

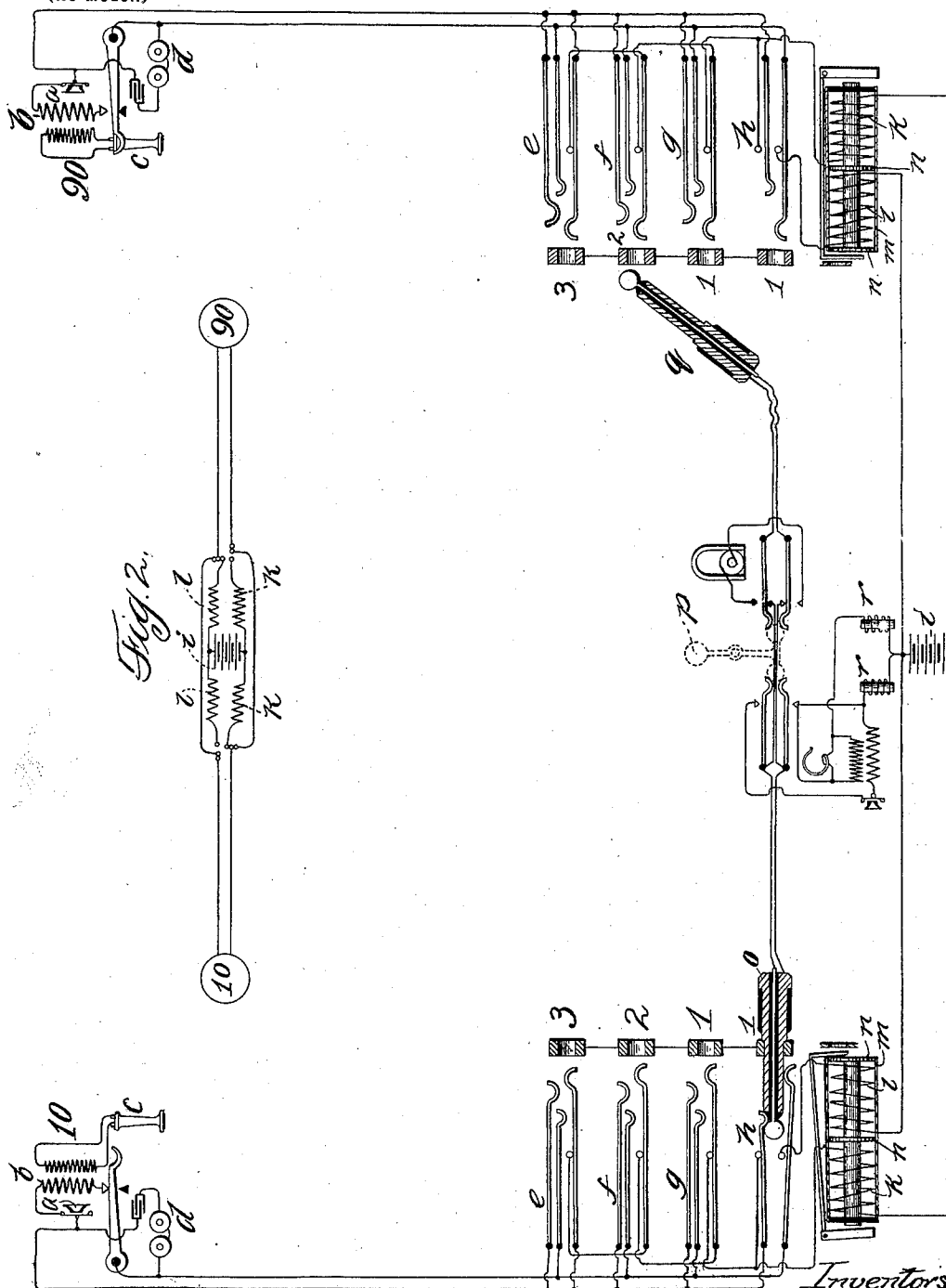
No. 655,810.

Patented Aug. 14, 1900.

A. STROMBERG & W. M. DAVIS.
TELEPHONE EXCHANGE SYSTEM.

(Application filed Apr. 26, 1899.)

(No Model.)



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Fig. 1.

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UNITED STATES PATENT OFFICE.

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TELEPHONE-EXCHANGE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 655,810, dated August 14, 1900.

