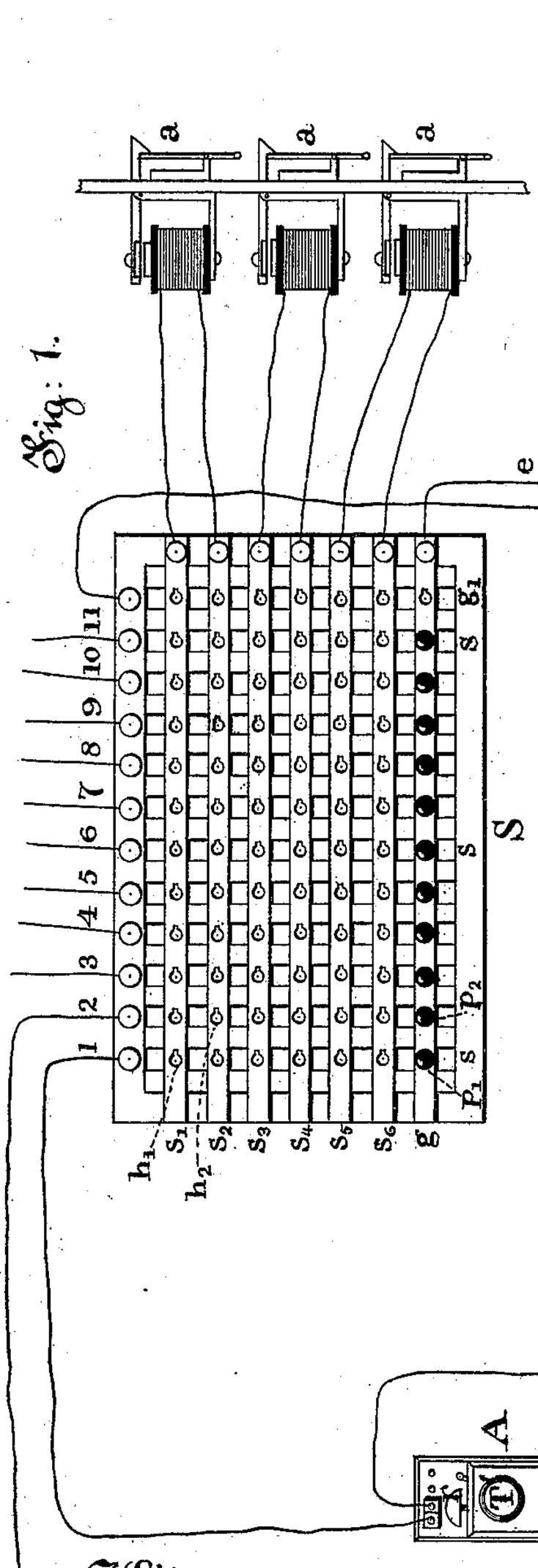
(No Model.) 2 Sheets—Sheet 1.

G. L. WILEY.

TELEPHONE EXCHANGE SYSTEM.

No. 358,317. Patented Feb. 22, 1887.

Fig: 1.



Central Station.

