

2 Sheets—Sheet 1.

Patented Jan. 7, 1896.

The diagram shows a telegraph circuit. On the left, component A is a switch mechanism with a handle 't' and a spring 's'. It is connected to a line 'a' and 'b'. A bell 'c' is connected to line 'a'. The line 'a' and 'b' run horizontally through component L, which contains three relays. The first relay has contacts 'j' and 'f' with a spring 'h' and 'g'. The second relay has contacts 'f' and 'g'. The third relay has contacts 'u' and 'i'. The line 'a' and 'b' then enter component C, which contains a bell 'B' and a switch mechanism with contacts 'y' and 'z'. The circuit is completed by a battery at the far right.

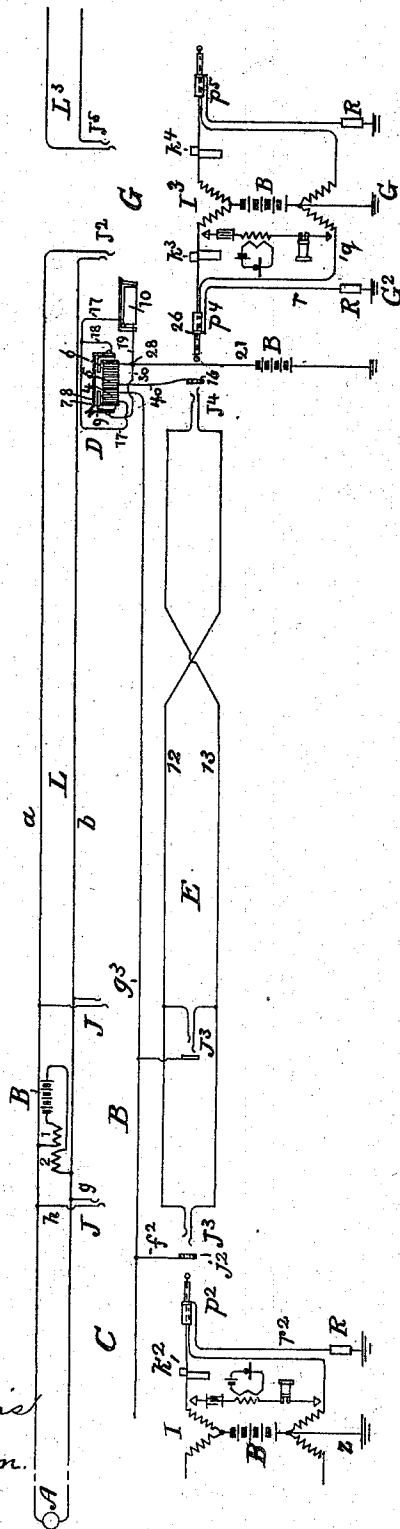
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T. C. WALES, JR. & T. SPENCER.
TELEPHONE SWITCHBOARD AND CIRCUIT.

No. 552,734.

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Fig. 6.



Attest.
Jesse Lewis
W.R. Edlin.

Fig. 8.

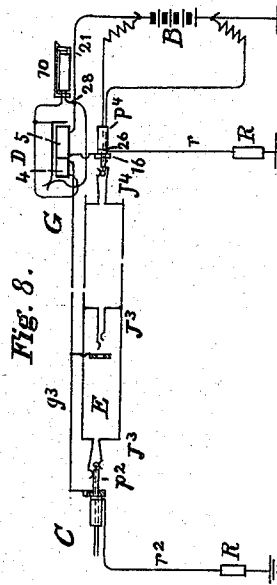
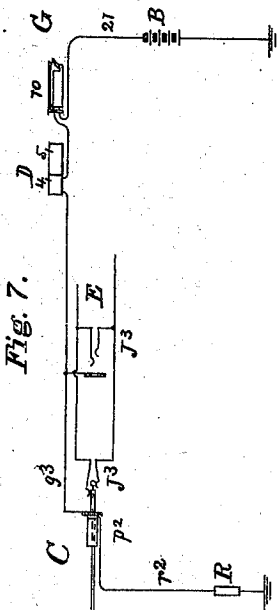


Fig. 7.



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UNITED STATES PATENT OFFICE.

