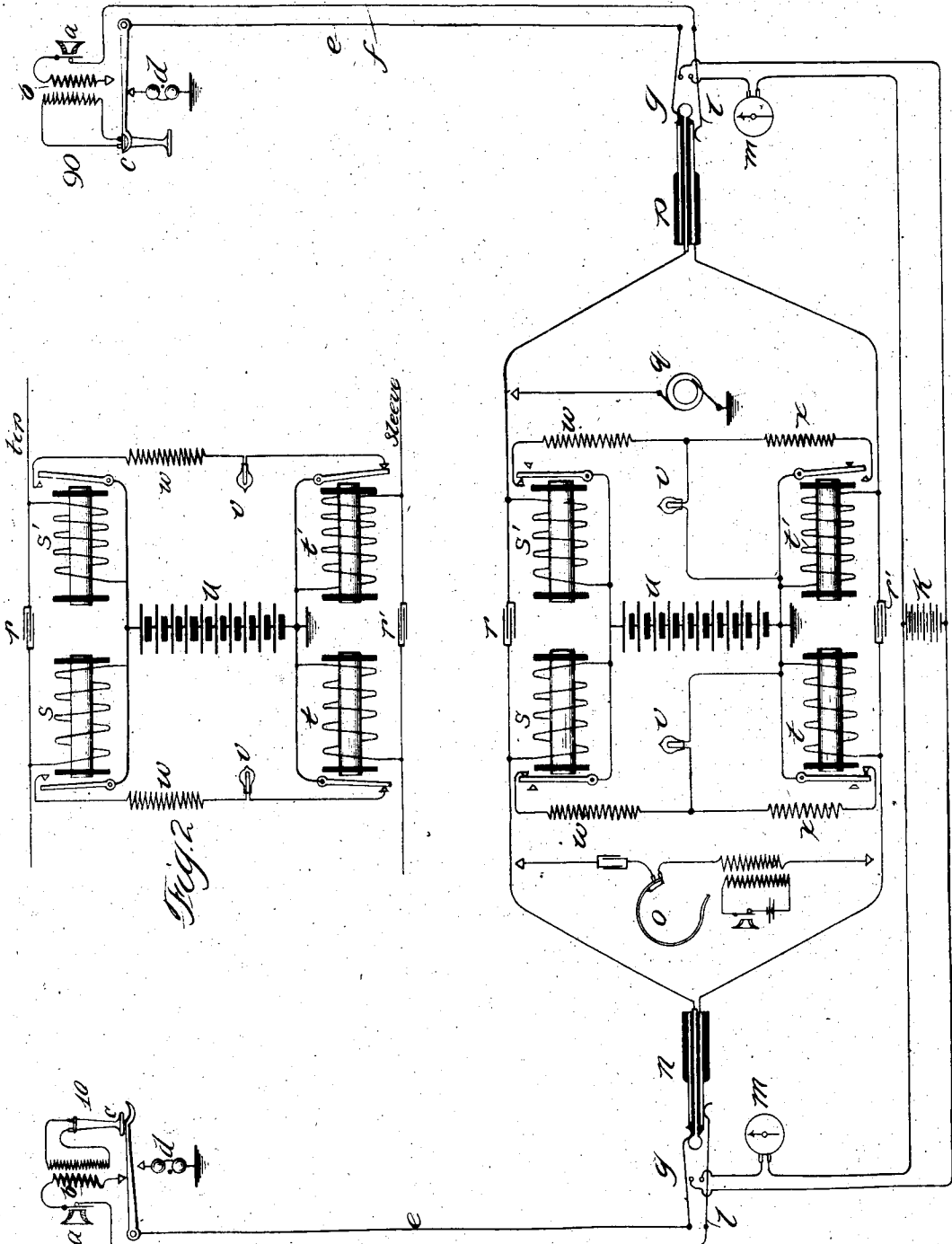


N. C. SCHELLENGER.
TELEPHONE EXCHANGE SYSTEM.
APPLICATION FILED FEB. 14, 1901.

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Patented May 9, 1911.



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UNITED STATES PATENT OFFICE.

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TELEPHONE-EXCHANGE SYSTEM.

991,654.

Specification of Letters Patent.

Patented May 9, 1911.

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To all whom it may concern:

Be it known that I, NEWTON C. SCHELLENGER, 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 supervisory and clearing-out signaling apparatus.

One object of my invention is to provide an improved supervisory signaling apparatus, which may be employed in connection with the cord circuits having but two strands. In accordance with my invention, I employ two indicators, preferably in the form of incandescent lamps, which, through the agency of electro-magnetic apparatus intervening between the same and the subscribers' stations, are adapted to indicate the condition of use of the calling and called subscribers' lines, respectively.

In practicing my invention, I employ two relays associated with each supervisory or clearing-out signal. A relay associated with each supervisory signal is operated through the agency of the switch hook at the corresponding station when the said switch hook supports the receiver at its station to effect the operation of said signal. When the switch hook is relieved of the weight of the receiver, the second relay is operated to restore the signal. I preferably employ at each subscriber's station a grounded bell of low resistance, say 200 ohms, which, when included in circuit with the corresponding telephone switch hook, when the latter is depressed by the supported receiver, serves to close circuit through a grounded common battery at the exchange, the first of the aforesaid relays being adapted for inclusion in this circuit. The armature of the relay thereupon serves to close circuit through the corresponding supervisory signal to effect its operation. The second relay associated with each supervisory signal is connected in bridge of the cord circuit and preferably in the same bridge and in series connection with its companion relay, so that when the

telephone switch is elevated, circuit may be closed through the said relays and the common battery in circuit therewith, by which arrangement the first relay has its condition of operation unchanged, while the second relay has its condition of use changed to restore the associated supervisory signal to its normal condition. The second relay may be employed either to shunt the associated supervisory signal or to open the circuit in which it is included; or the supervisory signal may be otherwise restored through the agency of the second relay. By these means I am enabled to retain the two sets of two relays each in bridge of the cord circuit, whereby the requisite impedance may be secured, while at the same time the operation of the supervisory signals may be secured through the agency of these relays without impairing their function as impedance devices.