Fig: 5

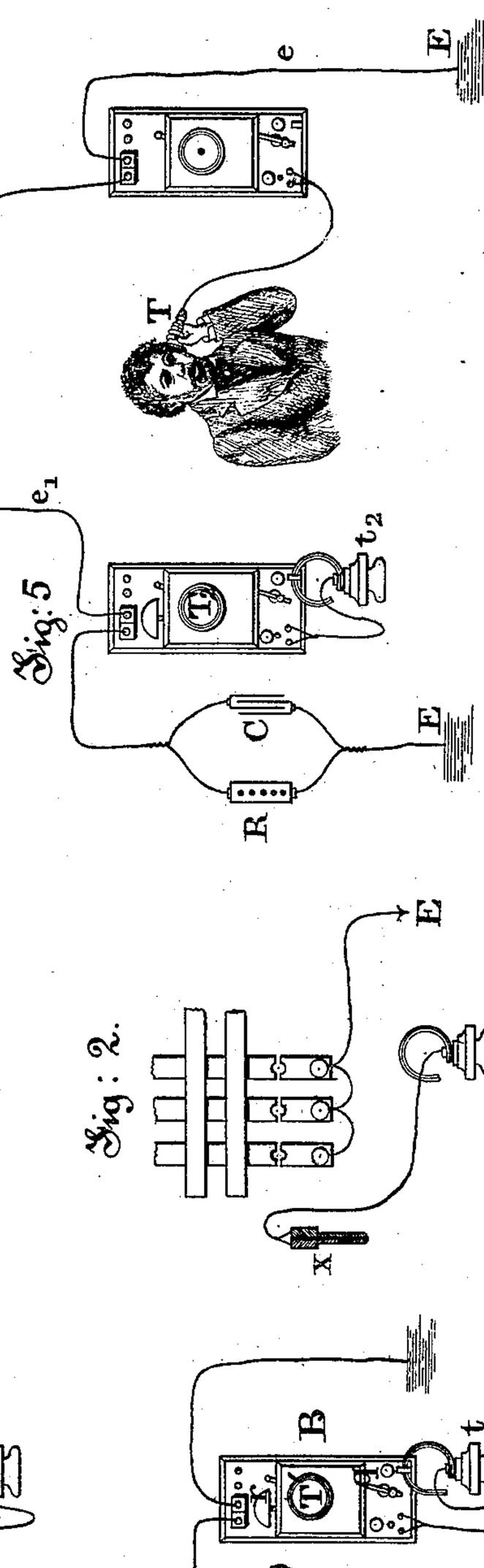
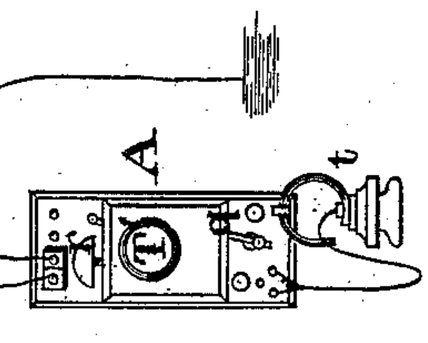


Fig: 2.



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(No Model.) 2 Sheets—Sheet 2.

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Fig: 3.