Application filed April 26, 1899. Serial No. 714,536. (No model.)

To all whom it may concern:

Be it known that we, ALFRED STROMBERG and WILLIAM M. DAVIS, citizens of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Telephone-Exchange Systems, (Cases Nos. 2 and 1,) of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

Our invention relates to telephone-exchange systems, and more particularly to that class of telephone systems in which centralized batteries are employed for supplying the transmitter-circuits at the subscribers' stations with current.

Our invention has for one of its objects the provision of improved circuits and apparatus whereby special clearing-out indicators may be dispensed with, one of the line-indicators being retained in connection with an established circuit between subscribers, and thereby performing the function of a clearing-out indicator.

Our invention in its preferred embodiment relates more particularly to multiple-switchboard telephone-exchange systems, and by its use we are enabled to prevent the false operation of the called-subscriber's line-indicator, that may be located at another section of the switchboard, the line-indicator of the calling subscriber being preferably the one that acts as a clearing-out indicator upon the establishment of a connection between subscribers.

The invention also has for its object the provision of means whereby the coil or winding of the line-indicator that is used as the clearing-out indicator may be used as an impedance-winding to prevent the passage of voice-currents and at the same time to permit of the flow of battery-current over the line. In order to maintain a balance of the system, we also preferably employ a second impedance-winding, which acts in the same capacity. Each telephone-line is thus provided with an annunciator or indicator having a winding which acts as an exciting-winding and also as an impedance-winding and in addition to

this winding a second winding which acts solely in the capacity of an impedance-winding. For the sake of convenience the two windings thus associated with each line are wound upon a common core, provision being made, however, to prevent that winding which acts solely as an impedance-winding from influencing the armature of the indicator. The centralized battery is preferably not included directly in the cord-circuit, as this would necessitate in the best telephone practice the employment of repeating-coils. The limbs of the telephone-lines are extended beyond their line-switches or spring-jacks to the common battery, from which the operator's telephone outfit is also supplied.

The invention has for its further object the provision of improved means whereby the test-thimbles of connected lines may be charged.

We will explain our invention more particularly by reference to the accompanying drawings, in which—

Figure 1 illustrates the preferred embodiment of our invention as applied to a multiple-switchboard telephone-exchange system. Fig. 2 illustrates, diagrammatically, the circuits that are established upon the connection of subscribers for conversation.

Like characters of reference refer to like parts in both views.

The apparatus at the substations 10 and 90 is well known to those skilled in the art. A transmitter *a*, with its coil *b*, and the receiver *c*, with its coil, are shown at each station, the secondary coil in circuit with the receiver being included in a local circuit therewith, while the primary coil in circuit with the transmitter is placed in series with both limbs of the corresponding telephone-line upon the removal of the receiver from its spring switch-hook. The transmitter primary winding of the induction-coil is thus shown in series with the telephone-line, the telephone-receiver being removed from its hook. The transmitter-circuit at station 90 is open, the receiver at said station being upon its hook. There is also provided at each station a call-bell *d*, preferably responsive to alternating current, each bell being preferably placed with the

condenser in a bridge between the limbs of each telephone-line, the telephone-lines extended from the substations to the exchange being connected with the sections 3, 2, and 1 of the multiple board. We prefer to employ at the answering-sections of the switchboard a special answering-jack in addition to the regular line-jack, the jacks *g* at board 1 being the regular line-jacks, while the jacks *h* at board 1 are the answering-jacks. The line-jacks are preferably each equipped with two long and one short line-spring, the longer spring being adapted for engagement with the sleeves of a connecting-plug, while the shorter spring is adapted for connection with the tips of the connecting-plugs. The answering-jacks, however, are preferably each equipped with but two springs, the shorter spring being adapted for engagement with the tips of the connecting-plugs, while the longer spring is adapted for engagement with the sleeves of the connecting-plugs. The two longer line-springs of each line-jack and the longer line-spring of each answering-jack are adapted to be electrically connected with the test-thimbles (indicated in section in front of the line-springs) by the sleeve of any inserted plug. The upper line-spring and the shortest line-spring of each line-jack are adapted by their engagement respectively with the sleeve and tip of the connecting-plug engaging the same to effect a continuation of the telephone-line connected with said springs through the operator's cord-circuit. The lower line-spring of each line-jack is provided with a back contact normally engaging the same, by means of which and the connections shown one of the limbs of each of the telephone-lines is normally extended to one pole of the common battery *i*. The exciting-winding *k* of each line-indicator is normally included in series with the longest line-springs of the line-jacks and the back contacts engaging the same, and consequently also with the limb of the telephone-line normally connected with the longest line-springs of said jacks.

