(No Model.) 2 Sheets—Sheet 1.

F. O. VAILLE.

TELEPHONE EXCHANGE SYSTEM.

No. 262,261. Patented Aug. 8, 1882.

Fig. 1.

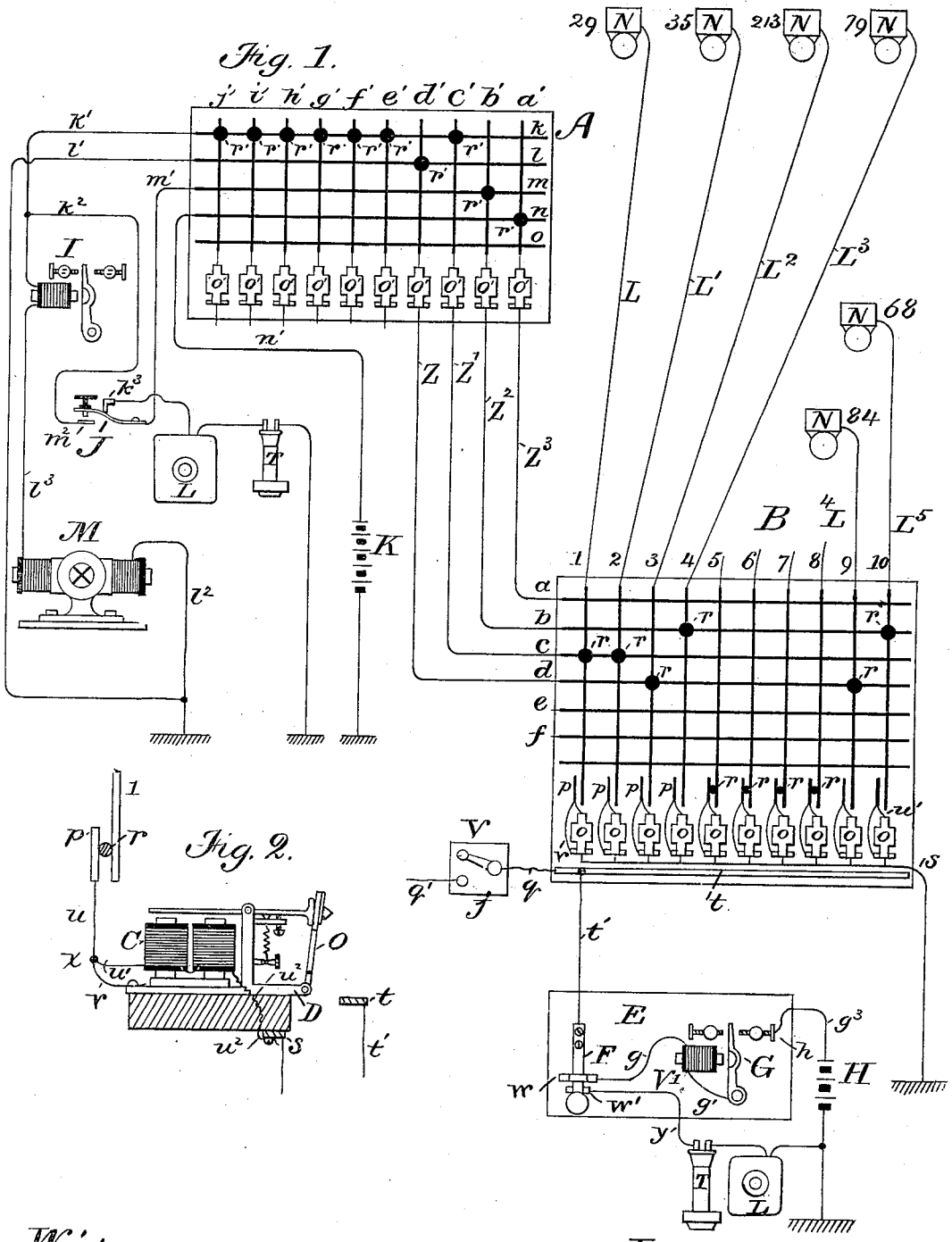

Fig. 2.

Witnesses.
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Inventor.
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Holt & Lockwood

(No Model.) 2 Sheets—Sheet 2.

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Fig. 3.