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TELEPHONE SWITCHBOARD AND CIRCUIT.

SPECIFICATION forming part of Letters Patent No. 552,734, dated January 7, 1896.

Application filed July 25, 1895. Serial No. 557,135. (No model.)

To all whom it may concern:

Be it known that we, THOMAS C. WALES, JR., residing at Boston, in the county of Suffolk and State of Massachusetts, and THEODORE SPENCER, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain Improvements in Telephone Switchboards and Circuits, of which the following is a specification.

The present invention relates to telephone switchboards and circuits, by means of which the sub-station lines converging thereto are connected together for conversation, and to a type of switchboards in which a common generator of electricity is employed by the sub-stations for calling and for energizing their transmitters, usually designated as "common" or "centralized" battery systems.

The invention refers to a multiple-switchboard system in which a centralized generator which supplies current for calling and for the telephone-transmitters at the sub-stations is also adapted for use as a current-supply for the busy test, and for restoring or resetting the line-annunciator and holding the same locked while the line is in use. The line-signal consists of a standard self-restoring annunciator modified by making the coil in two parts, each of the same impedance, with the generator in the middle of the coil, the locking-coil being connected on one side to the test-rings in each jack and on the other side to the common generator. The keyboard or cord-circuit is essentially the same as in other systems where the common generator is connected in between a split repeating-coil with a branch to ground, and with a clearing-out signal in each plug-circuit, except that a three-conductor cord is used, the third conductor being connected to ground through a resistance, and when the plug is inserted in the answering-jack the test-ring is connected to ground. By this arrangement the line-signal is restored upon the insertion of the plug into the jack. An efficient test is provided, which is apparent not only by a click in the ear of the operator, as is customary, but also by the vibration of the keyboard-signal. By means of the resistance in the third conductor, independent means are thus provided for

regulating the volume of the audible busy test.

The invention also relates to a system of connecting the terminals of the sub-station lines of one central office with the terminals of other sub-station lines associated with a distant central office by means of toll or trunk lines. The main outlines of the system are disclosed in Patent No. 330,066, issued to C. E. Scribner, November 10, 1885. The sub-station lines are multiplied to all of the switchboard-sections as usual, and are provided with a switch or jack upon the toll-board. Each trunk-circuit consists of three wires, which are multiplied upon each section of the switchboard. Two of the wires form a metallic conversation-circuit, from which extend branches to each spring-jack, and terminate at the toll-board in a jack or switch, while the third wire constitutes the signaling-circuit, and connects with the test-rings of each spring-jack, and extends to ground at the toll-section through a switching-relay, a trunk-signal and generator.

The toll-operator is provided with a key-board apparatus similar to that of the subscriber's operator's set. By means of the invention when a subscriber wishes to talk over a toll-line the subscriber's operator, who first receives the call, plugs into a trunk-line, which act operates the signal at the toll-board. When the toll-operator plugs into the trunk to receive the call from the subscriber the subscriber's operator's keyboard-signal is set, thereby automatically notifying her that the toll-operator has answered. At the same time the switching-relay is operated, thereby automatically resetting or restoring the trunk-line signal. Having received the call the toll-operator withdraws the plug from the trunk-line jack. This restores or resets the keyboard-signal at the subscriber's operator's table, thereby notifying her to take down the connection with the sub-station. The toll-board operator then proceeds to make the connection between the calling and called sub-stations in the usual manner, utilizing the jacks of the said sub-station circuits, which are upon the toll-board.

Referring to the drawings which embody

the invention, Figure 1 is a diagram representing a telephone-circuit extending between a sub-station and the central station. Fig. 2 is a diagram of the subscriber's operator's key-board or cord-circuit. Fig. 3 is a diagram of two sub-station circuits connected together. Figs. 4 and 5 are diagrams to illustrate the method of testing. Fig. 6 is a diagram illustrating the connection of two sub-stations by means of a toll or trunk circuit, and Figs. 7 and 8 illustrate the working of signals on the trunk-circuit.