Where each extra impedance-winding *l* is provided upon an extension of the core of the indicating-magnet, we preferably inclose the coils surrounding the core of each of said magnets by a tube *m*, of magnetic material, the extra impedance-winding upon each annunciator-core being inclosed by iron washers *n*, whereby when said impedance-winding is alone excited the lines of force are short-circuited, and thereby prevented from causing the actuation of the indicator-armature. Assuming that subscriber No. 10 is the calling subscriber and that he desires to communicate with subscriber No. 90, whose answering-jack is in this particular instance located at the same board with the answering-jack of subscriber No. 10, the calling subscriber removes his receiver from its hook, thereby closing the circuit from the battery *i* through the actuating-coil *k* of his line-indicator and the limbs of the telephone-line.

The operator in response to the signal conveyed by the indicator *k* inserts the answering-plug *o* of one of her cord sets into the answering-jack of the calling subscriber. It will be observed that the circuit connections of the answering-jacks are such that upon the insertion of the answering-plug the coil *k* of the calling-subscriber's indicator is not cut out of circuit, whereby this indicator is adapted to serve the purpose of a clearing-out indicator, the indicating-magnet being constantly excited during the time that the calling subscriber keeps his telephone-receiver from its hook. This same coil or winding *k* of the calling-subscriber's line-indicator we also employ as an impedance-winding, the extra coil or winding upon the core of the calling-subscriber's indicator being excluded from circuit by the depression of the longer line-spring of the answering-jack from its back contact, which forms one terminal of the latter coil.

The operator manipulates her key *p* to throw her telephone into circuit with the calling-subscriber's telephone and, ascertaining that the said subscriber desires communication with the called subscriber 90, inserts the connecting-plug *q* into the line-jack *g* of the called-subscriber's line. By this act, as will be apparent by an inspection of the drawings, the circuit through the coil *k* of the called-subscriber's line-indicator is opened at the back contact normally engaging the longest line-spring of the said line-jack, the extra impedance-coil *l* upon the core of the called-subscriber's line-indicator being maintained in circuit, no plug being inserted within the answering-jack *h* of the called subscriber, the answering-jacks controlling the continuity of the circuit of the extra impedance-coils *l*. The operator manipulates the key *p* to operate the signal-bell at the called-subscriber's station.

Upon the establishment of the telephone-circuit between two subscribers according to our invention we include the centralized battery *i* in a bridge between the sides of the combined circuit uniting the subscribers for telephonic communication, two impedance-coils being included in the same bridge, one upon each side of the battery, whereby a balance is maintained between the sides of the system, one of these impedance-coils being a coil of a line annunciator or indicator and the other impedance-coil being one that acts solely as such. The coil *k* of the called-subscriber's line-indicator being thus opened upon the establishment of the connection with his line, the said indicator is not operated upon the actuation of the called-subscriber's telephone-hook. When the subscribers are through conversation, their receivers are restored, the clearing-out signal being given by the line-indicator of the calling subscriber in being restored to its normal condition. Upon this signal the plugs uniting the subscribers' lines are withdrawn from their engaging spring-jacks.

In a multiple-switchboard system, where the called subscriber may have his annunciator located at another section of the switchboard than that where the calling-subscriber's annunciator is located, it is possible by means of our invention to render the said called-subscriber's annunciator inoperative during an established connection, whereby false signals to the operator at the called-subscriber's section of the switchboard are prevented. Preferably in accordance with our invention when employed in connection with multiple switchboards the association of the impedance-coils with the united telephone-lines is the same irrespective of the location of the annunciators of the connected subscribers. This association of the coils with the united telephone-lines is shown more clearly in Fig. 2, in which the exciting-coil of the calling-subscriber's line-indicator is included between one terminal of the common battery and a side of the telephone-circuit between the subscribers, the extra impedance-coil l , associated with the called-subscriber's line, being included in circuit between the other terminal of the battery and the remaining side of the telephone-circuit. The extra impedance-coil associated with the calling-subscriber's telephone-line is cut out of circuit, as is also the exciting-coil of the called-subscriber's indicator.