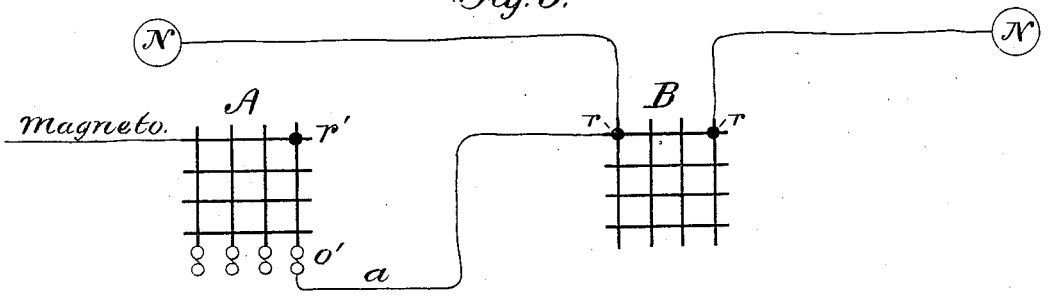


Fig. 4.

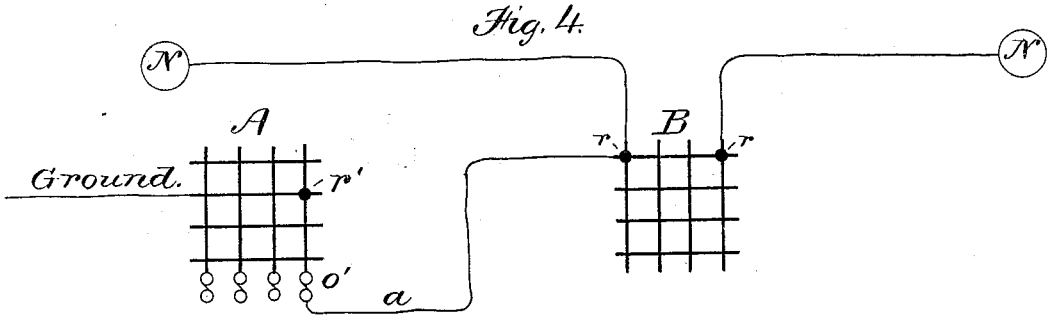


Fig. 5.

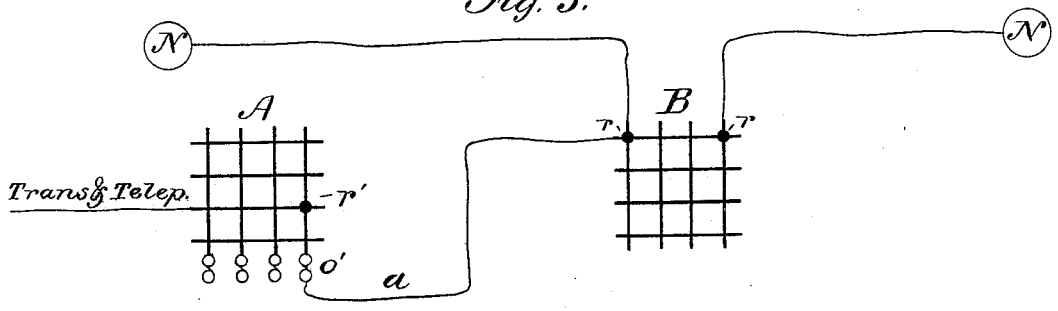
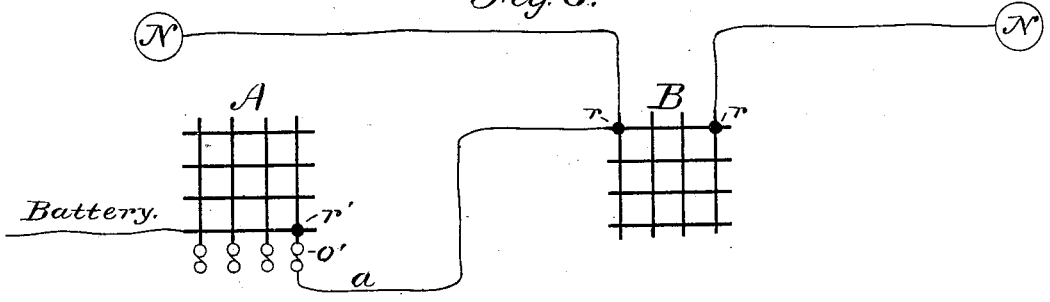


Fig. 6.



Witnesses.
Geo. Willis Pierce
J. H. Cheever.

Inventor
Frederick O. Vaille
by his attorney
Thos D Lockwood

UNITED STATES PATENT OFFICE.

FREDERICK O. VAILLE, OF DENVER, COLORADO.

