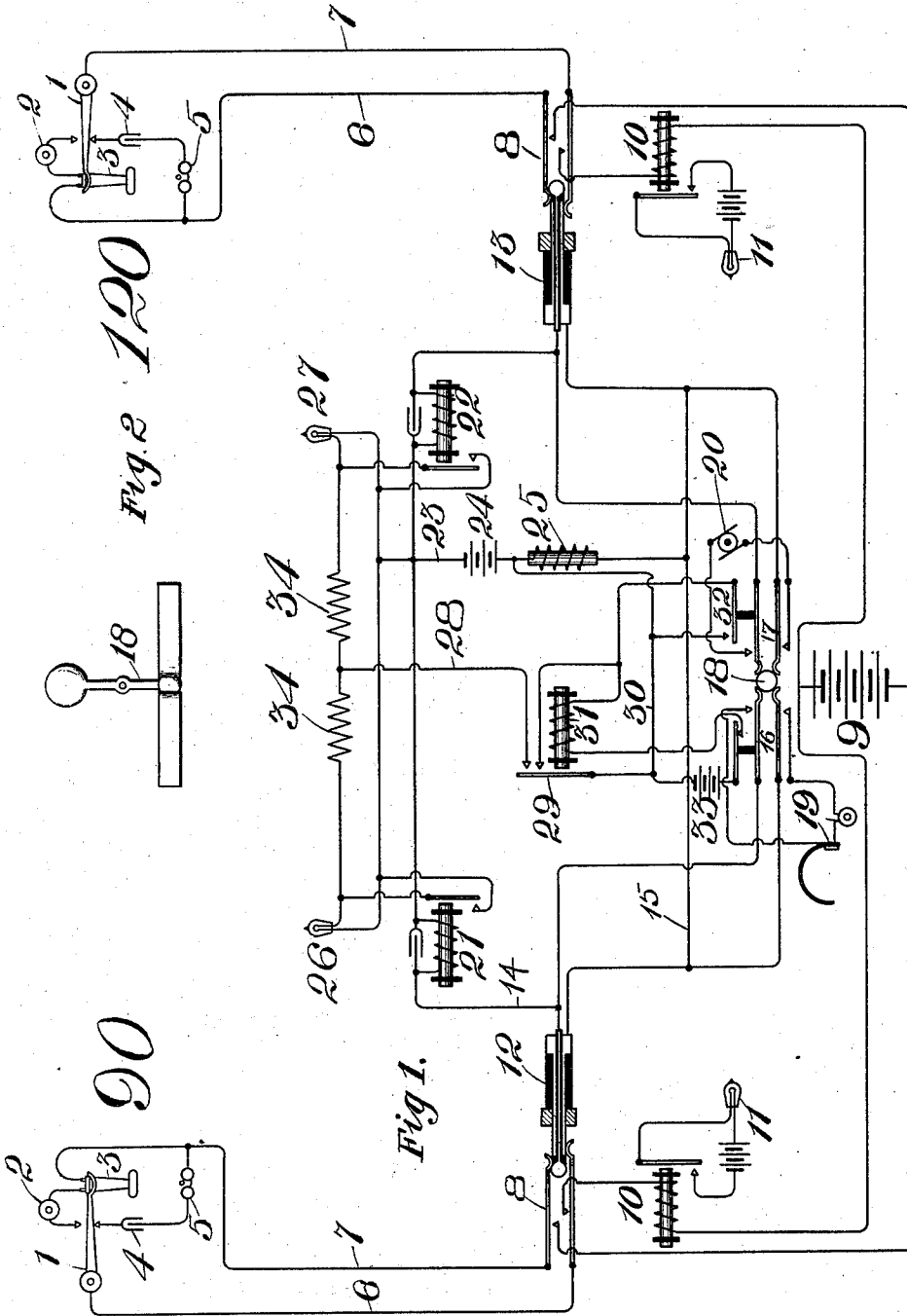


G. L. CRAGG.
TELEPHONE EXCHANGE SYSTEM.
APPLICATION FILED MAY 9, 1902.

NO MODEL.