The test-thimbles of the calling-subscriber's spring-jacks upon the different sections of the switchboard are connected with the centralized battery by means of the sleeve of the inserted answering-plug and the long line-spring of the answering-jack engaging said sleeve. The test-thimbles of the called-subscriber's spring-jacks upon the different sections of the switchboard are charged with current from the battery i by way of the tip of the answering-plug, which is connected with the sleeve of the connecting-plug, the latter sleeve engaging a test-thimble of one of the called-subscriber's spring-jacks. The sleeve of the answering-plug and the tip of the connecting-plug are connected. The test-thimbles of the calling-subscriber's spring-jacks are also charged with battery-current by way of the tip of the connecting-plug and the cord-strand uniting said tip with the sleeve of the answering-plug. By connecting the tips with the sleeves and the sleeves with the tips of the plugs we are enabled to transfer battery-current for the purposes of testing from one section of a switchboard to another through the agency of the cord-strands and without the necessity of employing special cord-strands which do not take part in the propagation of the voice-currents.

The operator's outfit is preferably associated with the cord-circuit, as shown, whereby the operator may receive calls and readily listen in at any time and whereby she also may test the electrical condition of a called line. The operator's transmitter is preferably supplied from the same common battery,

and impedance-coils rr of sufficiently-high resistance are preferably employed to prevent shunting of all the voice-current and current from the common battery upon the connection of the operator's telephone set with the cord-circuit.

While we have shown one particular type of switchboard and one peculiar arrangement of the operator's cord-circuit and a special construction for the line and answering spring-jacks, we do not wish to be limited to the precise embodiment of these features shown nor to the precise circuits shown; but,

Having described our invention, we claim as new and desire to secure by Letters Patent—

1. In a telephone-exchange system, the combination with two telephone-lines extending from substations to an exchange, of telephone switch-hooks at each of the substations for opening and closing the telephone-line at each substation; a centralized battery normally included in circuit with the said telephone-lines; a line-indicator for each of said telephone-lines, each normally included in circuit with said battery, whereby upon the completion of the circuit at either of said subscribers' stations the indicator corresponding to said station is operated, which station thus becomes the calling station; a cord-circuit for forming a continuation of one of said telephone-lines; means for effecting a connection between said cord-circuit and telephone-line without disconnecting the line-indicator corresponding to the said line from circuit; a jack-switch, and a connecting-plug united with said cord-circuit for effecting the connection of the cord-circuit and its connected telephone-line with the remaining telephone-line, said jack-switch being adapted upon the insertion of the said connecting-plug to disconnect the indicator from the said telephone-line, substantially as described.

2. In a multiple-switchboard telephone-exchange system, the combination with two telephone-lines, each extending to a plurality of sections of a multiple switchboard and connected at each of said sections with a jack-switch, of telephone switch-hooks at each of the substations for opening and closing the telephone-line at each substation; a centralized battery normally included in circuit with the said telephone-lines; a line-indicator for each of said telephone-lines, each normally included in circuit with said battery, whereby, upon the completion of the circuit at either of said subscribers' stations, the indicator corresponding to said station is operated, which station thus becomes the calling station; a cord-circuit for forming a continuation of the telephone-line extending from the calling station; means for effecting a connection between said cord-circuit and said calling telephone-line without disconnecting the line-indicator corresponding to the said line from circuit, and a connecting-plug united with said cord-circuit adapted for in-

sertion within a jack-switch of the remaining or called-subscriber's telephone-line to effect the connection of the cord-circuit with the remaining or called telephone-line, said jack-switch being adapted upon the insertion of the said connecting-plug to disconnect the indicator from the said telephone-line, substantially as described.

3. In a telephone-exchange system, the combination with two telephone-lines extending from substations to an exchange, of means at each of the substations for opening and closing the telephone-line at each substation; a centralized battery normally included in circuit with the said telephone-lines; a line-indicator for each of said telephone-lines, each normally included in circuit with said battery, whereby upon the completion of the circuit at either of said subscribers' stations the indicator corresponding to said station is operated, which station thus becomes the calling station; a cord-circuit for forming a continuation of one of said telephone-lines; means for effecting a connection between said cord-circuit and telephone-line without disconnecting the line-indicator corresponding to the said line from circuit; a jack-switch, and a connecting-plug united with said cord-circuit for effecting the connection of the cord-circuit and its connected telephone-line with the remaining telephone-line, said jack-switch being adapted upon the insertion of the said connecting-plug to disconnect the indicator from the said telephone-line, substantially as described.