I will explain my invention more fully by reference to the accompanying drawing, illustrating two embodiments thereof, in which—

Figure 1 is a diagrammatic view illustrating telephone substations united for conversation through a cord circuit constructed in accordance with the invention; and Fig. 2 a diagrammatic illustration of a modification of the cord circuit illustrated in Fig. 1.

Like parts are indicated by similar characters of reference in both views.

The apparatus at the substations 10 and 90 constitutes the preferred apparatus used in practicing my invention. A battery transmitter *a*, with its primary coil *b* and receiver *c*, is illustrated at each of these stations, a secondary coil being included in this instance in a local circuit with the telephone receiver thereat, while the primary coil in circuit with the transmitter is placed in circuit 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 at the station 10 is thus shown in series with the telephone line, the telephone receiver at this station being removed from its hook. This station may, for example, illustrate the station of a calling subscriber. The transmitter circuit at station 90, which may illustrate a called subscriber's station, is open, the receiver at said station being

upon its hook. There is also provided at each substation a call bell *d*, preferably responsive to alternating current, which I prefer to include in a grounded branch that is closed when the telephone receiver at that station is upon its hook. Each call bell *d* is preferably of low resistance, say 200 ohms. Other substation apparatus may be equipped, however, without departing from the spirit of my invention. Metallic circuit telephone lines extend from the substations to an exchange, the limbs *e* and *f* of which metallic lines extend to spring jacks *g g* at the exchange. A battery *k* is connected in bridge between the sides of idle telephone lines. The limb *f* of each line terminates in a spring lever *l* normally resting against a contact constituting a terminal of a line indicator, *m*, the other terminal of the line indicator being connected with one terminal of the said battery, while the remaining terminal of the battery is connected with the back contact of the remaining spring lever of the spring jack.

A subscriber, in initiating a call, closes circuit of the battery *k* through the line indicator, the springs and back contacts of the spring jack. The operator, in response to this signal, inserts the answering plug *n* within the jack of the calling subscriber and by means of a well known listening key includes her telephone set *o* in circuit with the calling subscriber's telephone set. Ascertaining that this subscriber desires communication with subscriber No. 90, she inserts the connecting plug *p*, the mate to plug *n*, within the line jack of the called subscriber, and by means of a well known ringing key includes the grounded generator *q* in circuit with the tip strand of the connecting plug, the limb *e* of a called subscriber's telephone line and his grounded bell *d*. The tip and sleeve strands of the cord circuit include condensers *r, r'*. Relays *s, s'* are included in series with each other and in shunt of the condenser *r*. The relays *t, t'* are correspondingly included in series with each other and together in a shunt connection about the condenser *r'*. A common battery *u* has one terminal connected between the relays *s, s'*, and the other terminal connected between the relays *t, t'*. By this arrangement the common battery *u* may feed current to each substation for the transmitter thereat, independently of the other, this result being effected by its connection with the relays, owing to the fact that condensers *r* and *r'* prevent passage of straight current across the cord circuit where these condensers are located. In order to prevent voice currents from being shunted through the connections including the common battery *u*, the shunt conductors, including the relays *s, s'* and *t, t'*, are provided with sufficient impedance or inductance. This inductance is prefer-

ably due to the windings of the relays. The advantages of such a method of distributing battery current to the transmitters at the subscribers' stations are well known to those skilled in the art. The relays *s, s'* each preferably has its armature provided with an alternate contact that constitutes one terminal of a local circuit, the other terminal of the said local circuit preferably comprising the armature. This local circuit includes a suitable form of supervisory signal, preferably in the form of an incandescent lamp *v* and also the common battery *u*. The said common battery may be, for example, a twenty-four volt battery, while the indicators *v, v* may be twelve volt lamps. To cut the current including the common battery and indicators down, I include resistance coils *w, w* in the local circuits that may be of, say, eighty-four ohms. Each of the relays *s, s', t, t'*, may be wound to, say, eighty-five ohms. The common battery *u* is grounded at the point where it is connected between the relays *t* and *t'*, so that when the telephone switch hooks are depressed by the receivers placed thereon, circuit is closed through the relays *s, s'*, or either of these relays, as the case may be, according to the position of the switch hooks, to close the said local circuit, or both of them, and effect a corresponding operation of the supervisory signals. The relays *t, t'* may, as illustrated in Fig. 1, have their armatures and alternate contacts included in shunt connections about the supervisory signals, resistance coils *x, x*, wound preferably to forty ohms, being included in these shunt connections. When the telephone switch hooks are elevated, these relays *t, t'* are energized and the said shunt circuits are established about the supervisory signals.

The general operation of the preferred form of my invention is substantially as follows: Upon insertion of the answering plug in the calling subscriber's jack, a practically permanently closed circuit is formed which includes the winding of one of the relays by means of which inclusion the said relay serves to place the supervisory lamp associated therewith in an operative condition; that is, it serves to place the signal lamp in a closed circuit with a source of current. The said closed circuit including the relay is established or maintained irrespective of the operative position of the switchhook at the calling subscriber's station. It will be seen that when the receiver is upon the switch hook and the said switch hook is depressed, current will flow from the battery *u* through the relay *s*, the limb *e* of the circuit, the signal bell *d* to ground, one terminal of the battery *u* being grounded. When the receiver is removed from the switch hook so that the switch hook is in its raised condition, it will be seen that current

still flows through the relay *s*, circuit through the same being traced from one terminal of the battery *u* through the relay *s*, limb *e* of the circuit, switch hook, secondary coil *b*, transmitter *a*, limb *f* of the subscriber's circuit, relay *t*, back to the other pole of the battery *u*.

It is of course possible to provide other circuit connections than those specifically shown herein for establishing a closed circuit through a relay, and I do not wish to limit myself to a closed circuit in which the subscriber's line and the switch hook form a part.

A closed circuit through the relay *s*, after being once established, is, as has been stated, maintained irrespective of the operative position of substation apparatus, and for this reason other means should be provided to render the supervisory signal inert and to effect a change in the operative condition of the supervisory signal when a change in the operative condition of substation apparatus takes place. This said means is preferably in the form of the second relay *t* which is directly under the control of substation apparatus. The specific means employed, in this instance, preferably has a shunt circuit including the resistance *x* that is shunted about the supervisory signal *v* when the same is to be rendered inert.