2 SHEETS—SHEET 1.



Witnesses:
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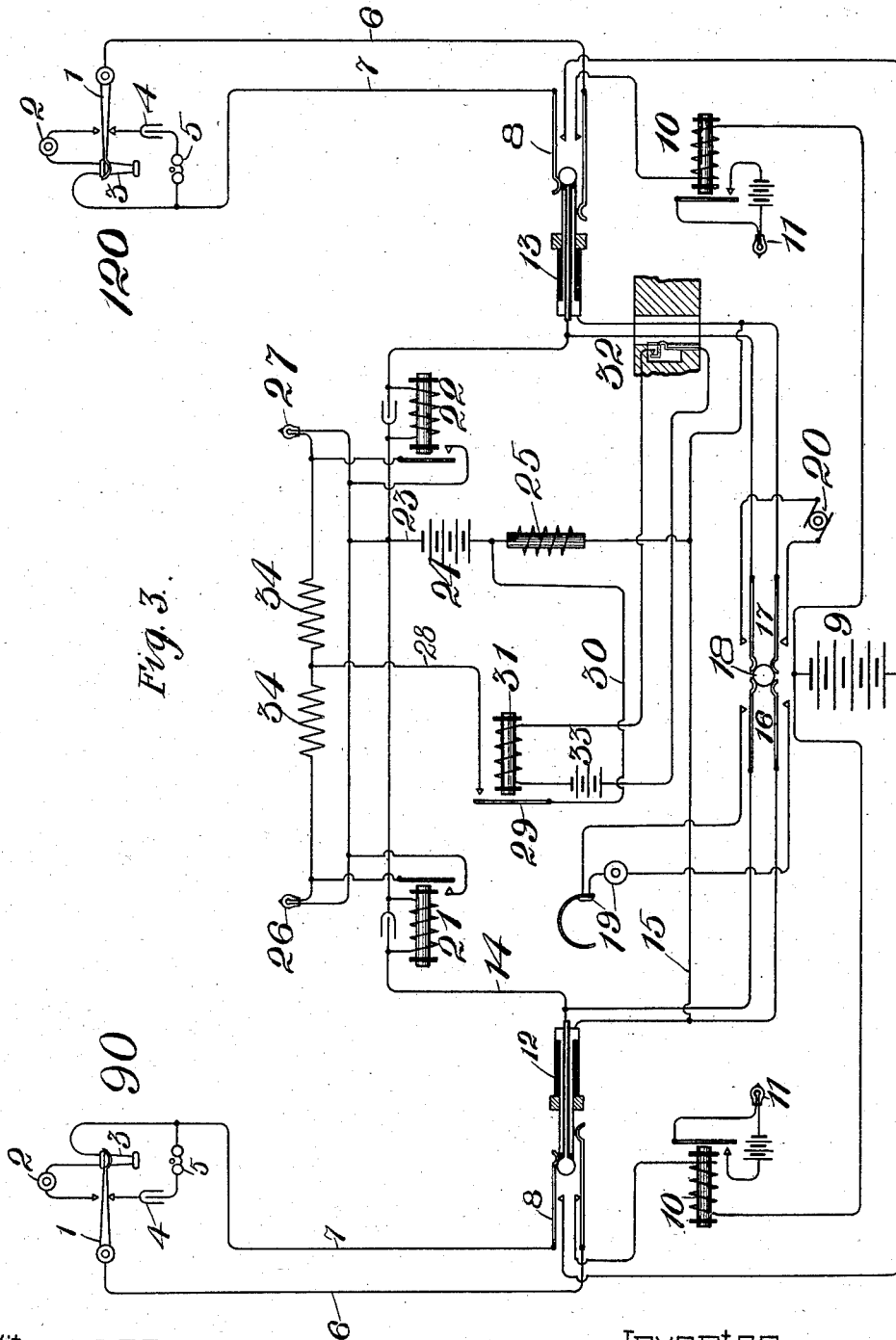


Fig. 3.

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UNITED STATES PATENT OFFICE.

GEORGE L. CRAGG, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF NEW YORK.

TELEPHONE-EXCHANGE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 743,457, dated November 10, 1903.