4. In a multiple-switchboard telephone-exchange system, the combination with two telephone-lines, each extending to a plurality of sections of a multiple switchboard and connected at each of said sections with a jack-switch, of means at each of the substations for opening and closing the telephone-line at each substation; a centralized battery normally included in circuit with the said telephone-lines; a line-indicator for each of said telephone-lines, each normally included in circuit with said battery, whereby, upon the completion of the circuit at either of said subscribers' stations, the indicator corresponding to said station is operated, which station thus becomes the calling station; a cord-circuit for forming a continuation of the telephone-line extending from the calling station; means for effecting a connection between said cord-circuit and said calling telephone-line without disconnecting the line-indicator corresponding to the said line from circuit, and a connecting-plug united with said cord-circuit adapted for insertion within a jack-switch of the remaining or called-subscriber's telephone-line to effect the connection of the cord-circuit with the remaining or called telephone-line, said jack-switch being adapted upon the insertion of the said connecting-plug to disconnect the indicator from the said telephone-line, substantially as described.

5. In a multiple-switchboard telephone-exchange system, the combination with two telephone-lines, each extending to a plurality of sections of a multiple switchboard and connected at each of said sections with a line-jack switch, of telephone switch-hooks at each of the substations for opening and closing the telephone-line at each substation; a centralized battery normally included in circuit with the said telephone-lines; a line-indicator for each of said telephone-lines, each being located at one section of the switchboard and normally included in circuit with said battery, whereby upon the completion of the circuit at either of said subscriber's stations the indicator corresponding to said station is operated, which station thus becomes the calling station; an answering-jack for each telephone-line located at the same section of the switchboard with each line-indicator of said line; a cord-circuit for forming a continuation of the telephone-line extending from the calling station; an answering-plug connected with said cord-circuit for insertion within the answering-jack of the calling line, said answering-jack and answering-plug being adapted to effect connection between the calling line and the cord-circuit without disconnecting the line-indicator of said line from circuit, and a connecting-plug adapted for insertion within a line-jack of the remaining or called-subscriber's telephone-line, said line-jack being adapted to effect the exclusion of the called-subscriber's line-indicator from circuit with the battery upon the insertion of the connecting-plug to prevent the operation of said line-indicator during the connection between the telephone-lines, substantially as described.

6. In a multiple-switchboard telephone-exchange system, the combination with two telephone-lines, each extending to a plurality of sections of a multiple switchboard and connected at each of said sections with a line-jack, of means at each of the substations for opening and closing the telephone-line at each substation; a centralized battery normally included in circuit with the said telephone-lines; a line-indicator for each of said telephone-lines, each being located at one section of the switchboard and normally included in circuit with said battery, whereby upon the completion of the circuit at either of said subscribers' stations the indicator corresponding to said station is operated, which station thus becomes the calling station; an answering-jack for each telephone-line located at the same section of the switchboard with each line-indicator of said line; a cord-circuit for forming a continuation of the telephone-line extending from the calling station; an answering-plug connected with said cord-circuit for insertion within the answering-jack of the calling line, said answering-jack and answering-plug being adapted to effect connection between the calling line and the cord-circuit without disconnecting

the line-indicator of said line from circuit, and a connecting-plug adapted for insertion within a line-jack of the remaining or called-subscriber's telephone-line, said line-jack being adapted to effect the exclusion of the called-subscriber's line-indicator from circuit with the battery upon the insertion of the connecting-plug to prevent the operation of said line-indicator during the connection between the telephone-lines, substantially as described.

7. In a telephone-exchange system, the combination with two telephone-lines extending from substations to an exchange, of a centralized battery normally in circuit with said telephone-lines; a transmitter-circuit at each subscriber's station adapted to be supplied with current from said centralized battery over the telephone-line; a telephone switch-hook at each station for controlling the continuity of the transmitter-circuit thereat; one impedance-winding, constituting also the winding of a line-indicator, and an extra impedance-winding provided in connection with each telephone-line, each indicator-winding being normally included in circuit with the battery and adapted to be excited upon the removal of the receiver from its switch-hook; means for establishing telephonic circuit between the substations for conveying voice-currents, and additional means coöperating with said means adapted upon the completion of circuit between subscribers' stations to include the winding of a line-indicator of one of said lines in bridge between the battery and one side of the telephone-circuit uniting the subscribers' stations and the extra impedance-winding of the other telephone-line in the same bridge between said battery and the other side of the telephone-circuit and serving to exclude the remaining impedance and line-indicator windings from circuit, substantially as described.