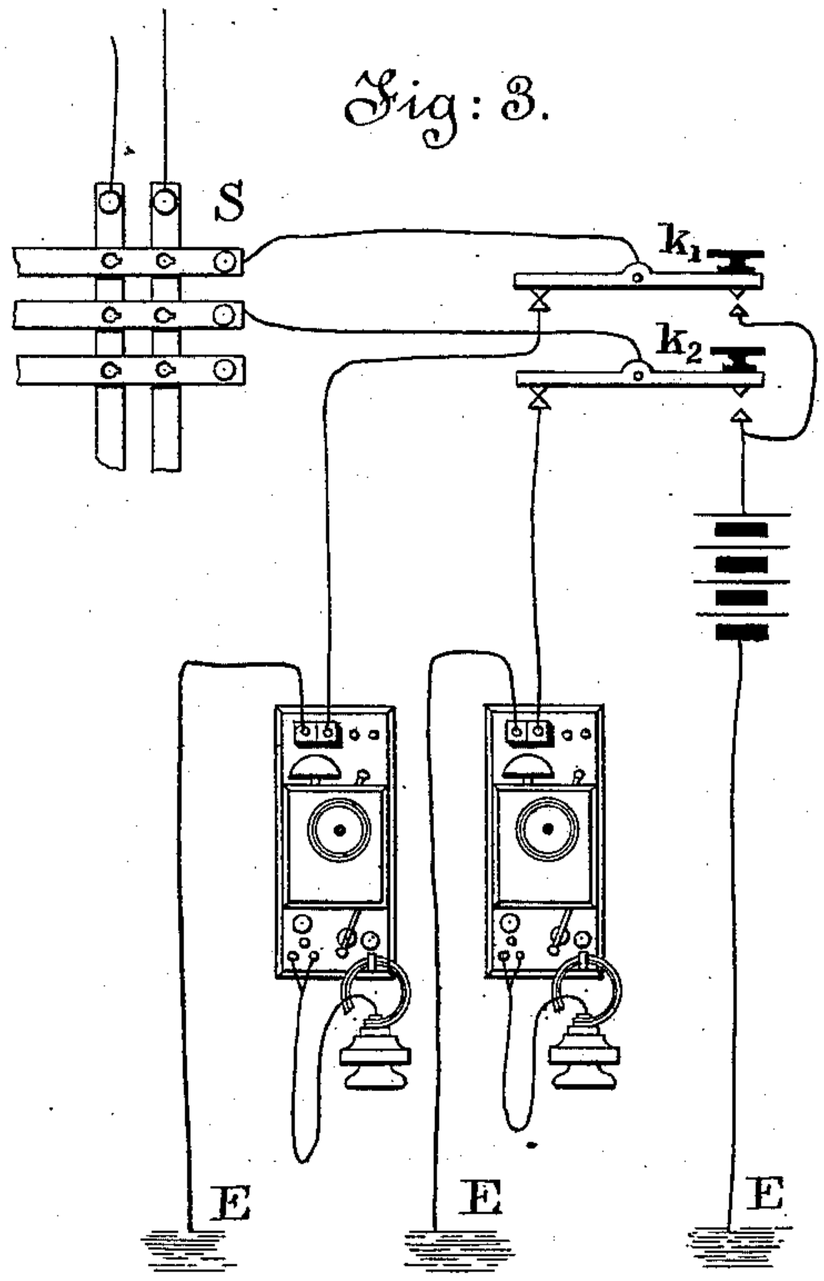
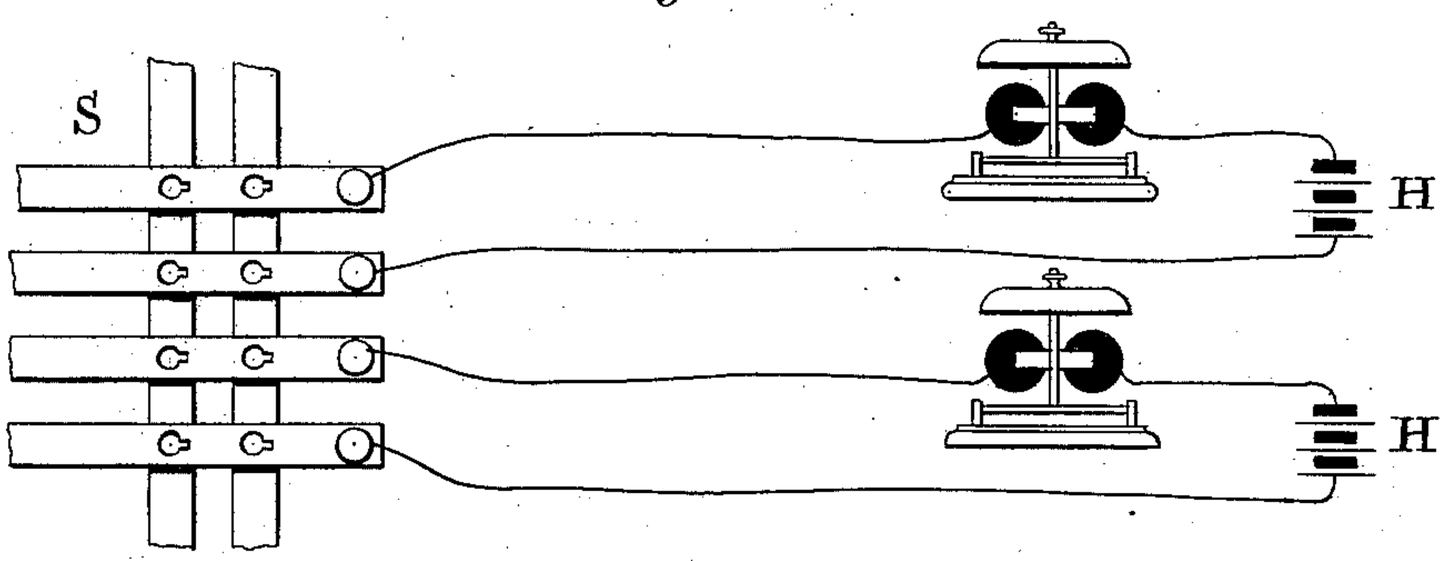


Fig: 4.