TELEPHONE-EXCHANGE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 262,261, dated August 8, 1882.

Application filed May 10, 1882. (No model.)

To all whom it may concern:

Be it known that I, FREDCK. O. VAILLE, of Denver, in the county of Arapahoe and State of Colorado, have invented certain Improvements in Telephone-Exchange Systems, of which the following is a specification.

This invention relates more especially to an organization of electric circuits and apparatus known as a "telephonic exchange system," whereby direct intercommunication can be established over telegraph or telephone lines extending in different directions from a central station or exchange between a number of separate sub-stations situated at various points within the geographical district which the central station is designed to serve. In an organization of this character the arrangement of the lines, commutators, and apparatus in the exchange or central station is such that any two sub-stations within the district may at a moment's notice be placed in direct telegraphic or telephonic communication by the act of an operator or attendant, who is kept constantly on duty at the central station, and who, upon being notified to do so by a subscriber or other person at a sub-station, unites the terminals of the two lines which are desired to be connected together by means of suitable switching or connecting devices provided for this purpose.

In every central telephone-station there are a certain number of specific and distinct operations, which must necessarily be performed, and certain instrumentalities are requisite for the accomplishment of such operations. It is necessary to provide devices for the proper reception of signals from the several sub-stations. It is necessary, also, to arrange for the intercommunication of different circuits and provide apparatus to that end. It is constantly found necessary to signal the different sub-stations, this operation also requiring special mechanism. We must also be able to supervise the entire operation, that we may assist the sub-stations to understand one another, disconnect them when they have finished conversation, and, if they so desire, furnish them with a second correspondent. To accomplish this function apparatus must be arranged whereby the central-station telephones can be rapidly and conveniently brought into communication with any circuit or with any two lines entering the central station.

To so combine the various circuits and instrumentalities requiste that the several operations hereinbefore enumerated shall be promptly, conveniently, and, in a great measure, automatically accomplished, while at the same time the precision and correctness of each special operation is insured, is the object of my invention.

To this end my invention consists in the entire separation of the functions of the central station from one another, so that signals are received by one set of operators, circuits are interchanged and combined by another, and connections supervised, signals transmitted, and disconnections made by a third.

It further consists in the specific arrangement of certain devices, whereby a signal received at the central station from any sub-station places the line over which it is received into direct communication with the central-station telephones without breaking its original circuit, and whereby the connection of any two circuits, by means of a switch-board connection-strip, automatically notifies the supervising operator that such a connection is made and simultaneously causes a call-signal to be transmitted to each of the two lines so connected, or, in the event of but one line being changed from its normal position to the connecting-strip, a signal is sent over that line alone, the supervising operator still being notified.

It further consists in certain instrumentalities and circuits, whereby any two circuits, when combined for intercommunication, remain at all times in communication with the central station.

It consists also in devices whereby the operator or attendant supervising any connection is enabled at all times to know the precise condition of the switch-board with reference to all sub-station lines connected.

In the accompanying drawings, Figure 1 is a diagram illustrating the organization of a central or exchange station, showing the relations of the various parts of the apparatus to each other and illustrating the method of operation. Fig. 2 is a side elevation of an annunciator having its electrical connections ar-

ranged in accordance with my invention. Figs. 3, 4, 5, and 6 are diagrams showing the relation of the supervising-switch to the main switch and connected circuits at different periods during the time of connection.

Referring to Fig. 1, L, L′, L^2, L^3, L^4, and L^5 represent a series of line-wires, each connected at the central station with the main switch-board B (which may be of any desirable form of construction) at the points indicated by the small numerals 1 2 3 4, &c., binding-screws of course being the practical means adopted for such attachment. Each wire extends to one or more sub-stations, each of which may be designated, for the sake of brevity and convenience, by any desired specific numbers, as shown. At the distant end of each sub-station line are placed, in a manner well understood, a signal-bell and electric generator, by which signals may be both received and transmitted, together with a receiving and transmitting telephone. All these devices and their arrangement at the sub-station in connection with the line are well known, and therefore do not require detailed description. The several lines L, after reaching the central-station switch-board, continue, by means of the vertical strips or bars of metal 1 2 3, over the face of the board and terminate normally, after passing through their respective annunciators *o*, in a common ground-wire, *s*. The connection of each annunciator will be made plain by reference to Fig. 2. It will be seen that the metal bar or strip ends at the lower edge of the switch-board, but makes contact normally by means of the plug *r* with a metal plate, *p*, which is, through the intervention of the wire *u* and the branch wire *w*′, connected with one terminal of the annunciator-helix C, the other terminal wire of which is connected by the wire w^2 with the ground-plate *s*.