Application filed May 9, 1902. Serial No. 106,604. (No model.)

To all whom it may concern:

Be it known that I, GEORGE L. CRAGG, a citizen 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, 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.

My invention relates to telephone-exchange systems, and has for its object the provision of improved means whereby supervisory signals at the exchange may be employed to indicate the condition of use of connected lines, the invention relating particularly to common battery systems, for use in connection with which my improved apparatus has been designed.

My invention has for its object the provision of a system of supervisory signals wherein the circuit or circuits containing the signals may be made unresponsive to changes in the relations of plugs and spring-jacks employed in uniting the lines for conversation, whereby the switchboard-wiring may be simplified. Hitherto a supervisory signal has been associated with a connecting-plug in a telephone-switchboard in a circuit normally open at two points, registering contacts being provided in the plug and spring-jack adapted to close the circuit at one point, a relay controlling the break at the other point, the relay being connected with the circuits of the plug to respond to currents therein. Such a system as this requires the completion of the local circuit through the agency of a plug and a registering contact in the jack within which the plug is inserted. The plug and the engaged registering contact are included serially in the supervisory circuit with the contacts controlled by the relay and the clearing-out signal. This greatly complicates the wiring of the switchboard, it being necessary to extend the supervisory circuits to the spring-jacks. I am enabled to dispense with the extra wiring that is required with the prior type of supervisory signaling system mentioned by having the supervisory circuit or circuits controlled mainly by the subscriber,

the balance of the control being had by the operator through the agency of an operator's relay controlled by a switch or by a key, preferably arranged in association with the operator's listening-key, whereby a slight tap of the listening-key will serve to deenergize the relay to restore the signals after their presentation. The operator's relay serves, preferably, when energized to partially effect one of the changes in the supervisory signaling circuit or circuits that is required before a subscriber may effect a clearing-out signal. To this end the relay is preferably included in a circuit that is totally distinct from the cord-circuit, (though I do not wish to be limited to this arrangement in all embodiments of the invention.) The circuit including the relay is preferably a local circuit and may for the purpose of its control by the operator be governed by the listening and ringing keys in such a manner that when the operator signals a called subscriber the said local circuit will be established to energize the relay, and in disconnecting lines a slight tap of the listening-key will serve to open the local circuit, restoring the supervisory signals that have been actuated, the local circuit including the serial contacts that are governed by the listening-key and closed together when the said key is inactive or idle. In this embodiment of the invention there are thus provided two switches in the relay-circuit, one of which is closed when the ringing-key is actuated, while the other is opened when the listening-key is actuated. The operator thus effects one step in the operation of each of the supervisory signals, the remaining step being effected by each subscriber, there being preferably provided for this latter purpose a relay, one corresponding to each subscriber when double supervision is to be had, which relays are desirably included in the cord-circuit, which cord-circuit is preferably provided with a bridge that separates the relays to limit the control of each to the corresponding subscriber. This bridge is preferably included in circuit with a common battery. The supervisory signals are preferably in the form of small incandescent lamps included in local circuits, which preferably have a common side

that includes a source of signaling-current, as a battery, and the contacts governed by the operator, so that when the side that is common to the supervisory circuits is closed, as specified, the said supervisory circuits are placed in condition to be further regulated by the subscribers. For the purpose of effecting the subscribers' share of the control of the supervisory signals the said signals or incandescent lamps are each provided with a shunting-switch, the shunting-switches being controlled by the relays that are included in the cord-circuit. The system is such that when subscribers are connected for conversation the switch-hooks at the substations when relieved of the weight of the receivers will close circuit through the relays included in the cord-circuit, thereby operating the shunting-switches to shunt the incandescent lamps from the signaling-current in the supervisory circuits. When the subscribers have finished conversation, circuit through the relays controlled by the subscribers will be opened, the shunting-switches being thereby opened to remove the shunts from about the incandescent lamps, whereupon the signaling-current in the supervisory circuits may cause said lamps to glow. I do not wish to be limited to the employment of shunting-switches, however, as obviously other means may be employed in the relay mechanism controlled by the subscribers for effecting the subscribers' share of the control of the supervisory signals.