The arrangement illustrated in Fig. 2 may be adopted as an alternative. In this arrangement the relays *s*, *s'* are preferably in the same circuit relation with the cord circuit as illustrated in Fig. 1, as are also the relays *t*, *t'*. In order to cut out the supervisory signals *v*, *v*, they are illustrated in Fig. 2 as being included in normally open local circuit conductors in which conductors the normal contacts of the relays *t*, *t'* and the engaging armatures are included. When the relays *t*, *t'*, illustrated in Fig. 2, are operated, a circuit through the supervisory signals *v*, *v* is opened, so that these signals are restored to the normal condition, whereby the same result is secured as in shunting the said signals. Circuit including the supervisory relays *s* and *t* is at once established upon the insertion of the answering plug within the calling subscriber's jack, as the said calling subscriber has his telephone removed from its hook. The corresponding signal *v* upon the left of the cord circuit is not actuated, as said signal is either shunted or has its circuit opened, according to the arrangement of Fig. 1 or of Fig. 2. The called subscriber's supervisory signal *v* upon the right of the cord circuit, however, is at once actuated, because initially the circuit including the bridge connection, including the relays *s'* and *t'* is not established, the grounded battery *u* being alone included in a grounded circuit with the relay *s'* and the grounded bell *d* at the called subscriber's

station. When the called subscriber responds by removing his telephone from its switch hook, the bridge connection including the relays *s'* and *t'* and the battery *u* is established, so that although the circuit through the corresponding signal *v* may be partially completed by the relay *s'*, it is either shunted because of the attraction of the armature of relay *t'*, in the arrangement illustrated in Fig. 1, or is cut out of circuit, owing to the attraction of the corresponding relay illustrated in Fig. 2. When the called subscriber's signal *v* is thus restored to its normal condition, the operator knows that he has responded and that the subscribers are in conversation. When both subscribers restore their receivers the relays *s* and *s'* are alone included in grounded circuits with the battery *u* and the call bells *d*, *d*, the relays *t*, *t'* being out of circuit, so that the supervisory signals *v*, *v* are both actuated or caused to glow, positively indicating to the operator that both subscribers have finished conversation, and that disconnection between the same may be effected. Obviously, when either subscriber restores his receiver, whether the other does or not, the supervisory signal corresponding to his line is caused to operate. The relays at each end of the cord circuit are preferably included in series with respect to each other in the same bridge strand across the cord circuit. I do not wish to be limited, however, to the particular arrangement of the bridge or branch conductors connected with the side of the cord circuit or to the relative arrangement of the relays at each end of the cord circuit, as other means may be employed for including the relays in circuit and for overcoming the impedance due thereto.

It will be observed that I have provided two pairs of relays in bridge of the cord circuit, a condenser being included in each strand of the cord circuit between the connections of the relays. The source of current is also grounded, whereby in one condition of use of the substation apparatus one relay will serve to place the corresponding supervisory signal in one condition of use and both relays of each pair included in multiple, cooperating, will place the said supervisory signal in another condition of use.

It is obvious that other modifications of my invention may be devised, without departing from the spirit thereof, and I do not, therefore, wish to be limited to the precise disclosure of the invention herein set forth; but

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, each of

said substations being provided with a telephone switch hook for supporting the receiver thereat, of a common battery at the exchange, supervisory signals located at the exchange, corresponding to calling and called subscriber's stations, supervisory relays at the exchange, one for each of the supervisory signals, means whereby the switch hooks at the subscribers' stations are adapted to operate each of said relays independently of the other to actuate the corresponding indicator, a second supervisory relay associated with each supervisory signal adapted through the agency of the switch hooks to restore the supervisory signals each independently of the other, and means whereby the latter relays are both actuated independently of each other by the said switch hooks, substantially as described.

2. In a telephone exchange system, the combination with telephone lines extending from subscribers' stations to an exchange, of a grounded signal bell at each subscriber's station, a switch hook at each subscriber's station adapted to connect the grounded bell with the side of the telephone line to which the switch hook is connected, a grounded common battery at the exchange, supervisory relays having terminals connected to the same side of the telephone line, a condenser between the said terminals, said grounded common battery having one terminal included between the remaining terminals of the said supervisory relays, whereby the said battery may be included in circuit with each supervisory relay independently of the other through the agency of the corresponding switch hooks at the subscribers' stations, a supervisory signal associated with each relay and adapted to be operated thereby, two additional supervisory relays having terminals of each connected together, the remaining terminal of the said common battery being connected to both the said terminals while the remaining terminals of the additional supervisory relays are connected with the remaining limbs of the telephone lines, a condenser included between the latter terminals of the additional supervisory relays, and means whereby when the said additional supervisory relays are both or either included in circuit with both limbs of the telephone line upon the release of the corresponding telephone switch hooks the supervisory signals are restored, substantially as described.

3. The combination with telephone lines extending from subscribers' stations to an exchange, of a cord circuit at the exchange provided with two strands for forming connections between two telephone lines, a condenser in each of said strands, two supervisory signals, one for each substation, four relays for the cord circuit, two in shunt of one condenser and two in shunt of the other,

a source of current, and a conductor having connection between the relays included in shunt of each condenser, whereby the relays corresponding to one end and the other end of the cord circuit may be operated through the agency of the corresponding switch hooks at the connected subscribers' stations, the armatures of the relays at each end of the cord circuit having contacts and connections for governing the operation of the corresponding supervisory signal jointly, substantially as described.

4. The combination with telephone lines extending from subscribers' stations to an exchange, of a cord circuit at the exchange provided with two strands for forming connections between two telephone lines, a pair of relays corresponding to each end of the cord circuit and included in bridge thereof, a source of current for inclusion in circuit with each of said pairs of relays, and a supervisory signal for each pair of relays and jointly controlled thereby through the agency of the substation apparatus, substantially as described.