8. In a telephone-exchange system, the combination with two telephone-lines extending from substations to an exchange, of a centralized battery normally in circuit with said telephone-lines; a transmitter-circuit at each subscriber's station adapted to be supplied with current from said centralized battery over the telephone-line; a telephone switch-hook at each station for controlling the continuity of a transmitter-circuit thereat; an impedance-winding constituting also the winding of a line-indicator associated with each of said lines and normally in circuit with said battery and telephone-line and adapted to be excited upon the removal of the telephone-receiver from its switch-hook; a cord-circuit for forming a continuation of one of said lines; a plug connected with the cord-circuit for connecting the remaining telephone-line with said cord-circuit, and means controlled by the apparatus for uniting the subscribers for conversation for excluding one of the line-indicator windings from circuit with said battery and including the other

line-indicator winding and the said battery in a bridge between the sides of the telephone-circuit between the substations, substantially as described.

9. In a multiple-switchboard telephone-exchange system, the combination with two telephone-lines, each extending to a plurality of sections of a multiple switchboard and connected at each of said sections with a line-jack switch, of telephone switch-hooks at each of the substations for opening and closing the telephone-line at each substation; a centralized battery normally included in circuit with the said telephone-lines; one impedance-winding, constituting also the winding of a line-indicator, and an extra impedance-winding provided in connection with each telephone-line, each indicator-winding being normally included in circuit with the battery and adapted to be excited upon the removal of the receiver from its switch-hook; means for establishing telephonic circuit between the substations for conveying voice-currents, and additional means coöperating with said means adapted upon the completion of circuit between subscribers' stations to include the winding of the line-indicator of one of said lines in bridge between the battery and one side of the telephone-circuit uniting the subscribers' stations and the extra impedance-winding of the other telephone-line in the same bridge between said battery and the other side of the telephone-circuit and serving to exclude the remaining impedance and line-indicator windings from circuit, substantially as described.

10. In a multiple-switchboard telephone-exchange system, the combination with two telephone-lines, each extending to a plurality of sections of a multiple switchboard and connected at each of said sections with a line-jack switch, of telephone switch-hooks at each of the substations for opening and closing the telephone-line at each substation; a centralized battery normally included in circuit with the said telephone-lines; a line-indicator associated with each line, the winding of each indicator being also an impedance-winding, the winding of each indicator being normally in circuit with said centralized battery and being excited upon the removal of the receiver from the corresponding telephone switch-hook, the line corresponding to the indicator thus excited becoming the calling line; an additional impedance-winding associated with each line; an answering-jack connected with each line and located at the same section of the switchboard with the line-indicator; an answering-plug adapted for insertion within said answering-jack and being adapted thereby to effect the connection of the calling line with the cord-circuit without interrupting the circuit through the indicating-winding, said plug and answering-jack being adapted to effect the disconnection of the additional impedance-winding associated with said calling line, and a connecting-plug

adapted for insertion within a line-jack of the remaining or called-subscriber's telephone-line, said plug and line-jack being adapted to exclude the indicator-winding of the called subscriber without excluding the additional impedance-winding associated with the called line, said plugs, by means of suitable circuit connections, being adapted to include the battery between the connected impedance-winding and indicator-winding in a bridge including said windings across the telephone-circuit between the subscribers, substantially as described.

11. In a multiple-switchboard testing system, the combination with two telephone-lines, each extending to a plurality of sections of a multiple switchboard and connected at each of said sections with a jack-switch, of test-thimbles one associated with each of said jack-switches, the test-thimbles of the jack-switches associated with each line being electrically connected; a cord-circuit provided with terminal plugs, each having a tip and a sleeve, the tip of each plug being connected with the sleeve of the other plug, to afford paths for testing current from the tips to the sleeves; a test-battery, and switch parts at the jack-switches connected with said test-battery and adapted for engagement with the tips of said plugs upon the insertion thereof within the jack-switches, whereby said test-thimbles are charged with current from said test-battery through the agency of the cord-strands independently of the subscribers' apparatus, substantially as described.