35 I will explain my invention more fully by reference to the accompanying drawings, in which—

Figure 1 is a diagrammatic view of a telephone-exchange system, showing an operator's relay controlled by the ringing and listening keys. Fig. 2 is a side elevation of an operator's combined listening and ringing key. Fig. 3 is a diagrammatic view of a telephone-exchange system, illustrating the control of the operator's relay by means of a plug-seat switch.

Like parts are indicated by similar characters of reference throughout the different figures.

50 Referring first more specifically to the apparatus disclosed in Figs. 1 to 3, inclusive, any suitable form of substation apparatus may be employed. There are illustrated in each of the diagrams Figs. 1 and 3 at each of the substations, which may be numbered 90 and 120, a telephone switch-hook 1, a transmitter 2, a receiver 3, a condenser 4, and a signal-bell 5, the switch-hook when depressed serving to include the signal-bell in circuit by way of the condenser, at the same time opening the circuit including the receiver and transmitter, and when elevated to close the circuit through the receiver and transmitter and open the circuit through the bell. The limbs 6 and 7 of the telephone-lines extend from the substations and are connected with the long and short line-springs, respectively,

of the spring-jacks 8. These line-springs are shown as being provided with back contacts that are engaged thereby when the jacks are free of plugs, so that the limbs 6 7 of the telephone-lines may be continued as signaling extensions containing a common battery 9, there being interposed between the battery 9 and each substation that may be thus connected therewith a line-electromagnet 10, controlling some suitable form of line-indicator 11. The plugs that are employed at the exchange may be of any suitable type. The plugs 12 and 13 illustrated may constitute, respectively, the answering and connecting plugs, the tips of the plugs being preferably connected by means of a tip-strand 14, while the sleeves of the plugs are connected by means of a sleeve-strand 15. The strands of the cord-circuit are connected with the springs 16 of a listening-key and the springs 17 of a ringing-key, there being preferably associated with these sets of springs 16 and 17 a common actuating-lever 18, which when moved in one direction may cut an operator's telephone-battery 19 into circuit with a calling subscriber and when moved in the other direction may cut a signaling-generator 20 into circuit with a called subscriber. One of the strands of the cord-circuit, as the tip-strand, preferably contains two supervisory signaling-magnets 21 22, corresponding to the calling and called subscribers, respectively, there being preferably included in shunt about each of these electromagnets a condenser whereby the impedance thereof is removed from the cord-circuit. The magnets 21 and 22 are adapted to be controlled by the subscribers, and in order that each magnet may be limited to the control of a single subscriber they are preferably electrically separated by means of a bridge conductor 23 uniting the cord-strands and containing a source of direct current 24 and an impedance-coil 25, which coil prevents the shunting of voice-currents. The particular disposition of the bridge conductor and impedance-coil therein, however, is a matter of detail and may be modified without departing from the spirit of my invention, as may also the association of the relays 21 and 22 with the cord-circuit.

The relays 21 and 22 are provided with armatures, as indicated, which armatures are preferably provided with front contacts, so that when the subscribers have their telephones off their switch-hooks the said armatures may be attracted to preferably shunt the supervisory signals 26 and 27 from circuit with the battery 24, which is adapted for association with the signals 26 and 27 in a manner to be hereinafter set forth. The signals 26 and 27, which are preferably small incandescent lamps, are included each in a circuit independent of the other, which circuit has a common side that comprises a conductor 28, an armature 29, and a conductor 30, together with a portion of the bridge-conductor intervening between the conductor 30 and the tip-

strand, which portion of the bridge-conductor contains the common battery 24. The conductor 28 terminates in a contact constituting a front contact for the armature 29, which contact is engaged with the armature 29 through the manipulation of the operator's apparatus. For this purpose the operator's relay 31 includes switching mechanism controlled by the operator, the circuit being closed through the relay 31 to complete the common side of the circuits containing the signals 26 and 27 to place these circuits in condition to be further controlled by the subscribers.