5. The combination with telephone lines extending from subscribers' stations to an exchange, of a cord circuit at the exchange provided with two strands for forming connections between two telephone lines, a pair of relays corresponding to each end of the cord circuit and included in bridge thereof, a source of current for inclusion in circuit with each of said pairs of relays, a supervisory signal for each pair of relays and jointly controlled thereby through the agency of the substation apparatus, and a condenser included in each cord strand between the connections of the relays therewith, substantially as described.

6. The combination with telephone lines extending from subscribers' stations to an exchange, of a cord circuit at the exchange provided with two strands for forming connections between two telephone lines, a condenser in each of said strands, two supervisory signals, one for each substation, four relays for the cord circuit, two in shunt of one condenser and two in shunt of the other, a source of current, a conductor having connection between the relays included in shunt of each condenser, whereby the relays corresponding to one end and the other end of the cord circuit may be operated through the agency of the corresponding switch hooks at the connected subscribers' stations, the armatures of the relays at each end of the cord circuit having contacts and connections for governing the operation of the corresponding supervisory signals jointly, the said source of current being grounded, and a ground connection for each telephone line to include the said source of current in a grounded circuit, one relay of each pair that is controlled by a subscriber's station apparatus

ratus being included in the corresponding grounded circuit containing the ground connection and the ground at the source of current, whereby one relay of each of these latter pairs may place the supervisory signal in one condition of use and both relays co-operating place the supervisory signal in another condition of use, substantially as described.

7. The combination with telephone lines extending from subscribers' stations to an exchange, of a cord circuit at the exchange provided with two strands for forming connections between two telephone lines, a pair of relays corresponding to each end of the cord circuit and included in bridge thereof, a source of current for inclusion in circuit with each of said pairs of relays, a supervisory signal for each pair of relays and jointly controlled thereby through the agency of the substation apparatus, the said source of current being grounded, and a ground connection for each telephone line to include the said source of current in a grounded circuit, one relay of each pair that is controlled by a subscriber's station apparatus being included in the corresponding grounded circuit containing the ground connection and the ground at the source of current, whereby one relay of each of these latter pairs may place the supervisory signal in one condition of use and both relays co-operating place the supervisory signal in another condition of use, substantially as described.

8. The combination with telephone lines extending from subscribers' stations to an exchange, of a cord circuit at the exchange provided with two strands for forming connections between two telephone lines, a pair of relays corresponding to each end of the cord circuit and included in bridge thereof, a source of current for inclusion in circuit with each of said pairs of relays, a supervisory signal for each pair of relays and jointly controlled thereby through the agency of the substation apparatus, a condenser included in each cord strand between the connections of the relays therewith, the said source of current being grounded, and a ground connection for each telephone line to include the said source of current in a grounded circuit, one relay of each pair that is controlled by a subscriber's station apparatus being included in the corresponding grounded circuit containing the ground connection and the ground at the source of current, whereby one relay of each of these latter pairs may place the supervisory signal in one condition of use and both relays co-operating place the supervisory signal in another condition of use, substantially as described.

9. The combination with a telephone substation provided with a receiver, a transmitter and a switch hook, of a magnet adapted for inclusion in the circuit, a branch con-

ductor connected with the cord circuit including the said magnet, a source of current adapted for inclusion in circuit with the magnet winding through the agency of the switch hook, the armature of the said magnet being provided with a contact and engaged thereby upon a change in the operative condition of the said magnet, a supplemental electromagnet, means for effecting its inclusion in circuit with its source of current and with the switch hook at the substation independently of the aforesaid electromagnet, and a signal co-operatively associated with said magnets, its circuit including the aforesaid armature and its contact, substantially as described.

10. The combination with telephone lines extending from subscribers' stations to an exchange, of a cord circuit at the exchange provided with two strands for forming connections between two telephone lines, a pair of relays corresponding to each end of the cord circuit and included in bridge thereof, a source of current for inclusion in circuit with each of said pairs of relays, a supervisory signal for each pair of relays and jointly controlled thereby, and switching apparatus for controlling the operation of the relays, substantially as described.

11. The combination with telephone lines extending from subscribers' stations to an exchange, of a cord circuit at the exchange provided with two strands for forming connections between two telephone lines, a pair of relays corresponding to each end of the cord circuit and included in bridge thereof, a source of current for inclusion in circuit with each of said pairs of relays, a supervisory signal for each pair of relays and jointly controlled thereby, switching apparatus for controlling the operation of the relays, and a condenser included in each cord strand between the connections of the relays therewith, substantially as described.

12. The combination with telephone lines extending from subscribers' stations to an exchange, of a cord circuit at the exchange provided with two strands for forming connections between two telephone lines, a pair of relays corresponding to each end of the cord circuit and included in bridge thereof, a source of current for inclusion in circuit with each of said pairs of relays, a supervisory signal for each pair of relays and jointly controlled thereby, the said source of current being grounded, and a ground connection for each telephone line to include the said source of current in a grounded circuit, one relay of each pair being included in the corresponding grounded circuit containing the ground connection and the ground at the source of current, whereby one relay of each of these latter pairs may place the supervisory signal in one condition of use and both relays co-operating place the super-

visory signal in another condition of use, substantially as described.

13. The combination with telephone lines extending from subscribers' stations to an exchange, of a cord circuit at the exchange provided with two strands for forming connections between two telephone lines, a pair of relays corresponding to each end of the cord circuit and included in bridge thereof, a source of current for inclusion in circuit with each of said pairs of relays, a supervisory signal for each pair of relays and jointly controlled thereby, switching mechanism for controlling the operation of the relays, a condenser included in each cord strand between the connections of the relays therewith, the said source of current being grounded, and a ground connection for each telephone line to include the said source of current in a grounded circuit, one relay of each pair that is controlled by a subscriber's station apparatus being included in the corresponding grounded circuit containing the ground connection and the ground at the source of current, whereby one relay of each of these latter pairs may place the supervisory signal in one condition of use and both relays coöperating place the supervisory signal in another condition of use, substantially as described.