To accomplish a certain specific result, which will be hereinafter made manifest, I permanently connect a branch wire, *v*, as shown in Figs. 1 and 2, with the main annunciator-wire *u* at the point *x*, which must invariably be at the line or outer side of the annunciator-coil, and attach the other end of the same to the metal base D of the annunciator. This branch ordinarily has no effect at all on the electrical condition of the line; but when a call-signal is sent from a sub-station the impulse passing through the annunciator-magnet energizes the same, causing the attraction of its armature. The drop or shutter *o* is thus released and falls upon a support or anvil, *t*, which is formed of metal and is common to all the drops of the series. This is connected by a conducting-wire, *t*′, with the main stem of a key or press-button, F, contacting by its own resiliency with a back-limit plate or bridge, *w*, this again being connected by wire *g* with an electro-magnetic signaling device, V′—such as a magnet provided with a vibrating armature—and thence through wire *g*′, armature G, limit-screw *h*, and wire g^3 to some generator or source of electricity, H, which may be a battery, as shown; or, if found desirable, wire g^3 may be branched from the main magneto generator or battery and pole-changer of the exchange.

Immediately below the key or press-button F is a metal plate, *w*′, upon which the said key makes contact when pressed, contact with the bridge being simultaneously broken. The plate *w*′ is attached to a wire, *y*, leading to a receiving-telephone, T, and transmitter L, and thence to the earth. The whole of this receiving apparatus is for convenience placed on table E.

Attached to the common contact bar or anvil *t* is a wire, *q*, which connects the same with a button-switch, V. This is used to connect or disconnect a second switch-board, which, if used, may be placed side by side with the first one. When the switch V is placed on the button *j* the drops of the adjoining section, (not shown,) although falling upon their own anvil, are in electrical connection with the instruments on table E. This arrangement may be extended so far as may be found desirable, each section being provided with a button-switch, V, by which they may each work with their own receiving-instruments or may be switched together by the switch V, to the end that when desired one operator at table E can respond to the calls of all the sections. The connecting-plugs *r* of the line-circuits 1 to 4 and 9 and 10 are shown as being withdrawn from their ordinary places, and as being in use upon the face of the board in the act of connecting various sub-station lines. Those belonging to the lines 5 to 8, inclusive, are still in their place.

For distinction, I herein call the switch-board B "the main switch," as to it all the main lines run. At any convenient place near the said main switch B, I locate a second switch-board, A, which I call the "disconnection-board." It is not necessary that this board A shall have more than four horizontal conducting-strips, *k*, *l*, *m*, and *n*. Its vertical conducting-strips or bars, *a*′ to *j*′, however, must be equal in number to the horizontal connecting-strips *a b c d e f* of the main board. I place an annunciator-drop, *o*′, immediately below each of the said vertical conducting-bars *a*′ *b*′ *c*′, and connect the helices of the electro-magnets of the said annunciator-drops each on one side with its own vertical strip and on the other with separate wires Z, leading from the horizontal bars *a b c* of the main switch B, so that the strip *a*, for example, of the switch B is metallically connected by the wire Z^3 and the annunciator-coil *o*′ with the vertical strip *a*′ of the disconnecting-switch A. By thus interposing the drop *o*′ between the vertical strips of the switch A and the horizontal strips of the switch B any communication passing between the two switches must necessarily pass through the drop *o*′ and cause it to fall. The interposition of the resistance of the annun-

ciator-coil at this point also subserves another purpose, which will hereinafter appear.

The connecting-plugs r' of the disconnecting-board B, (which may be of any desired construction, inasmuch as their only function is to establish contact between the upright and cross bars of the switch,) all normally rest on the upper cross-bar, k, in which position seven of the plugs are shown, so that in a state of rest, when none of the sub-station lines are connected together for intercommunication, all the plugs r' are arranged in a row, connecting all the upright strips $a\ b\ c$ with the cross-strip k. To this cross-strip k is attached a conducting-wire, k', leading through an electro-magnetic alarm—which may be of any desired construction, although I prefer a signaling instrument of the class technically known as "buzzers"—to an electrical generator, M, which may be a magneto or dynamo electric machine, as shown, or, if preferred, may be a voltaic battery, having its current thrown into waves of alternating direction by an automatic pole-changer. The other pole of the generator M is connected with the earth by the wire l^2. Thus, when all the plugs r' are on the switch-bar k, all the horizontal strips $a\ b\ c$ of the main switch B are virtually open terminals of a charged electric circuit, which, commencing at the earth, may be traced over the wire l^2, generator M, wire l^3, buzzer I, wire k', horizontal strip k, plugs r', thence *via* all the upright strips of the board A, the connecting-wires Z, and the horizontal bars or strips $a\ b\ c$ of board B. I will here mention that if the generator M is a magneto or dynamo machine it must be kept in rapid rotation by a constant power.