Referring to Figs. 1, 2, 3, and 4, L represents a circuit composed of two sides or limbs *a b*, extending from a sub-station A to a central station C. At the sub-station the side *a* connects with the hook-switch *s* and the side *b* extends through the receiving-telephone *t* to one side of the telephone-transmitter T, which is connected on its opposite side by the wire *e* to anvil-contact 25.

d is a permanent bridge between the conductors *a b* and includes a bell *c* of very high resistance.

At the central station the conductors *a b* are represented upon each switch-section by the open terminals *h g* in the switches or jacks J, and the former conductor *a* includes one coil *l* of the line-signal *u* and connects with one pole of the common battery B, while the other conductor *b* includes the coil 2 of the said signal and connects with the other pole of the said battery. The test-circuit *g*² is connected to the test-rings *j* by the branches *f* and to the upper pole of the battery B by wire *i*, which includes the locking-coil 3 of the line-signal.

In all the diagrams where the battery B is referred to it is to be understood that it is the same battery common to several uses.

p and *p*² are connecting or looping plugs provided with three conductors *o*, *q*, and *r*, and *o*², *q*², and *r*², respectively. The conductors *o* *o*² connect the plug-tips through helices *i*² and *i*³, respectively, of the repeating-coil I with the wire *w* and to one pole of the battery B, and the conductors *q* *q*² connect the plug-sleeves through the helices *i*⁴ and *i*⁵, respectively, with the opposite pole of the said battery. The conductors *r* *r*² are connected from their respective plug-plates 26 through the resistances R to ground.

k and *k*² are clearing-out signals in each cord-circuit.

20 represents the conductor by means of which the operator's outfit, consisting of the condenser *m*, secondary helix *i*⁶ of induction-coil I², and receiver *t*² are bridged between the cord-conductors *o* and *q*, or between *o*² and *q*², by means which are not shown, but which are well understood.

z is a wire connecting the battery B to ground.

Fig. 3 represents two circuits connected together by means of the cords and plugs, neither the latter nor the locking-coils being shown.

We will suppose that a sub-station wishes a connection. The telephone *t* is removed from its hook switch which rises and closes the circuit through the wire *e*, thereby shunting the bell *c* with the low-resistance transmitter and receiver, and causing current from the battery B to circulate through the coils of the line-signal *u* of sufficient strength to draw up its armature, thus causing the shutter to fall. The operator inserts plug *p* into the answering-jack J to receive the call, and bridges the telephone-set across the cord-circuit. Three things are effected by the insertion of the plug—first, the line-signal is reset and locked, as a circuit is established (see Fig. 5) from ground by wire *z*, battery B, locking-coil 3, wire *g*², branch *f*, ring *j*, plug-contact 26, wire *r*³, resistance R to ground; second, line is made to test "busy" through the switchboard by reason of current from battery B on the wire *g*², and, third, the repeating-coil is bridged across the line-circuit, thus shunting the windings 1 and 2 of the line-annunciator.

Receiving the call the operator proceeds to test the line called for. If the line is not busy no circuit is found through the battery, as will be seen in Fig. 4, where the tip of the testing-plug *p*² is applied to a test-ring *j*, and the connection is made. If, however, the line wanted is busy, by reason of the insertion of a looping-plug at another section of the switchboard, thereby causing current to flow upon the wire *g*², the fact will be indicated by a "click" in the telephone *t*² (see Fig. 5) and by the fluttering or vibration of the keyboard-signal *k*², as when the tip of the plug *p*² touches the test-ring *j* the current which is flowing from battery B via wire *g*² and coil 3, branch *f*, wire *r*³ to ground, as described, will then divide at the point 27, (Fig. 5,) and part will flow via helix *i*³, conductor *o*², signal *k*², plug-tip, test-ring *j*, branch *f*, to wire *g*², and operate the said signal *k*². At the same time there will be a sudden change in the potential in the bridge 20, which will produce a click in the telephone *t*².

The second part of the invention, relating to toll or trunk circuits, is illustrated in Figs. 6, 7, and 8.

L represents a sub-station circuit extending to a central station C, and there being represented upon each switchboard-section by open terminal line-jacks J, and appearing upon the toll-board section G in an open-terminal jack J².

E is a metallic local trunk-circuit, consisting of the conductors 12 13, extending through all of the switchboard-sections and provided thereat with open-terminal jacks J³ and terminating at the toll-section in an open-terminal jack J⁴.