14. In a telephone system, the combination with subscribers' lines extending from substations to an exchange, of a cord circuit at the exchange for interconnecting subscribers' lines, a pair of relays corresponding to each end of the cord circuit and included in branch of the cord circuit, a supervisory signal associated with each pair of relays and jointly controlled thereby, means at the substation for effecting operation of the corresponding signal through the agency of one of the said relays of the pair associated with said signal, and means whereby the operative condition of the remaining relay of each pair is independent of the operative condition of substation apparatus, substantially as described.

15. In a telephone system, the combination with subscribers' lines extending from substations to jacks at an exchange, of a cord circuit at the exchange for interconnecting subscribers' lines, a relay associated with said cord circuit, means including a jack and a cord circuit plug inserted in the jack for establishing a closed circuit through said relay, which is independent of the operative position of substation apparatus, a second relay also associated with said cord circuit, means whereby the latter relay is responsive to changes in operative position of substation apparatus, said relays being serially included in a bridge across the said cord circuit, a source of current for energizing said relays, means forming a circuit for the flow of current from said source in series

through said relays to the telephone substation and a supervisory signal jointly controlled by said relays, substantially as described.

16. In a telephone system, the combination with subscribers' lines extending from substations to jacks at an exchange, of a cord circuit at the exchange for interconnecting subscribers' lines, a relay associated with said cord circuit, means including a jack and a cord circuit plug inserted in the jack for establishing a closed circuit through said relay, which is independent of the operative position of substation apparatus, a second relay also associated with said cord circuit, means whereby the latter relay is responsive to changes in operative position of substation apparatus, a source of current for energizing said relays, said relays and said source of current being serially included in a bridge across said cord circuit, and a supervisory signal jointly controlled by said relays, substantially as described.

17. In a telephone system, the combination with subscribers' lines extending from substations to jacks at an exchange, of a cord circuit at the exchange, supervisory signals located at the exchange corresponding to calling and called subscribers' stations, relays at the exchange, one for each of the supervisory signals, means whereby changes in operative position of substation apparatus are adapted to operate each of said relays independently of the other, a second supervisory relay associated with each supervisory signal and included, with each of said aforesaid relays, in branch of the cord circuit, means including a jack and a cord circuit plug inserted in the jack for establishing a closed circuit through each of the latter relays, which circuit is independent of the operative position of substation apparatus, a source of current for said relays, and means whereby the armatures of the aforesaid relays are adapted jointly to control the supervisory signals associated therewith, substantially as described.

18. In a telephone system, the combination with subscribers' lines extending from substations to jacks at an exchange, of a cord circuit at the exchange, supervisory signals located at the exchange corresponding to calling and called subscribers' stations, relays at the exchange, one for each of the supervisory signals, means whereby changes in operative position of substation apparatus are adapted to operate each of said relays independently of the other, a second supervisory relay associated with each supervisory signal and included, with each of said aforesaid relays, in branch of the cord circuit, means including a jack and a cord circuit plug inserted in the jack for establishing a closed circuit through each of the latter relays, which is independent of the

operative position of substation apparatus, a source of current for said relays, means whereby the armatures of the last aforesaid relays are adapted when attracted to complete circuit through the corresponding supervisory signals, and means whereby the armatures of the first aforesaid relays when attracted are adapted to render said signals inert, substantially as described.

10 19. In a telephone system, the combination with subscribers' lines extending from substations to jacks at an exchange, of a cord circuit at the exchange, supervisory signals located at the exchange corresponding to calling and called subscribers' stations, relays at the exchange, one for each of the supervisory signals, condensers interposed between opposite ends of said cord circuit whereby changes in operative position of substation apparatus are adapted to operate each of said relays independently of the other, a second supervisory relay associated with each supervisory signal and included with each of said aforesaid relays in branch of the cord circuit, means including a jack and a cord circuit plug inserted in the jack for establishing a closed circuit through each of the latter relays, which circuit is independent of the operative position of substation apparatus when said cord circuit is associated with a subscriber's line, a source of current for said relays, and means whereby the armatures of the aforesaid relays are adapted jointly to control the supervisory signals associated therewith, substantially as described.

20. The combination with telephone lines extending from substations to jacks at an exchange, of a cord circuit at the exchange provided with two strands for forming connections between subscribers' lines, a pair of relays corresponding to each end of the cord circuit and included in bridge thereof, a source of current for energizing the said relays, a supervisory signal for each pair of relays and jointly controlled thereby, switching mechanism at the substations for controlling the operation of one of each pair of relays, means including a jack and a cord circuit plug inserted in the jack, whereby a closed circuit is established through the remaining relay of each pair which is independent of the operative position of the substation apparatus, and a condenser included in each cord strand between the connections of the relays therewith, substantially as described.

21. The combination with telephone lines extending from substations to jacks at an exchange, of a cord circuit at the exchange provided with two strands for forming connections between subscribers' lines, a pair of electromagnets corresponding to each end of the cord circuit and included in bridge thereof, a source of current for energizing

the said electromagnets and included in the same bridge therewith, a supervisory signal for each pair of electromagnets, armatures and contacts for said electromagnets, means whereby one of said armatures of each pair when actuated is adapted to complete circuit through the supervisory signal associated therewith, means whereby the remaining armature when actuated is adapted to render said signal inert, switching mechanism at the substations for controlling the operation of one of each pair of electromagnets, means including a jack and a cord circuit plug inserted in the jack, whereby a closed circuit is established through the remaining electromagnet of each pair which is independent of the operative position of the substation apparatus, and a condenser included in each cord strand between the connections of the electromagnets therewith, substantially as described.

22. The combination with a telephone line extending from a telephone substation to a jack at an exchange, said substation having a receiver, a transmitter and a switch hook, of a magnet adapted for inclusion in the circuit, a source of current adapted for inclusion in circuit with the magnet winding through the agency of the switch hook, a supplemental electromagnet in a circuit conveying all of the current supplied to the substation transmitter, a cord circuit including a plug for connecting a telephone line with another, a circuit including the supplemental electromagnet substantially permanently closed by the plug of the cord circuit and the jack engaging the said plug, and a signal jointly controlled by said electromagnets, the said electromagnets being included in branch of the cord circuit, substantially as described.