12. In a multiple-switchboard system, the combination with two telephone-lines, each extending to a plurality of sections of a multiple switchboard and connected at each of said sections with a jack-switch, of test-thimbles, one associated with each of said jack-switches, the test-thimbles of the jack-switches associated with each line being electrically connected, a testing-circuit for the test-thimbles independent of the subscribers' apparatus, connecting-plugs having a tip and sleeve connected by a cord-strand, a test-battery adapted for connection with a set of said thimbles and said strand, and a switching portion at each jack connected with said test-battery and adapted for engagement with the said tip upon its insertion within a jack-switch, thereby to connect the test-thimble engaging the said sleeve with the test-battery, through the agency of the said cord-strand, substantially as described.

13. In a telephone-exchange system, the combination with two telephone-lines extending from substations to an exchange, of a centralized battery normally in circuit with said telephone-lines, a transmitter-circuit at each subscriber's station adapted to be supplied with current from said centralized battery over the telephone-line, a telephone switch-hook at each station for controlling the continuity of the transmitter-circuit thereat, an impedance-winding constituting also the

winding of a line-indicator associated with each of said lines and normally in circuit with said battery and telephone-line and adapted to be excited upon the removal of the telephone-receiver from its switch-hook, a cord-circuit for forming a continuation of one of said lines, a plug connected with the cord-circuit for connecting the remaining telephone-line with said cord-circuit, an additional impedance-winding, and means controlled by the apparatus for uniting the subscribers for conversation for excluding one of the line-indicator windings from circuit with said battery and including the other line-indicator winding and the additional impedance-winding in a bridge with said battery between the sides of the telephone-circuit between the substations, substantially as described.

14. In a telephone-exchange system, the combination with two telephone-lines extending from substations to an exchange, of a centralized battery normally in circuit with said telephone-lines, a transmitter-circuit at each subscriber's station adapted to be supplied with current from said centralized battery over the telephone-line, a telephone switch-hook at each station for controlling the continuity of the transmitter-circuit thereat, an impedance-winding constituting also the winding of a line-indicator associated with each of said lines and normally in circuit with said battery and telephone-line and adapted to be excited upon the removal of the telephone-receiver from its switch-hook, a cord-circuit for forming a continuation of one of said lines, a plug connected with the cord-circuit for connecting the remaining telephone-line with said cord-circuit, an additional impedance-winding, and means controlled by the apparatus for uniting the subscribers for conversation for excluding one of the line-indicator windings from circuit with said battery and including the said battery between the other line-indicator winding and the additional impedance-winding in a bridge between the sides of the telephone-circuit, substantially as described.

15. In a telephone-exchange system, the combination with two telephone-lines extending from substations to an exchange, of a centralized battery normally in circuit with said telephone-lines, a transmitter-circuit at each subscriber's station adapted to be supplied with current from said centralized battery over the telephone-line, a telephone switch-hook at each station for controlling the continuity of the transmitter-circuit thereat, an impedance-winding constituting also the winding of an indicator, a cord-circuit for forming a continuation of one of said lines, a plug connected with the cord-circuit for connecting the remaining telephone-line with said cord-circuit, two additional impedance-windings, one associated with each telephone-line, and means controlled by the apparatus for uniting the subscribers for conversation

for connecting the said battery between the indicator-winding and an extra impedance-winding in a bridge between the sides of the telephone-circuit, substantially as described.

5 16. In a telephone-exchange system, the combination with two telephone-lines extending from substations to an exchange, of a centralized battery normally in circuit with said telephone-lines, a transmitter-circuit at each
10 subscriber's station adapted to be supplied with current from said centralized battery over the telephone-line, a telephone switch-hook at each station for controlling the continuity of the transmitter-circuit thereat, an
15 indicator-winding, two impedance-windings one associated with each telephone-line, a

cord-circuit for forming a continuation of one of said lines, a plug connected with the cord-circuit for connecting the remaining telephone-line with said cord-circuit, and means 20 controlled by the apparatus for uniting the subscribers for conversation for including an impedance-winding, the battery and said indicator-winding in the circuit between the substations, substantially as described. 25

In witness whereof we hereunto subscribe our names this 24th day of April, A. D. 1899.

ALFRED STROMBERG.

WILLIAM M. DAVIS.

Witnesses:

GEORGE L. CRAGG,

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