Since the horizontal strips of switch B are each normally insulated from one another and have no electrical connection with any conductor, it is obvious that though they are constantly charged by the electricity from the generator M, no result can accrue from such a state of charge until the circuit is closed by causing one or more of the said horizontal bars to make contact with some conductor leading to the earth. When one of the plugs r on the main switch B is removed from its ordinary socket p and placed at the intersection of any of the cross horizontal strips with its own upright strip, the circuit of the generator is completed, and a succession of electrical pulsations are transmitted over the line to the sub station, there ringing the bell and giving the signal. If two plugs are at once placed on the same strip, the current divides, half going to one sub-station and half to the other. In the drawings I have shown the plugs r of the circuits 1 and 2 placed on the horizontal bar c of the switch. Thus the circuit of the generator is closed *via* the plug r', strip c', wire Z', horizontal bar c, plugs r, on lines 1 and 2, and to ground at the distant sub-station, and thus, by the simple act of moving the plugs, the alarm is automatically given at the sub-stations, the main generator-circuit bifurcating at the two plugs on the bar c, and the circuit being formed as graphically shown in the diagram Fig. 3, in which N N represent the sub-stations connected by their respective line-wires with the main switch-board B, the plugs $r\ r$ making a connection of both lines by means of the wire a through an annunciator, o', with the switch-board A at the uppermost horizontal strip, and thence by the connecting-wire to the magneto-generator. Furthermore, as the annunciator o' is included in the new circuit thus formed, its magnet is energized and its shutter dropped, giving to the supervising operator the intelligence that two lines are connected and on that strip. It is clear that placing any of the plugs r on any of the cross-strips $a\ b\ c$ will produce the same result, so long as the corresponding vertical strip on the disconnecting-switch has its plug r' on the generator-strip k.

The second bar, l, of the disconnecting-switch A is permanently connected by a wire, l', with the earth direct. When any two sub-station lines are completely connected together, and conversation has commenced, the plug r', belonging to the upright strip which represents on the disconnecting-board the horizontal strip which connects the said two lines, is moved down to the second bar, l. This serves a double purpose. The supervising operator is thus, by the position of the plug, apprised that the two lines are connected and the subscribers conversing, and by such an arrangement, moreover, the two lines connected are throughout the conversation maintained in communication with the central station through the annunciator-drop o'. Although this is a steady leak to earth, the resistance of the annunciator-coil prevents the leakage of so much electricity as would tend to materially diminish the sound.

In the drawings the line-strips 3 and 9, connecting the sub-stations 213 and 84, are in the described position, the plugs r are placed on the strip d, that being connected by wire Z, annunciator o', strip d', plug r', with strip l, wire l', and ground. I have also shown this position in detail in the diagram, Fig. 4.

To the third horizontal strip, m, is attached a connecting-wire, m', leading to a switch, J, which in this case I have shown as a strap-key making normal contact with a bridge, k^3, leading to transmitting and receiving telephones L T, and thence to earth. Just below the key is a front contact, m^2, connected with a wire, k^2, which branches from the generator-wire l^3. The functions of these devices are as follows: When it is necessary for the supervising operator to speak to either or both sub-stations of two connected lines the plug r' is slid down and placed on the third strip, m, thus placing the telephones L T in branch circuit with the two connected lines in precisely the same manner as the two foregoing operations are performed.

Switch-bars 4 and 10, connecting sub-stations 79 and 68, are shown in Fig. 1 as being so arranged, while Fig. 5 is a diagrammatic

detail of the same position. The key and front contact connected with the generator-branch I provide, so that if either sub-station fails to respond to the automatic ring, and the operator on listening ascertains such failure, he may easily give a second call-signal by pressing the key instead of again moving the plug r'. I may, if I so desire, use a two-point button-switch instead of the key.