23. The combination with telephone lines extending from substations to jacks at an exchange, each of the said substations being provided with a receiver, a transmitter and a switch hook, of cord connecting apparatus terminating in answering and connecting plugs for uniting subscribers for conversation, two electro-magnets, one corresponding to each end of the cord circuit, circuits for the said electro-magnets each substantially constantly closed by the corresponding cord circuit plug and jack engaging the same, an additional electro-magnet included, with each of said aforesaid electro-magnets, in branch of the cord circuit, said additional electro-magnets being included in circuits controlled by the switch hooks at the substations, and two indicators each jointly controlled by said electro-magnets included in branch of the cord circuit, substantially as described.

24. The combination with telephone lines extending from substations to jacks at an exchange, each of the said substations being

provided with a receiver, a transmitter and a switch hook, of cord connecting apparatus terminating in answering and connecting plugs, for uniting subscribers for conversation, two electromagnets, one corresponding to each end of the cord circuit, circuits for the said electromagnets each substantially constantly closed by the corresponding cord circuit plug and jack engaging the same, additional electromagnets included in circuits controlled by the switch hooks at the substations, two indicators each jointly controlled by a magnet thus included in closed circuit and a corresponding magnet controlled by a switch hook, the said magnets being thus divided into pairs connected in branch of the cord circuit, each end of the cord circuit having a pair of magnets associated therewith, and a condenser in each cord strand between the connections of the electromagnets with the cord strands, substantially as described.

25. The combination with telephone lines extending from substations to jacks at an exchange, each of the said substations being provided with a receiver, a transmitter and a switch hook, of cord connecting apparatus terminating in answering and connecting plugs, for uniting subscribers for conversation, two electromagnets, one corresponding to each end of the cord circuit, circuits for the said electromagnets each substantially constantly closed by the corresponding cord circuit plug and jack engaging the same, additional electromagnets included in circuits controlled by the switch hooks at the substations, two indicators each jointly controlled by a magnet thus included in closed circuit and a corresponding magnet controlled by a switch hook, the said magnets being thus divided into pairs, each end of the cord circuit having a pair of magnets associated therewith, said pair of magnets comprising one magnet included in closed circuit and the other included in a circuit controlled by the corresponding switch hook, a condenser in each cord strand between the connections of the electromagnets with the cord strands, and bridge connections including the said electromagnets, substantially as described.

26. The combination with telephone lines extending from substations to jacks at an exchange, each of the said substations being provided with a receiver, a transmitter and a switch hook, of cord connecting apparatus terminating in answering and connecting plugs, for uniting subscribers for conversation, two electromagnets, one corresponding to each end of the cord circuit, circuits for the said electromagnets each substantially constantly closed by the corresponding cord circuit plug and jack engaging the same, additional electromagnets included in circuits controlled by the switch hooks at the sub-

stations, two indicators each jointly controlled by a magnet thus included in closed circuit and a corresponding magnet controlled by a switch hook, the said magnets being thus divided into pairs, each end of the cord circuit having a pair of magnets associated therewith, said pair of magnets comprising one magnet included in closed circuit and the other included in a circuit controlled by the corresponding switch hook, a condenser in each cord strand between the connections of the electromagnets with the cord strands, and two bridge connections across the cord circuit, each including a pair of electromagnets.

27. In a telephone exchange system, the combination with telephone lines extending from substations to an exchange, each of said substations being provided with a telephone switch hook for supporting the receiver thereat, of a common battery at the exchange, supervisory signals located at the exchange corresponding to calling and called subscribers' stations, supervisory relays at the exchange, one for each of the supervisory signals, bridge conductors including said relays, means whereby the switch hooks at the subscribers' stations are adapted to operate each of said relays independently of the other, a second supervisory relay associated with each supervisory signal for restoring the supervisory signals, bridge conductors for the second supervisory relays, and means whereby circuit through each of said latter relays may be closed independently of the other and independently of the operative position of the corresponding switch hooks, substantially as described.

28. In a telephone exchange system, the combination with telephone lines extending from substations to an exchange, each of said substations being provided with a telephone switch hook for supporting the receiver thereat, of a common battery at the exchange, supervisory signals located at the exchange corresponding to calling and called subscribers' stations, supervisory relays at the exchange, one for each of the supervisory signals, means whereby the switch hooks at the subscribers' stations are adapted to operate each of said relays independently of the other, a second supervisory relay associated with each supervisory signal for restoring the supervisory signals, bridge conductors for the second supervisory relays, and means whereby circuit through each of said latter relays may be closed independently of the other and independently of the operative position of the corresponding switch hooks, substantially as described.

29. The combination with telephone lines extending from subscribers' stations to an exchange, of a cord circuit at the exchange provided with two strands for forming connections between two telephone lines, a pair

of relays corresponding to each end of the cord circuit and included in bridge thereof, a source of current for inclusion in circuit with each of said pairs of relays, switching apparatus for controlling the operation of said relays, and a supervisory signaling lamp for each pair of relays, each supervisory signaling lamp being included in a local circuit serially including a contact controlled by each relay of a pair, substantially as described.

30. In a telephone system, the combination with subscribers' lines extending from substations to jacks at an exchange, of a cord circuit comprising two talking strands at the exchange for interconnecting subscribers' lines, a relay associated with said cord circuit, means including a jack and a cord circuit plug inserted in the jack for establishing a closed circuit through said relay which is independent of the operative position of substation apparatus, a second relay also associated with said cord circuit, means whereby the latter relay is responsive to changes in the operative position of substation apparatus, said relays being included in a bridge across the telephone line, a source of current for energizing said relays, means closing a circuit for the flow of current in series through said relays and a supervisory signaling lamp in a local circuit serially including contacts controlled by said relays, substantially as described.

31. In a telephone system, the combination with subscribers' lines extending from substations to jacks at an exchange, of a cord circuit at the exchange for interconnecting subscribers' lines, a relay associated with said cord circuit, means including a jack and a cord circuit plug inserted in the jack for establishing a closed circuit through said relay which is independent of the operative position of substation apparatus, a second relay also associated with said cord circuit, means whereby the latter relay is responsive to changes in the operative position of substation apparatus, a source of current for energizing said relays, said relays and said source of current being serially included in a bridge across said cord circuit, an armature for each of said relays, and a supervisory signaling lamp in a local circuit adapted to be closed when the armature of said first relay is in its attracted position and when the armature of said second relay is in its unattracted position, substantially as described.