The form of operator's switching mechanism shown in Figs. 1 and 2 may be employed, wherein the listening and ringing keys are shown as being provided with a common actuating-lever 18, the spring 16 of the listening-key carrying a contact engaging a corresponding contact constituting a terminal of the conductor containing the helix of the relay 31, while a spring of the ringing-key 17 carries a contact which constitutes the other terminal of the helix 31, adapted when the ringing-key is actuated to engage a contact 32 to thereby include a battery 33 in circuit with the relay 31 by way of the contacts controlled by the listening-key when the said listening-key is in its normal position. In this manner circuit through the relay 31 may be closed to close the common side of the circuits containing the supervisory signals to render these signals further subject to the subscribers. When the subscribers are in conversation, the shunts of the lamps 26 and 27 will be closed, said lamps being then extinguished. When a subscriber restores his telephone, the circuit of the corresponding relay controlled by the subscriber is opened, the shunt about the corresponding signal-lamp being thereby removed to permit the lamp to glow by means of current furnished over the side that is common to both signaling-circuits, owing to the attraction of the armature 29. When both subscribers have restored their receivers, both signal-lamps are caused to glow or the supervisory signals are otherwise presented, whereupon the operator in effecting disconnection may restore the supervisory signals by a slight operation of the listening-key to open the local circuit containing the magnet 31.

By the arrangement indicated in Fig. 3 the operator's electromagnet 31 is preferably included in a circuit containing the contacts of a plug-seat switch 32, which may be engaged when the plug is removed from its seat to close the circuit. When the plug is restored to its seat, the contacts of the plug-seat switch are separated, thereby to open the circuit containing the operator's electromagnet 31 to restore the supervisory signals.

In Fig. 3 I have indicated the connecting-plug as being associated with a plug-seat switch, though I do not wish to be limited to the particular plug that may be selected.

I have shown the supervisory relays that are subject to the control of the subscribers

as being included directly in the same strand of the cord-circuit; but I do not wish to be limited to any particular association of the supervisory relays with the cord-circuit, as any means for securing their operation through the agency of the substation apparatus may be adopted without departing from the spirit of the invention.

For the purpose of effecting the proper division of current passing to the signal-lamps there may be provided an adjusting resistance 34 in each signal-circuit.

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

1. In a telephone-exchange system, the combination with telephone-lines extending from substations to an exchange, of cord connecting apparatus at the exchange for uniting subscribers for conversation, a relay included serially in the cord-circuit and adapted for operation by the substation apparatus, a supervisory signal partially controlled by the said relay, a second relay for completing the control of the supervisory signal, and means operating independently of the spring-jacks and plugs for controlling the continuity of the circuit including the second relay, substantially as described.

2. In a telephone-exchange system, a combination with telephone-lines extending from substations to an exchange, of cord connecting apparatus at the exchange for uniting subscribers for conversation, a relay included serially in the cord-circuit and controlled by apparatus at a substation, a supervisory signal partially controlled by the said relay, a second relay for completing the control of the supervisory signal, a local circuit including the second relay, and switching apparatus independent of the plugs and spring-jacks, said switching apparatus being included in said local circuit for effecting its control, substantially as described.

3. In a telephone-exchange system, the combination with telephone-lines extending from substations to an exchange, of cord connecting apparatus at the exchange for uniting subscribers for conversation, supervisory signals, one corresponding to each subscriber, supervisory relays, one for each supervisory signal, each controlled by the corresponding subscriber's apparatus independently of the other subscriber's apparatus, whereby a partial control of the supervisory relays may be effected, an operator's relay serving to complete the control of the supervisory signals, and means independent of spring-jacks and plugs controlled by the operator for governing the actuation of the operator's relay, substantially as described.

4. In a telephone-exchange system, the combination with telephone-lines extending from substations to an exchange, of cord connecting apparatus at the exchange for uniting subscribers for conversation, supervisory signals, one corresponding to each subscriber,

supervisory relays, one for each supervisory signal, each controlled by the corresponding subscriber's apparatus independently of the other subscriber's apparatus, whereby a partial control of the supervisory signals may be effected, an operator's relay serving to complete the control of the supervisory signals, a local circuit including the latter relay, and switching mechanism in the local circuit independent of the spring-jacks and connecting-plugs and controlled by the operator for governing the latter relay, substantially as described.