The fourth bar, n, connects by wire n' with a battery, K, of sufficient strength to operate the annunciator o' when connected with one or more subscribers' lines. When by occasional listening a conversation is ascertained to be concluded, or when a subscriber rings "off," and thus drops the annunciator o', the supervising operator will at once place the plug r' on the lower bar, n. The circuit of the battery K, which has hitherto been open, is thus closed through to the terminal sub-stations of the connected lines. The magnet of the annunciator o' consequently becomes active, and the armature is attracted, releasing the drop, and it is then found impossible to replace the drop so long as the circuit of the battery is thus closed. The situation is shown in diagram by Fig. 6. The operator then passes an order to the switchman to disconnect the two lines, and not until both lines are accordingly disconnected is the circuit of the battery opened, so as to permit the drops to be replaced. By the use, therefore, of my invention, the supervising operator can keep a check upon the operations of the switchmen, and the appearance of the disconnecting-switch furnishes a complete indicator of the condition of the main switch-board. If all his plugs r' remain on the top bar, k, the operator knows that no sub-station lines are interconnected. If, when the plugs are so disposed, one or more of the annunciator-drops o' fall, it becomes evident that one or more subscribers' lines are connected on each of the cross-strips of the main board corresponding to the drops that fall. If he desires to listen, and thereby supervise and assist the conversation, he may do so by placing the proper plug r' on the third strip, m. If he sees the plug r' located on the second strip, l, he knows that the conversation is fully under way and that the two sub-station lines may, by giving a signal, cause his drop o' to fall, and thus intimate their desire for disconnection or for reconnection with some other line. If the plug r' is on the fourth strip and the corresponding drop refuses to be replaced, he is aware that, though the conversation is finished and he has given the order to disconnect, the disconnection has not yet been attended to by the switchman. If, on the contrary, when the plug is on the fourth strip, he finds that the drop may be replaced, he becomes aware that the circuits have been disconnected from one another, and avails himself of the information to replace the plug r' on the top bar once more.

In the operation of my improved system it will be understood that I may employ as many horizontal connecting-strips in the main switch as I find necessary, provided that I connect with each one an annunciator and a vertical strip in the disconnecting-switch A. I may also, if I prefer, group the horizontal strips a b c, when they become sufficiently numerous, placing, for example, the six uppermost strips in one group, designating that group as group A, and the individual strips of the group A' A^2, and so on. The next group would be known as B, and would be similarly numbered. In the event of such a system of grouping, the receiving operator would designate the precise strip of any group with which any two circuits would be connected. I have operated the system as follows: A receiving operator is seated at the receiving-table E, a switchman at the main switch B, and a supervising operator at the disconnecting-switch A. A sub-station, we will say, No. 29, desires to converse with No. 35, and transmits the call-signal in a manner well understood. The annunciator-drop o on the line L, connecting with 29, falls upon the anvil t, and thus, by means of the derived circuit v, the drop o, and anvil t, causes an audible signal or buzz on the buzzer V'. The operator presses the key, thus bringing her telephones into the derived circuit and receives the order, "connect 29 with 35." She repeats the order and at the end of the repetition designates where the connection should go on the main board. Thus "29 with 35 on a," or, if the strips were numerous and grouped, "29 with 35 on A'." This repetition serves both to notify the subscriber that his call is correctly understood and to indicate to the switchman on what strip to place the two lines. I use the buzzer V' for convenience as a signal to the receiving operator; but I do not restrict myself to its use, as I may, if I so elect, cut it out by a switch, so that the receiving-telephone may be always in the derived circuit, and in that case the operator would be required to listen constantly for calls. The entire duty of the receiving operator is to receive calls and designate the switch-strip upon which the several circuits are to be placed. The switchman stands before the main switch B, and when he hears the operator repeat any two numbers and conclude the repetition with the number of a switch-strip, he changes the plugs accordingly. The operator has now called "29 with 35 on a," and the switchman therefore takes the plug r of vertical strip 1, connecting with 29, from its normal position just above the annunciator, and places it at the point where 1 intersects a. He also removes the plug of line 2, connecting with 35, to the same strip a, and by so doing the two lines are connected together through the metal strip a, the normal connection with the respective annunciators and ground-plate is broken, and as by the contact of the strip c with the two lines the generator-circuit is also closed the annunciator o' at the disconnect-

ing-switch drops, and the supervising operator is thus apprised that a connection has been made between two line-circuits, the substation bell at both stations being simultaneously rung by the current from the electrical generator M, which flows over each line from the moment of connection. The connection is now in charge of the supervising operator at the disconnecting-switch A.