32. In a telephone system, the combination of substations having grounded bells, a central station having line connections with said substations, a cord circuit with a condenser in each strand thereof, supervisory signals associated with the cord circuit, means for supplying current bridged across the cord circuit and connected with the cord

circuit strands at points each side of said condensers, impedance relays interposed between said supply and said strands, and a connection for grounding said source of current supply, whereby both the bells at the substations and the supervisory signals at the central station are brought into action by the closing of grounded circuits between the substations and the central station, substantially as described.

33. The combination with a telephone line, of a source of electricity and a pair of relays energized thereby adapted to be bridged between the limbs of the talking circuit thereof, a switch at the substation and a switch at the central station for controlling the circuit through said relays, and a signal adapted to be controlled by the conjoint action of said relays, substantially as described.

34. The combination with a pair of telephone lines, of an inductive device through which the same are adapted to be united for conversation, a charging source of electricity and a pair of relays adapted to be bridged between the two limbs of each of said lines, one pair of relays being individual to one of said lines and the other pair being individual to the other line, switches at the substations, and at the central station for controlling the circuit through said relays, and a signal controlled by the conjoint action of each pair of relays, substantially as described.

35. The combination with a metallic telephone line, of an operator's plug and a cord circuit, a source of current and a pair of relays bridged across said circuit, a third conductor connected with one pole of said source, one of said relays being adapted to be operated over the metallic line when the subscriber's telephone is in use, and the other to be operated by current supplied from said source over a part of the line and said third conductor when the subscriber's telephone is not in use and the operator's plug is connected with the line, substantially as described.

36. In a telephone system, the combination with a telephone line of a source of current and a relay bridged between the two limbs of the talking circuit thereof, a second relay at the central office deriving energizing current from said bridged source of current over a path including a portion of one side of the talking circuit individual to said line, a switch at the substation for controlling the circuit through the first relay, a switch at the central station for controlling the circuit through both relays, and a signal controlled by the conjoint action of said relays, substantially as described.

37. The combination with a metallic telephone line free from permanent grounds outside the central office, of a substation hav-

ing a telephone transmitter connected with said line, a third conductor, a pair of relays at the central office, a source of current supplying current through said pair of relays to the substation transmitter, one of said relays being energized over the telephone line and the other being adapted for energization over a portion of the talking circuit and the third conductor, substantially as described.

38. The combination with a metallic telephone line, of a pair of relays and the charging current source bridged across the line at the central station, a third conductor to which one pole of the current source is connected, both of said relays being adapted to be operated over the metallic telephone line and one of said relays being adapted to be operated over a portion of said line and the third conductor, substantially as described.

39. The combination with a telephone line, of a charging source of electricity in a bridge between the limbs thereof, a pair of electromagnetically independent electromagnetic windings included in said bridge, one on each side of said source of electricity and both energized thereby, and a signaling device rendered inert by the passage of current through both of said windings and adapted to be actuated by the passage of current through one of said windings, substantially as described.

40. The combination with a telephone line, of a charging source of electricity bridged between the limbs thereof, a pair of electromagnetic windings included in said bridge, one on each side of said source of electricity, and through which the whole of the energizing current is supplied to the telephone line during conversation, and a signaling device rendered inert by the passage of current through both of said windings, and adapted to be actuated by the passage of current through one of said windings, substantially as described.

41. The combination with a telephone line, of a charging source of electricity in a bridge between the limbs thereof, a pair of electromagnetic windings included in said bridge, one on each side of said source of electricity and both included in the path of current supplied to the telephone line, the said electromagnetic windings furnishing impedance to said bridge across the limbs of the telephone line, and a signaling device rendered inert by the passage of current through both of said windings and adapted to be actuated by the passage of current through one of said windings, substantially as described.

42. The combination with a telephone line, of a charging source of electricity bridged between the limbs thereof, a pair of electromagnetically independent electromagnetic windings included in said bridge, one on

each side of said source of electricity, and through which the whole of the energizing current is supplied to the telephone line during conversation, and a signaling device rendered inert by the passage of current through both of said windings and adapted to be actuated by the passage of current through one of said windings, substantially as described.

43. The combination with a telephone line, of a charging source of electricity bridged between the limbs thereof, a pair of electromagnetic windings included in said bridge, one on each side of said source of electricity, the said electromagnetic windings furnishing impedance to said bridge and furnishing the sole path for the supply of energizing current to the telephone line for purposes of voice transmission, and a signaling device rendered inert by the passage of current through both of said windings and adapted to be actuated by the passage of current through one of said windings, substantially as described.

44. In a telephone system, the combination with subscribers' lines having connection terminals and line signaling devices at the central office, of a cord circuit to establish connections between the lines for conversation, said cord circuit having a strand in each side of the talking circuit, means for inductively connecting, but conductively separating, the two ends of the cord circuit, means at the central office for supplying current to the lines for conversation, electromagnetically independent supervisory relay windings connected in series with said means for supplying current and between said cord strands and upon each side of said inductive means, a normally inoperative supervisory signal for each end of the cord circuit controlled respectively by the said windings on the same side of the inductive means, the excitation of one of the said windings on each side of the inductive means causing the operation of the corresponding signal, and the simultaneous excitation of the associated winding causing the said signal to become inoperative, substantially as described.

45. In a telephone system, the combination with subscribers' lines having connection terminals and line signaling devices at the central office, of a cord circuit to establish connections between the lines for conversation, said cord circuit having a strand in each side of the talking circuit, means for inductively connecting and conductively separating the two ends of the cord circuit, means at the central office for supplying current to the lines for conversation, supervisory relay windings connected in series with said means for supplying current and between said cord strands and upon each side of the said inductive means, and

constituting the sole path for the supply of current to the telephone lines for conversation, a normally inoperative supervisory signal for each end of the cord circuit controlled respectively by the said windings on the same side of the inductive means, the excitation of one of said windings on each side of the inductive means causing the operation of the corresponding signal, and the simultaneous excitation of the associated winding causing said signal to become inoperative, substantially as described.