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UNITED STATES PATENT OFFICE.

GEORGE L. WILEY, OF ELIZABETH, NEW JERSEY, ASSIGNOR TO THE WESTERN ELECTRIC MANUFACTURING COMPANY, OF CHICAGO, ILLINOIS.

TELEPHONE-EXCHANGE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 358,317, dated February 22, 1887.

Application filed December 13, 1880. Serial No. 22,151. (No model.)

To all whom it may concern:

Be it known that I, GEORGE L. WILEY, a citizen of the United States, and a resident of Elizabeth, in the county of Union and State of New Jersey, have invented certain new and useful Improvements in Telephone-Exchange Systems and Circuits Therefor, of which the following is a specification.

My invention relates, especially, to that method of intercommunication which has received the name of the "district or exchange telephone system," which consists of a central station connected by means of telegraph or telephone lines radiating in different directions, with a number of sub-stations variously located within the geographical district which the central station is designed to serve. The organization and arrangement of the central station is such that any two of the sub-stations may, at a moment's notice, be placed in direct telegraphic or telephonic communication with each other by the act of a person who is in constant attendance at the central station, and who, upon being notified to do so by either party, connects together the two lines leading to the respective sub-stations, by means of suitable switching or connecting devices provided for this purpose.

Prior to the date of my invention it was usual to place in connection with each sub-station line entering the central office an electro-magnetic alarm-bell or a visual indicator, termed an "annunciator," both of well-known construction, so that when an electric current was transmitted from one of the sub-stations to the central station a signal was given to the attendant, either by sounding the alarm-bell or by dropping the visual indicator, or both, whereupon the attendant would place his telephone in connection with that line and ascertain what was wanted. Another method sometimes employed consisted in making use of a special signaling-circuit distinct from the sub-station lines and placing a person in constant attendance at a telephone connected with this circuit in the central station to receive the calls from the sub-stations, and thus dispense with a separate signaling apparatus in connection with each line, as in the first-mentioned arrangement.

The general object of my invention is to obviate certain objections incident to the methods heretofore in use, and at the same time to materially simplify both the construction and operation of a district or telephone-exchange system.

To this end my invention consists, first, in an improved combination of devices for operating district telephone or exchange systems, which consists of two or more lines radiating from a central station to two or more sub-stations, a transmitting-telephone connected with each of said lines at its sub-station, and a receiving-telephone at the central station included in an earth-wire which normally completes the circuit of all the sub-station lines, by means of which the attendant at the central station may be at once informed what sub-station is desired to be connected without the necessity of preliminary signaling; second, in the combination of two or more normally-closed electric circuits extending from a central station to a like number of sub-stations, a transmitting-telephone at each sub-station, and a receiving-telephone at the central station placed in an earth-wire common to all the sub-station lines, whereby the attendant at the receiving-telephone in the central station may place himself within hearing of the transmitting-telephones of all the sub-stations; third, in the combination of two or more normally-closed electric circuits, two or more transmitting-telephones, and a receiving-telephone in an earth-wire common to all of said circuits, with an artificial resistance in said earth-wire and a condenser attached thereto, whereby rhythmical or telephonic vibrations may be readily conveyed to earth through the receiving-telephone, while ordinary electrical pulsations may be sent through or past the central station without being materially affected by the action of the said earth-wire; fourth, in the combination of two or more sub-station lines converging to a central station and united at that point to each other and to a single conductor, with a telephone included in the circuit of the last-named conductor.

In the accompanying drawings, Figure 1 is a theoretical plan of a central station and a group of sub-stations connected therewith

which embodies my invention; and Figs. 2, 3, 4, and 5 are modifications of the same or of details of the same.