5. In a telephone-exchange system, the combination with telephone-lines extending from substations to an exchange, of cord connecting apparatus at the exchange for uniting subscribers for conversation, a relay included serially in the cord-circuit and adapted for operation by the substation apparatus, a supervisory signal partially controlled by said relay, a second relay for completing the control of the supervisory signal, and means operated independently of the spring-jacks and plugs for controlling the second relay, substantially as described.

6. In a telephone-exchange system, the combination with telephone-lines extending from substations to an exchange, of cord connecting apparatus at the exchange for uniting the subscribers for conversation, supervisory signals, one corresponding to each subscriber, supervisory relays, one for each supervisory signal, each controlled by the corresponding subscriber's apparatus independently of the other subscriber's apparatus, whereby a partial control of the supervisory signals may be effected, a common battery adapted for inclusion in circuit with the said relays by substation apparatus, and electromagnetic means operable exclusive of the spring-jacks and plugs whereby the operator may complete the control of the supervisory signals, substantially as described.

7. In a telephone-exchange system, the combination with telephone-lines extending from substations to an exchange, of cord connecting apparatus at the exchange for uniting the subscribers for conversation, a supervisory signal, a supervisory relay for the supervisory signal controlled by substation apparatus, whereby a partial control of the supervisory signal may be effected, a common battery adapted for inclusion in circuit with the said relay by substation apparatus, and electromagnetic means operable exclusive of the spring-jacks and plugs whereby an operator may complete the control of the supervisory signal, substantially as described.

8. In a telephone-exchange system, the combination with telephone-lines extending from substations to an exchange, of cord connecting apparatus at the exchange for uniting the subscribers for conversation, supervisory signals, one corresponding to each subscriber and each included in a local circuit, supervisory relays, one for each supervisory

signal, each controlled by corresponding subscriber's apparatus independently of the other subscriber's apparatus, whereby a partial control of the corresponding signal-circuit may be effected, a common battery adapted for inclusion in circuit with the said relays by substation apparatus, and electromagnetic means operating exclusive of the spring-jacks and plugs whereby the operator may complete the control of the supervisory-signal circuits, substantially as described.

9. In a telephone-exchange system, the combination with telephone-lines extending from substations to an exchange, of cord connecting apparatus at the exchange for uniting the subscribers for conversation, a supervisory signal, a local circuit therefor, a supervisory relay for the supervisory signal and partially controlling its circuit, said relay being controlled by the substation apparatus, a common battery adapted for inclusion in circuit with the said relay by substation apparatus, and electromagnetic means operable exclusive of the spring-jacks and plugs whereby an operator may complete the control of the supervisory-signal circuit, substantially as described.

10. In a telephone-exchange system, the combination with telephone-lines extending from substations to an exchange, of cord connecting apparatus at the exchange for uniting the subscribers for conversation, supervisory signals, one corresponding to each subscriber and each included in a local circuit, supervisory relays, one for each supervisory signal, each controlled by the corresponding subscriber's apparatus independently of the other subscriber's apparatus, whereby a partial control of the corresponding signal-circuit may be effected, a common battery adapted for inclusion in circuit with the said relays by substation apparatus, electromagnetic means operable exclusive of the spring-jacks and plugs, whereby the operator may complete the control of the supervisory-signal circuits, and an operator's make-and-break switch included in a local circuit with said electromagnetic means, substantially as described.

11. In a telephone-exchange system, the combination with telephone-lines extending from substations to an exchange, of cord connecting apparatus at the exchange for uniting the subscribers for conversation, a supervisory signal, a local circuit therefor, a supervisory relay for the supervisory signal and partially controlling its circuit, said relay being controlled by the substation apparatus, a common battery adapted for inclusion in circuit with the said relay by substation apparatus, and electromagnetic means operable exclusive of the spring-jacks and plugs whereby an operator may complete the control of the supervisory-signal circuit, the said means including a make-and-break switch in the signal-circuit, substantially as described.

