed circuits, and which, moreover, shall be extremely simple and inexpensive.

It consists in combining the ordinary busy-test apparatus, which comprises a battery or other generator branching through a retardation-coil to the sleeve-uniting conductor of a double cord connecting the two loop-plugs of a pair, with an earth branch leading through a relay of high resistance and inductance from the tip-uniting or test-making conductor of other pairs of loop-plugs, which relay controls apparatus adapted, should the line tested be busy, to cause the flow of a current through the telephone-helix and to produce in the said telephone a peculiar and distinctive signal, and also with means—such as a relay acting in opposition to that first named—for preventing this apparatus from responding to discharges from a metallic circuit or to diversions of current from an earth-completed circuit, which otherwise would tend to produce confusing signals, which might occur even during the pendency of a connection.

The drawing which accompanies this specification is a diagram of two sub-station circuits which are assumed to enter a central office M and to be represented by plug-socket connections at each of a series of sections X Y Z of a multiple switchboard. One of these circuits W is shown as being a metallic circuit and has two main conductors L and L². One of these L, entering the central station from a sub-station S, passes through the contact-springs s and resting contacts or anvils

e therefor of a series of spring-jacks J, one at each switchboard-section, and from the last anvil-contact e continues to a call-annunciator A, passing from thence by conductor L⁴ to the return-conductor L², this returning directly to the sub-station, branching, however, by wires d to each of the conducting-frames g of its own spring-jacks at the several sections. The front parts of these frames g are technically known as "test-rings." The other circuit W² is an earth-completed circuit. One end is grounded at its sub-station and the sole line-conductor L traverses the switchboard, spring-jacks, and annunciator in the manner indicated above. From the annunciator the circuit continues to the wire L², branching by normally-discontinuous wires d to the test-ring g, and this conductor terminates at an earth E² at a point exterior to the switchboard, including in its circuit, in a manner well understood, the balancing-resistance v.

It must be understood that in practice the call-annunciators A of an exchange are distributed between the sections, a certain number being assigned to each operator.

At each switchboard-section are a number of double-conductor or loop-plug connectors P, united in pairs by the double conductors 29 and 30. For clearness but one cord and pair of plugs are shown at each section. The plugs P each have a conducting-tip adapted, when fully inserted in any jack J to make contact with the line-spring s, as shown at section Z, and also serving when held against any test-ring g to bring the busy-test apparatus into operation. The tip-conductors of any pair of plugs are electrically united by a conductor 29. The plugs P also each have a conducting-sleeve p² insulated from the tips by an interposed bushing of non-conducting material, and these are adapted upon the insertion of the plug into a jack, first, to close a loop talking-circuit through the switchboard by making continuous the branch d, leading to the jack-frame concerned, in virtue of the contact established between the said jack-frame and the sleeve-conductor, and, second, to raise the potential of all other test-rings g of the same circuit by the connection between the said sleeve to which the