*g*³ is a conductor forming the signaling-circuits of the local trunk-circuit, and extending through the switchboard to the toll-section and is provided with branches *f*², connected with test-rings *j*² at each jack J³ upon the switchboard-sections, and at the toll-section

extends through a twenty-five-ohm coil 4 of a switching-relay D and by wire 17 through a mechanically self-resetting trunk-signal 10, wires 19 and 21, and battery B to ground. The relay D is similar to that shown in Patent No. 494,385, issued in 1893 to F. A. Pickernell, to which reference is made, and consists of a core whose poles 6 and 7 are extended over to face each other on the outside of its two coils 5 and 4, which are wound serially thereon, one, 4, being wound to a resistance of twenty-five ohms, and the other, 5, to a resistance of five hundred ohms. Upon the end of the five-hundred-ohm coil 5, but insulated therefrom, is secured a spring-armature 8, which extends over both poles 6 and 7 to normally touch a spring 9, which is secured to but insulated from the pole 7. A wire 18 connects the wire 17 with the armature 8, and a wire 30 connects the spring 9 with the wire 21 at a point 28, to which the wire 19 is also connected. The wire 21 extends from point 28 through the helix 5 and continues by wire 40 to the testing ring 16.

The toll-operator's keyboard at G is similar to the outfit at subscriber's operator's table C. L³ represents an outgoing trunk-circuit.

We will suppose that the sub-station A calls up in the manner described and wishes a trunk-line connection. The operator at C leaves the answering-plug in the jack J and inserts the other or test-plug p^2 into the jack J³ of the local trunk E. This operates the visual-signal 10 at the toll-board, as a circuit is made from ground, resistance R, wire r^2 , plate on plug p^2 , ring j^2 , wire g^3 , coil 4, wire 17, signal 10, wires 19 and 21, battery B to ground. The toll-operator plugs into jack J⁴ and talks directly to the calling sub-station. When the plug p^4 was inserted in the jack J⁴, the keyboard-signal k^2 was set, as a circuit was made from ground at G, conductor g , sleeve of plug p^4 , conductor 12, tip of plug p^2 , signal k^2 , battery B and ground. The setting of the signal notifies the subscriber's operator that the toll-operator has answered. At the same time the relay was operated, automatically restoring the trunk-line signal 10 to its normal position. The twenty-five-ohm coil 4 of the relay is not sufficient to close the relay-contacts 8 and 9 and restore the signal 10 by short-circuiting it; but when the plug p^4 is inserted into the jack J⁴ a circuit is made from ground at G² via conductor r , resistance R, plug-plate 26, ring 16, wire 40, five-hundred-ohm coil 5, to point 28, and to ground by wire 21 and battery B. As the contacts 8 and 9 are brought together a closed circuit is formed via conductor g^3 , coil 4, wires 17 and 18, contacts 8 and 9, wire 30 to point 28, wire 21, battery B to ground. This short-circuits the signal and it is mechanically reset.

Although current from battery B circulates through the twenty-five-ohm coil, so long as the operator's plug h^2 remains in the socket J³, the latter is not able, as has been said, to draw down the armature into contact with spring

9; but it will nevertheless keep it down when the contact is once closed by the five-hundred-ohm coil. Hence, being thus reset, signal 10 will remain in this condition until a call is again made by the subscriber's operator.

Having received the call the toll-operator withdraws the plug from the trunk-jack, which act restores the keyboard-signal k^2 at C, thereby notifying the subscriber's operator to take down the connection, who thereupon withdraws the plug p from the jack J and plug p^2 from jack J³. The toll-board operator then connects the subscriber's line with the outgoing toll-line L³, and the connection is afterward supervised in the ordinary manner.

When the subscriber's operator at C makes a connection with any sub-station circuit, the transmitter there is energized by the battery B between the helices of the repeating-coil I, and also when the toll-operator has been notified as described that a connection is wanted and plugs into the local trunk-circuit and talks with the calling sub-station, the transmitter at the said station is still energized by current through the subscriber's operator's cord-circuit; but after the connection has been made with the outgoing trunk-circuit the transmitter at the calling sub-station is energized from the common battery through the toll-operator's cord-circuit, as will be readily seen.