As hereinbefore indicated, the plugs r' are on the top or generator bar, k. When, now, by means of the generator-circuit closing through the drop o' to the two connected lines, the said drop falls the supervising operator allows the plug r' to remain for a short time on the generator-strip k, so that both lines will be signaled—35 that his attention may be attracted and 29 that he may know that 35 is called. He then slides the plug r' down to the telephone-strip m to see that the two subscribers are properly connected, and that they commence the conversation. The plug is then placed upon the ground-strip l, where it remains as long as the subscribers are talking, so that they may be always connected through an annunciator with the central station. A signal from either of the two connected lines now once more drops the annunciator o', whereupon the operator slides the plug again to the telephone-strip m to see what is wanted, thus enabling the subscriber to signify his desire for disconnection or to be connected with a second line.

The operator constantly occupies himself by sliding the plug down onto the listening-strip to ascertain whether persons are talking or not. When he thus ascertains that the subscribers have finished their conversation he slides the plug r' down to the battery-strip, and orders the switchman to disconnect the circuits. In practice I have done this by tickets having the designated strip printed thereon. The ticket being passed to the switchman, his duty is at once to disconnect both circuits and restore their normal connections, after which he forwards the same ticket to the receiving operator, or otherwise informs her that the strip a is clear and ready for another connection. The drop o', influenced by the battery K, will not be held up by its armature until both circuits are disconnected, and as soon as the supervising operator ascertains that the two circuits are disconnected by his ability to put up the drop he returns the plug r' to the top or generator strip, and is ready for another call upon that strip.

Having thus specifically described my invention and its application, I claim—

1. The combination, in a telephone-exchange, of a main switch-board, a series of main lines connected therewith, a series of annunciators, one for each line, a receiving-table provided with telephones and alarm devices, connecting devices between the annunciators and the receiving-table, whereby when a signal is received over any main line the receiving-table is automatically connected with said line, and an auxiliary switch-board permanently connected, as indicated, with the main switch-board, whereby any two lines connected together upon the main switch-board may be supervised by an operator at the auxiliary board, irrespective of the distance between the said main and auxiliary switch-boards.

2. In a telephone-exchange system, the combination, substantially as hereinbefore set forth, of a main switch-board adapted for the reception of a series of main lines, and an auxiliary switch-board, the vertical conducting-bars of the latter being each connected through the electro-magnet of an annunciator with a corresponding connection-bar of the main switch, whereby when any two main circuits are connected together upon any connection bar or strip of the main switch-board, a branch circuit is established through the auxiliary switch-board, for the purposes specified.

3. In a telephone-exchange system, the combination, with a series of main lines extending to sub-stations and a main switch-board therefor, of an auxiliary switch provided with a calling-generator, receiving and transmitting telephones, a steady battery, and a ground-wire, each in separate branch circuits, and having its vertical strips connected by wires with the horizontal strips of the main switch, whereby when one or more line-circuits are connected with a connection-strip, the corresponding vertical strip of the auxiliary switch with that one of the four branches to which it is plugged becomes a terminal of the said line circuit or circuits, as and for the purposes specified.

4. A main switch-board having its vertical conducting-bars connected with a series of main lines, combined with an auxiliary switch-board whose vertical strips or bars are permanently connected each with a corresponding horizontal connecting-strip of the main switch, and having its horizontal bars or strips severally connected, one with an electrical generator, one with the earth direct, one with receiving and transmitting telephones, and one with a steady battery, substantially as described.

5. In a telephone-exchange, an auxiliary or disconnecting switch-board having its vertical conducting-strips connected through a series of annunciator-magnets with the connecting-strips of a main switch-board and its horizontal conducting-strips severally connected permanently to an electrical generator for signaling purposes, transmitting and receiving telephones, a constant battery, and a ground-wire, substantially as and for the purposes specified.

6. The combination, with an annunciator normally connected in the main-line circuit between the main line and the ground terminal thereof, of a normally-open derived circuit consisting of the metallic base and drop or shutter of said annunciator, a wire connecting the same with the main circuit at a point on the line side of the annunciator, and a metallic

support or anvil common to a series of annunciators and permanently connected through a signaling-instrument or one or more telephones to earth, whereby when a call-signal is received and the annunciator-drop falls upon the metal support the derived circuit, including the receiving-instruments, is automatically established without breaking the original circuit through the annunciator to earth, as described.

7. The combination, with a main circuit to earth, including an annunciator-helix, of a normally-open derived circuit comprising the metallic frame and drop of said annunciator, a wire connecting the same with the main circuit, and a contact-bar connected to earth through a receiving-instrument, the said normally-open circuit being adapted to close automatically upon the reception of a call-signal by means of the contact between the drop and the contact-bar, independent of the original circuit through the annunciator to each, which remains intact.