circuit of the test-generator B is branched and the socket g within which the said sleeve rests. Each other socket or test-ring g of the same line thus becomes a terminal of the said testing-circuit, and it thus becomes possible at any section to test a line by closing such a test-circuit through any suitable indicator—for example, the operator's telephone. The sleeve-conductors p^2 of any pair of plugs P are united by a conductor 30. The operator's telephone T and transmitter (not shown) can by means of looping cam-keys f , one for each pair of cords, be bridged between the cord conductors. A clearing-out annunciator A² is also bridged between each pair of cord conductors, uniting the point a on conductor 30 with the point A² on conductor 29. The operator's telephone T and its loop are of course supplied at each section, though fully shown in the drawing at X only. One of the terminals of the telephone is connected by wire 25 and the other by wire 26 with the inner springs z of the loop-key, these being arranged when the key f is elevated to be pressed into contact with the outer springs x , which connect by wires 50 and 51 with the cord conductors 29 and 30, respectively. The telephone T is at the same time included in another circuit—viz., the short circuit H, which also includes the secondary helix i^4 of the induction-coil I², which has its primary helix i^3 in another local circuit H², this being in turn adapted to be inductively acted upon through the instrumentality of the second induction-coil I, whose secondary helix i^2 is in the circuit H² and whose primary helix i is in circuit with such an automatic vibratory circuit-breaker k as is technically called a "buzzer" and with a local battery b^4 , this apparatus serving as a source of sound. This buzzer and its circuit may be common, as is indicated by the branching wires u and w^2 , to any number of the switchboard-sections, and it acts to set up intermittent induced currents in the intermediate circuit H² when the same is closed, which currents, acting inductively upon the telephone T, produce therein a sharp and peculiar audible signal of a rasping or buzzing character which cannot be mistaken for any other sound; but the said intermediate circuit H² is normally open, and while in such condition the induced currents which the buzzer k tends to set up within it cannot circulate. Its condition is controlled by the armature-lever h of two electro-magnets m and m^2 , which armature is normally held away from the contact-stop t and against the dead-stop s^2 either by a sufficient bias or by a light counter-spring. When the movable armature-contact h so rests against the dead-stop s^2 , the intermediate circuit H² is obviously open between its contact-surface and the contact-stop t , because the said instrumentalities form part of such circuit and no sound due to the buzzer k can reach the telephone; but when the circuit is closed at this point sounds from the said buzzer may

be heard in the telephone; and my invention provides when a line is tested to find out whether it is at liberty or in use that if it be already in use the act of testing shall in some way close the intermediate circuit, and thus produce the buzzer-signal in the telephone, while if the said line be at liberty the intermediate circuit will not be closed between h and t , and consequently no such sound as would otherwise be produced will be heard in the telephone. This is accomplished by interpolating the high-resistance electro-magnet m (which by reason of its function is a true relay) in a branch conductor 61, which extends from a point q on the tip-conductor 29 through the said relay m to earth. If by reason of a plug connection with the line to be tested at any section of the switchboard the test-battery circuit be continued to the remaining spring-jacks of said line at the other sections, it is evident that upon the application of the test-plug P of a pair at any of the said other sections to any of such remaining spring-jacks the test-circuit will be completed to earth through the tip-conductor 29 and relay m , and that the said relay, becoming energized, will close the circuit H² by attracting its armature, and for the moment of application of said plug to said jack the buzzer-signal will be heard in the telephone. On the contrary, if a plug be not already in any of the spring-jacks of the circuit the potentials of the test-rings g of such circuit will not be raised, and notwithstanding the application of the test-plug P to the test-ring g the relay m will not be energized and no signal will be heard in the telephone, showing that the line under test is not in use. The condenser c is placed in the through-circuit of the tip-uniting conductor 29 to permit the free action of voice-currents, while preventing the undesired passage that way of the current of the testing-battery B.

As already intimated, it sometimes occurs that when a line has been tested and found unoccupied and when in consequence the plug has been thrust into the jack to complete the connection a discharge of electricity or an intrusive current passes through the relay m in sufficient strength to cause the attraction of the armature h thereof, and it is evident that upon such an occurrence a false, unnecessary, and undesired signal will be received, and lines which are being used will continue to operate the test-signal, thus confusing the operators. To prevent such confusing-signals, I provide a second electro-magnet m^2 and arrange it to act upon the armature h in opposition to the magnet of the relay m . This electro-magnet I include in the circuit-conductor 30, which unites the conducting-sleeves p^2 of the paired plugs, and I then bridge it by the condenser c' , which is connected across the terminals of the said magnet from the point a to the point y by the wires 62 and 63 in order that the through transmission of speech may be facilitated.

It will be seen that any discharge passing from a connected line through the magnet *m* and tending to give a confusing test-signal will be opposed and its results neutralized by a similar current simultaneously passing through the magnet *m*², which is in connection with the other side of the same line, and is therefore adapted to equally participate in any such transfer of electricity.