Having now fully described the invention, we claim—

1. In a multiple switchboard system, the combination of a plurality of substation circuits, each provided with line signals having three coils, the two conductors of each circuit connecting through one of the coils to the opposite poles of a common generator of electricity; a test circuit connected to test rings upon each section of the switchboard and through the third coil of the line signal to one pole of said generator; and an operator's cord circuit with a repeating coil in a bridge between its conductors, the said common generator being included between the windings of the said coil, there being in each cord a third conductor connected to ground through a resistance; whereby the said common generator is adapted for use as a current supply for the substation transmitters, for the busy test, and for operating and resetting the line signals.

2. In a multiple switchboard system, the combination of a plurality of substation circuits, each provided with line signals having three coils, the two conductors of each circuit connecting through one of the coils to the opposite poles of a common generator of electricity; a test circuit connected to test rings upon each section of the switchboard and through the third coil of the line signal to one pole of the generator; an operator's cord circuit with a repeating coil in a bridge between its conductors, the said generator being included between the windings of the said

coil, there being in each cord a third conductor connected to ground through a resistance, and in each plug tip conductor a clearing out signal; by means of which when a tested line is found busy an audible signal is heard in the operator's telephone and the clearing out signal gives a visible indication.

3. In a multiple switchboard system, the combination of a substation circuit provided with switches upon each switchboard section and appearing in a switch upon the toll section; a local trunk circuit consisting of three conductors two of which form a conversation circuit provided with switches upon each switchboard section and with a switch upon the toll section, the third wire constituting a signaling circuit having a contact ring in each switch of the conversation circuit, and normally connected to ground at the toll section through the low resistance coil of the switching relay and a trunk signal and battery; and operators' cord circuits at the switchboard and toll sections provided with a third conductor connected to ground through a resistance; whereby upon the insertion of a calling plug at any switchboard section the trunk signal is operated substantially as described.

4. In a multiple switchboard system, the combination of a substation circuit provided with switches upon each switchboard section and appearing in a switch upon the toll section; a local trunk circuit consisting of three conductors two of which form a conversation circuit provided with switches upon each switchboard section and with a switch upon the toll section, the third wire constituting a signaling circuit having a contact ring in each switch of the conversation circuit, and normally connected to ground at the toll section through the low resistance coil of the switching relay and a trunk signal and battery; and operators' cord circuits at the switchboard and toll sections provided with a third conductor connected to ground through a resistance; whereby upon the insertion of a calling plug at any switchboard section the trunk signal is operated and upon the insertion of an answering plug at the toll section the trunk signal is restored and a signal displayed or set at the subscriber's operator's section, substantially as described.

5. In a multiple switchboard system, the combination with a substation circuit, provided with telephones in a normally open branch, multiplied upon each switchboard section and appearing in a switch upon the toll board; of the subscriber's operator's cord circuit with a repeating coil in a bridge between its conductors and with a generator of electricity included between the windings of the said coil; of a local trunk circuit multiplied upon each switchboard section and appearing in a switch upon the toll section; and of a toll operator's cord circuit with a repeating coil in a bridge between its conductors and with the said generator of electricity included between the windings of the said cords; whereby current from the said generator circulates in the substation transmitter through the subscriber's operator's cord circuit and through the toll operator's cord circuit, as set forth.

6. The combination of a signaling circuit and a conversation circuit; with a switching relay as described having two coils of different resistance and a circuit closing armature, the coil of least resistance being in a grounded end of the signaling circuit with a resetting annunciator and battery, the high resistance coil being in a circuit having one end open in a switch in said conversation circuit, the other end being grounded through the said battery; and means for closing the circuit including the high resistance coil and battery consisting of a cord plug having a third conductor to ground through a resistance, as set forth.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 2d day of July, 1895.

THOMAS C. WALES, JR.

Witnesses:

GEO. WILLIS PIERCE,
JOSEPH A. GATELY.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 15th day of July, 1895.

THEODORE SPENCER.

Witnesses:

JOHN CONYNGHAM REVENS,
HORACE D. REEVE.