At the central station I provide a switch-board, S, for the purpose of facilitating the connection and disconnection of the different lines. This switch-board may be of any of the well-known forms in general use for telegraphic purposes, although, for facility and convenience, I usually prefer to make use of the arrangement shown in the drawings, which is known as the "lock-switch." This consists of a number of vertical metallic straps or bars, *s s s*, equal in number to the number of different sub-station lines for which accommodation is to be provided, which are arranged parallel to each other and close together, and are mounted upon a non-conducting frame or support. In front of these upright bars, and at right angles to them, is placed a second series of similar bars, *s' s²*, &c., which are in like manner supported and insulated from each other, and are separated by a small intervening space from the vertical bars *s s s*. At each crossing of one of the longitudinal bars, in front of a vertical one, a hole is drilled transversely through both bars, so that a closely-fitting metallic pin, as *p' p²*, may be inserted, which, when in place, will form an electrical connection between the said bars.

The number of horizontal bars required in any particular case will usually be equal to about half the number of vertical bars, the number of the latter being determined by the number of lines to be accommodated, as hereinbefore stated. The horizontal bars are connected in pairs to the terminals of a number of annunciators or visual signals *a a a*, the construction and use of which will be hereinafter explained. One additional horizontal bar, *g*, is provided, which is connected with the earth at E by means of an earth-wire, *e*. In this earth-wire is placed a receiving telephone, T, and in connection with this I sometimes place a transmitting-telephone also, although this is not absolutely necessary in all cases.

The several line-wires designated by the numbers 1 2 3 4, &c., are connected with the corresponding vertical bars of the switch-board S, and extend thence to the respective sub-stations, where they are severally connected with the earth. Two of these sub-stations are shown at A and B in Fig. 1, all the others being assumed to be precisely similar to these. Each sub-station is provided with a call or alarm bell, *r*, a transmitting-telephone, T', a receiving-telephone, *t*, and a switch, *q*, (which may or may not be automatic in its action,) for placing either the telephone or the call-bell in the circuit of the line, as desired. If preferred, the transmitting and receiving telephones may be combined in one and the same instrument.

When the apparatus thus described is at rest and in its normal position, switch-pegs *p' p²*, &c., are inserted in the lower bar, *g*, of the switch S, so as to electrically connect the series of vertical bars *s s s*, each with every other and with the earth, as shown in Fig. 1. The operation of effecting a special direct connection between any two sub-stations is then performed in the following manner: If a person, for example, at sub-station A wishes to communicate directly with the person at sub-station B, he first speaks through the transmitting-telephone T' to the attendant at the central station, who is continually listening at the telephone T, and informs him that he wishes to be connected with sub-station B. The attendant thereupon removes the pegs *p'* and *p²* and places them in the holes *h'* and *h²*, the effect of which is to disconnect the wires 1 and 2 from the receiving-telephone T and from the earth, and to connect them directly with each other through the bar *s'*, annunciator *a*, and bar *s²*. Sub-station A then operates his signaling apparatus and rings the call-bell *r*, at sub-station B, and upon receiving his response proceeds to communicate with him in the usual manner, precisely as if the two sub-stations were connected by a direct and wholly independent line. When they have finished, one of them operates his signaling apparatus, which drops the shutter of the annunciator *a*, thus notifying the attendant at the central station to restore the various connections to their normal position.

In lieu of the arrangement of annunciators shown at *a a* in Fig. 1, I often prefer, for the sake of simplicity, to make use of the arrangement shown in Fig. 5, which consists of a receiving and transmitting telephone, *t²* and T², placed in an earth-wire, *e'*, which terminates in an extra vertical bar, *g'*, upon the switch-board S. At some convenient point in the earth-wire *e'*, preferably between the telephone and the earth, I prefer to insert a rheostat or artificial resistance, R, in connection with a condenser, C, one terminal of the latter being connected directly to the earth or to the earth-wire below the rheostat, and the other terminal to the earth-wire between the rheostat and the switch-board. In this case the attendant, after receiving a notification, as before, connects the wires 1 and 2, for example, upon the same horizontal bar, as *s'*. He can then at any time, by inserting a connecting-peg at the intersection of the bars *s'* and *g'*, ascertain, by listening at the telephone *t²*, whether the parties have completed their conversation, and this without interrupting their conversation or signaling, for the reason that while the rheostat R prevents the escape to earth of any considerable portion of signaling-currents passing between A and B, yet the condenser permits rhythmical vibrations or telephonic currents to pass with great facility, as is well understood by those skilled in the art.