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

1. The combination, substantially as herebefore described, of an ordinary multiple switchboard busy-test apparatus comprising an electrical generator connected with the sleeve-uniting conductor of a double conducting-cord extending between the two plugs of a pair with an earth branch leading through a high-resistance relay-magnet from the tip-uniting conductor of other pairs of loop-plugs, and apparatus controlled by said relay and adapted on the operation thereof to produce signals in a telephone with which it is inductively connected, indicating the condition of a tested line.

2. In a busy-test apparatus for multiple switchboards, a series of conducting-plug sockets for each line, all electrically united, a test-battery or like generator, loop or double conductor plug connectors adapted to be inserted in said sockets, and a connection from said test-generator through one of the conductors of said plugs to the several sockets of a line, in any one of which the said plugs is inserted, combined with a test-plug, a branch conductor extending from the tip of said plug to earth and adapted to close the circuit of said test-generator during the test of a busy line, a normally-open test-circuit extending between a telephone and a vibrator or other source of sound, also connected with said circuit and connecting inductively with both, and a relay included in the circuit of the said earth branch conductor, controlling said normally-open test-circuit and adapted to close the same when energized by the act of testing a busy line and to thereby connect the telephone with the source of sound, substantially as described.

3. An apparatus for producing a specialized busy-test for multiple switchboards, comprising a telephone, a source of sound, such as a buzzer or vibrator, producing intermittent currents, a normally-open local circuit extending between said vibrator and said telephone, connecting inductively with both and adapted when closed to reproduce in the latter the sounds transmitted by the former, a test-battery having one pole grounded, means, substantially as indicated, for connecting all the plug-socket frames or test-rings of a line to the other pole thereof by the act of inserting a plug-connector in any one of them, a conductor extending from an earth connection to the tip of a testing-plug, whereby the circuit

of said test-battery may be closed by the contact of said tip with any of the plug-sockets so connected, and a relay included in the circuit of said conductor and arranged to close the said normally-open local circuit by the attraction of its armature and to produce the signal in the telephone when the circuit of said test-battery is closed through its coils, but to remain inert when the line tested is unoccupied, substantially as described.

4. The combination, substantially as herebefore described, of an ordinary multiple switchboard busy-test apparatus comprising a test-battery or equivalent generator connected with the sleeve-uniting conductor of a double conducting-cord extending between the two plugs of a pair with an earth branch leading through a relay-magnet of high resistance and inductance from the tip-uniting conductor of other pairs of the loop-plugs, apparatus controlled by said relay and inductively connected with a telephone, said apparatus being adapted on the operation of said relay to produce signals in the said telephone indicative of the condition of the tested line, and means, such as a relay or electro-magnet, included in the sleeve-uniting conductor of said pairs of plugs and acting in opposition to the first relay, whereby false signals due to discharges of extraneous currents passing through the coils of said first relay are prevented.

5. In a busy-test apparatus, a telephone for noting the test-signals, a source of sound, such as a vibrator or buzzer, for producing intermittent currents in a local circuit, a normally-open intermediate circuit inductively connecting the circuit of said vibrator with the telephone and adapted when closed to enable the former to produce sounds in the latter, a pair of loop-plug connectors for uniting any two lines, each plug having a tip-conductor and a sleeve-conductor insulated from each other and two conductors uniting the tips and sleeves, respectively, a relay in the circuit of a branch, connecting the tip-uniting conductor with the earth, which conductor in testing a busy line becomes a portion of the test-battery circuit, an armature therefor acting as a circuit-closer of said normally-open circuit and adapted to close the same when attracted by the relay-magnet and to open the same when retracted, and an electro-magnet in circuit with the sleeve-uniting conductor of said plugs, acting upon the same armature in opposition to the said relay-magnet, substantially as and for the purposes specified.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 31st day of March, 1892.

JAMES L. MCQUARRIE.

Witnesses:

GEO. WILLIS PIERCE,
FRANK C. LOCKWOOD.