8. As a means of automatically and simultaneously signaling any two sub-stations located on different main lines, the combination, in a system of electric switching and signaling, of a series of connection-strips, each adapted to temporarily unite any two main lines, and an electrical generator common to the series and normally in electrical connection with each and every connection-strip of the said series, substantially as described.

9. As a means of automatically signaling any two sub-stations located on different lines in a telephone-exchange system, the combination of a series of connection-strips in a switch-board with a generator or source of electricity, having one pole or electrode connected with the earth and the other or complementary pole normally connecting by means of branch wires with all or a part of the said series of connection-strips, substantially as specified.

10. In a telephone-exchange system, a series of sub-station lines, switch devices, substantially as indicated, for the direct interconnection of any two of said lines, and auxiliary devices combined therewith for the simultaneous establishment from a point at or near the junction between the said two lines of a branch circuit extending to an auxiliary switch and normally connected thereat with an operative electrical generator, whereby the act of connecting two lines together is caused to automatically signal the stations located thereon, but transferable at will from the said generator to a telephone, a constant battery, or a direct ground-wire, substantially as specified.

11. In a telephone-exchange system, a series of main lines, a main switch-board therefor, an auxiliary switch-board having each of its vertical strips connected electrically with a connecting-strip of the main switch, and an annunciator included in the circuit of the connecting-wire between the said main and auxiliary switches, combined with an electrical generator permanently connected with one of the horizontal strips of the auxiliary switch-board to which the vertical strips are all normally plugged, whereby when one or more main lines are connected together on any main switch-connecting strip the generator-circuit is closed and a signal automatically transmitted to the sub-stations of each line so connected, and the annunciator of the auxiliary switch caused simultaneously to drop and indicate that a connection is made, substantially as hereinbefore described.

12. A series of main lines, a main switch-board therefor, and an auxiliary switch-board connected, as described, with the main switch-board, in combination with an annunciator connected in circuit between the two switch-boards, a telephone or telephones, a key or switch, and wires connecting the said key and the telephones with one of the horizontal strips of the auxiliary switch-board, whereby when the said horizontal strip is connected with any two subscribers' lines by being plugged to a vertical strip in contact with such lines conversation may be listened to or either sub-station spoken with without disturbing the communication between the said two lines, as specified.

13. The combination, substantially as described, of a switch-board connecting-strip, a key or switch permanently connected therewith, a telephone or telephones in a branch circuit to earth and normally connected by the back limit or bridge of said key with the key and switch-board strip, and a branch wire from an electric generator terminating in a front contact or anvil for said key, whereby the said key when pressed is adapted to transiently sever its normal contact with a telephone and form a new contact with the generator, for the purposes specified.

14. In a telephone-exchange system, a series of main lines, a main switch-board therefor, and an auxiliary switch-board connected in the manner described with the main switch-board, in combination with an annunciator connected in circuit between the two switch-boards, and a ground-wire permanently attached to one of the horizontal conducting-strips of the auxiliary switch-board, whereby when any two sub-station lines are connected together and the vertical strip of the auxiliary switch corresponding to the connection-strip in use is plugged to the said grounded strip the connection of the central station with the sub-station lines is constantly maintained without interfering with the communication of the connected lines.

15. The combination, substantially as hereinbefore described, of a main switch-board, an auxiliary switch-board, wires connecting the horizontal conducting-bars of the main switch with the vertical conducting-bars of the auxiliary switch, and an annunciator-helix ar-

ranged between the said switch-boards in the circuit of the said conducting-wires, for the purposes specified.

16. The combination, substantially as hereinbefore set forth, of a series of main lines, a switch-board whereby any two of the same can be placed in direct communication one with another, and an auxiliary switch-board adapted for the convenient supervision of the same when so connected with an annunciator, and a constant battery connected on one side with the earth and on the other with one of the horizontal conducting-strips of the auxiliary switch, whereby when any vertical strip forming a branch of two connected main lines is plugged to the said horizontal strip the annunciator appertaining to the said vertical strip is included in the circuit of the said battery, is thus caused to drop, and cannot be replaced until both lines are disconnected, and the battery-circuit thus broken, as described.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 2d day of May, 1882.

FREDERICK O. VAILLE.

Witnesses:

LUCIUS M. CUTHBERT,

JOHN W. O'BRIEN.