12. In a telephone-exchange system, the

combination with a telephone-line extending from substations to an exchange, of cord connecting apparatus at the exchange for uniting the subscribers for conversation, supervisory signals, one corresponding to each subscriber, a local circuit including said supervisory signals, supervisory relays, one for each supervisory signal, each controlled by corresponding subscriber's apparatus independently of the other subscriber's apparatus, whereby a partial control of the corresponding signal-circuit may be effected, a common battery adapted for inclusion in circuit with the said relays by substation apparatus, and electromagnetic switching means controlled by the operator independently of the plugs and spring-jacks for connecting said common battery with the local circuit including the supervisory signals, whereby the operator may complete the control of said signals, substantially as described.

13. In a telephone-exchange system, the combination with a telephone-line extending from substations to an exchange, of cord connecting apparatus at the exchange for uniting the subscribers for conversation, supervisory signals, one corresponding to each subscriber, a local circuit including said supervisory signals, supervisory relays, one for each supervisory signal, each controlled by corresponding subscriber's apparatus independently of the other subscriber's apparatus, whereby a partial control of the corresponding signal-circuit may be effected, a common battery adapted for inclusion in circuit with the said relays by substation apparatus, and electromagnetic means associated with the operator's listening and ringing keys and operated thereby for connecting said common battery with the local circuit including said supervisory signals, substantially as described.

14. In a telephone system, the combination with telephone-lines extending from substations to an exchange, of cord connecting apparatus at the exchange for uniting subscribers for conversation, supervisory signals, one corresponding to each subscriber, a supervisory relay for each supervisory signal, each relay controlled by the corresponding subscriber's apparatus independently of the other subscriber's apparatus, whereby a partial control of the supervisory signals may be effected, an operator's relay serving to complete the control of the supervisory signals, a local circuit including the operator's relay, and switching contacts included in said local circuit and associated with the operator's listening and ringing keys for controlling the continuity of said local circuit including said operator's relay, substantially as described.

15. In a telephone-exchange system, the combination with telephone-lines extending from substations to an exchange, of cord connecting apparatus at the exchange for unit-

ing subscribers for conversation, a supervisory signal, a local circuit therefor, a supervisory relay for the supervisory signal for partially controlling its circuit, said relay being controlled by the substation apparatus, a common battery adapted for inclusion in circuit with the said relay by substation apparatus, and electromagnetic means controlled by the operator independently of the plugs and spring-jacks for connecting said common battery with said local circuit including said supervisory signals, whereby the operator may complete the control of said signals, substantially as described.

16. In a telephone-exchange system, the combination with telephone-lines extending from substations to an exchange, of cord connecting apparatus at the exchange for uniting the subscribers for conversation, supervisory signals, a local circuit independent of spring-jacks or plugs including said supervisory signals, supervisory relays, one for each supervisory signal included serially in the cord-circuit and adapted for operation by the substation apparatus, whereby a partial control of the supervisory signals may be effected, a battery for providing said local circuit with current, an additional local circuit including said battery, and switching means, independent of spring-jacks, included in said additional local circuit for controlling the continuity thereof, whereby to complete the control of the local circuit including the supervisory signals, substantially as described.

17. In a telephone-exchange system, the combination with telephone-lines extending from substations to an exchange, of cord connecting apparatus at the exchange, for uniting the subscribers for conversation, supervisory signals, a local circuit independent of spring-jacks and plugs, serially including said supervisory signals, supervisory relays, one for each supervisory signal, included serially in the cord-circuit and adapted for operation by the substation apparatus, whereby said supervisory relays may be partially controlled, a battery for supplying current to said local circuit including the supervisory signals, an additional local circuit independent of spring-jacks and plugs including said battery, and switching means included in said additional local circuit, independent of spring-jacks, for controlling the continuity of said additional local circuit, whereby the operator may complete the control of the supervisory signals, substantially as described.

In witness whereof I hereunto subscribe my name this 7th day of May, A. D. 1902.

GEORGE L. CRAGG.

Witnesses:

FLORENCE WICKLIN,
JOHN STAHR.