Fig. 2 represents a modification of the switch-board in which the earth-wire is connected to a detached section of each of the vertical bars, and thus a connection may be formed with any one of the bars by inserting between the bar and its detached section a divided peg, *x*, which

has the terminals of a telephone connected to its two insulated parts, as shown in the figure.

Another modification is shown in Fig. 3, in which each horizontal connecting-bar of the switch-board has a sending and a receiving telephone normally connected between it and the earth through the resting contacts of keys k' and k^2, which have their working contact-stops connected with a battery, F, common to all the bars. When a key is depressed, its telephone is thrown out of the circuit, and the current from the battery F is transmitted to the switch-board, and there divides and goes over both the sub-station lines connected with that horizontal bar, so that the attendant at the central station may by this means simultaneously signal both sub-stations, if desired. The rheostat and condenser, arranged as hereinbefore described, may be advantageously applied to this arrangement of circuits.

In Fig. 4 I have shown a modification in which the visual annunciator of Fig. 1 is replaced by an electro-magnetic bell and signaling-battery, H. This avoids the necessity of placing signaling-batteries or magneto-generators at the sub-stations, for the reason that the attendant at the central station having been, as heretofore explained, notified by telephone to make the desired connection, does so, and at the same time includes the battery and alarm-bell in the connected circuit. The battery supplies a constant current through the coupled lines, by means of which one sub-station may signal the other in the ordinary manner by means of the battery located at the central station, and the two sub-stations may hold conversation with each other without removing the battery from the circuit.

In constructing and arranging a telephone-exchange system in accordance with my invention it is in all cases desirable that the signaling electro-magnet at each sub-station should be wound with a great number of convolutions of very fine wire, so as to give a high resistance. This resistance will in all cases be removed from the circuit when the operator at the sub-station is using his telephone, and will therefore not interfere with the free transmission of communications, while the resistances remaining in circuit at each of the other sub-stations will oppose the tendency of the telephonic vibrations from the speaking-station to distribute themselves from the common earth-connection over all the other lines. The same effect may be produced, but less advantageously, by inserting special artificial resistances in the several lines.

By the use of my invention it is possible to dispense with the cumbrous and expensive system heretofore employed of attaching an electro-magnet and annunciator or other equivalent signal to each separate line entering the central station, and also to avoid the expense of the alternative method of constructing a separate circuit for signaling, while at the same time I am enabled to secure all the substantial advantages of both these systems.

I make no claim to the combination and arrangement, which I have described and shown, of placing a visual signal or annunciator in the circuit of two connected sub-station lines, for the purpose of notifying the attendant at the central station to restore the circuits to their normal condition after the two correspondents have finished their conversation.

I claim as my invention—

1. The combination, substantially as hereinbefore set forth, of two or more lines extending from a central station to two or more sub-stations, a transmitting-telephone connected with each of said lines at its sub-station, and a receiving-telephone at the central station included in an earth-wire which normally completes the circuit of all the sub-station lines.

2. The combination, substantially as hereinbefore set forth, of two or more normally-closed electric circuits extending from a central station to two or more sub-stations, a transmitting-telephone at each sub-station, and a receiving-telephone at the central station in an earth-wire common to all the sub-station lines.

3. The combination, substantially as hereinbefore set forth, of two or more normally-closed electric circuits extending from a central station to two or more sub-stations, a transmitting-telephone at each sub-station, a receiving-telephone at the central station in an earth-wire common to all the sub-station lines, an artificial resistance in said earth-wire, and a condenser attached to said earth-wire in such a manner as to transmit rhythmical vibrations around said artificial resistance.

4. The combination, substantially as hereinbefore set forth, of two or more sub-station lines converging to a central station and united at that point to each other and to a single conductor and a telephone included in the circuit of the last-named conductor.

Signed by me this 9th day of December, A. D. 1880.

GEORGE L. WILEY.

Witnesses:
NELSON ZABRISKIE,
MILLER C. EARLE.