46. In a telephone system, the combination with subscribers' lines having connection terminals and line signaling devices at the central office, of a cord circuit to establish connections between the lines for conversation, said cord circuit having a strand in each side of the talking circuit, means for inductively connecting and conductively separating the two ends of the cord circuit, means at the central office for supplying current to the lines for conversation, supervisory relay windings connected in series with said means for supplying current and between said cord strands and upon each side of the said inductive means, and supplying inductive resistance between said cord strands, a normally inoperative supervisory signal for each end of the cord circuit controlled respectively by the said windings on the same side of the inductive means, the excitation of one of said windings on each side of the inductive means causing the operation of the corresponding signal, and the simultaneous excitation of the associated winding causing said signal to become inoperative.

47. In a telephone system, the combination with subscribers' lines having connection terminals and line signaling devices at the central office, of a cord circuit to establish connections between the lines for conversation, said cord circuit having a strand in each side of the talking circuit, means for inductively connecting and conductively separating the two ends of the cord circuit, means at the central office for supplying current to the lines for conversation, electromagnetically independent supervisory relay windings connected in series with said means for supplying current, and between said cord strands and upon each side of the said inductive means, and constituting the sole path for the supply of talking current from said supply means to the associated subscriber's line, a normally inoperative supervisory signal for each end of the cord circuit controlled respectively by the said windings on the same side of the inductive means, the excitation of one of the said windings on each side of the inductive means causing the operation of the corresponding signal and the simultaneous excitation of the associated winding, causing

the said signal to become inoperative, substantially as described.

48. In a telephone system, the combination with a telephone line, of a pair of electromagnetically independent relay windings and a source of current supplying current through said relay windings in a bridge between the two limbs of the talking circuit thereof, a switch at the substation and a switch at the central station for controlling the circuits through said relay windings, and a signal controlled by the conjoint energization of said relay windings, substantially as described.

49. In a telephone system, the combination with a telephone line, of a source of current and a pair of relay windings bridged between the two limbs of the talking circuit thereof, and through which all of the current is supplied to the telephone line during conversation, a switch at the substation and a switch at the central station for controlling the circuits through said relay windings, and a signal controlled by the conjoint energization of said relay windings, substantially as described.

50. In a telephone system, the combination with a telephone line, of a pair of relay windings constituting an inductive resistance and a source of current delivering current through said relay windings in a bridge between the two limbs of the talking circuit thereof, a switch at the substation and a switch at the central station for controlling the circuits through said relay windings, and a signal controlled by the conjoint energization of said relay windings, substantially as described.

51. In a telephone system the combination with a telephone line, of a source of current and an electromagnetic winding bridged between the two limbs of the talking circuit thereof, a second electromagnetic winding connected in a circuit including a portion of one side of the talking circuit, and means for energizing it, the current for conversational purposes being supplied to said line wholly through said electromagnetic windings, a switch at the substation, and a switch at the central station for controlling the circuits through said electromagnetic windings, and a supervisory signal controlled by the joint action of said electromagnetic windings, substantially as described.

52. The combination with a metallic telephone line free from permanent grounds outside the central office, of a cord circuit, a charging current source, a third conductor, a pair of relay windings associated with the cord circuit, one of said windings being energized over the telephone line and the other over a portion of the talking circuit, and the third conductor, the said relay windings constituting the sole path for the

supply of current to the telephone line during its connection for conversation, and a signal controlled by the conjoint action of said relay windings, substantially as described.

53. The combination with a telephone line, of a charging source of electricity and a pair of electromagnetically independent relay windings connected in a bridge between the limbs of the talking circuit thereof and conveying current from said charging source to said telephone line, a switch at the central station for controlling the circuit through said relay windings, and a signal adapted to be controlled by the conjoint action of said windings, substantially as described.

54. In a telephone system, the combination with a cord circuit having two talking strands, of a source of electricity and a pair of relay windings adapted to be bridged between the two talking strands of the cord circuit, a telephone line connected with said cord circuit and free from any source of current supply other than that through the said relay windings and cord circuit strands, a switch at the central station for controlling the circuit through said relay windings, and a signal adapted to be controlled by the conjoint action of said windings, substantially as described.

55. The combination with a telephone line, of a charging source of electricity and a pair of relay windings connected in a bridge between the limbs of the talking circuit thereof, the said relay windings furnishing inductive resistance to the bridge circuit and supplying talking current to the telephone line, a switch at the central station for controlling the circuit through said relay windings, and a signal adapted to be controlled by the conjoint action of said windings, substantially as described.

56. In a telephone exchange system, a plurality of bi-metallic telephone lines extending from substations to a central office, a pair of link conductors at the central office for connecting the two limbs of one line with the two limbs of another line for conversation, a source of current at the central office, a pair of electromagnetically independent electromagnet windings through which current is fed from said source through said link conductors to supply current for conversational purposes to a telephone line, and signaling mechanism actuated by said electromagnet windings.

57. In a telephone exchange system, a telephone line extending from a substation to a central office, a pair of link conductors at the central office for connecting said line with another for conversation, a source of current at the central office, a pair of electromagnet windings through which current

is fed from said source through said link conductors to said telephone line, the said electromagnet windings being relatively disposed to introduce impedance into the circuit through which current is fed to the telephone line, and a clearing out device actuated by the magnetic effects of said electromagnet windings.

58. In a telephone exchange system, a telephone line extending from a substation to a central office, a source of current at the central office, a pair of electromagnetically independent electromagnet windings constituting the sole path for the supply of talking current to said telephone line, and signaling mechanism adapted to assume either of two conditions as determined solely by the magnetic effects of said electromagnet windings.

59. In a telephone exchange system, a telephone line extending from a substation to the central office, a source of current at the central office, a pair of electromagnet windings constituting the sole path for the supply of talking current to said telephone line, an armature for each of said electromagnet windings, each armature being actuated solely by the magnetic effect of the associated electromagnet winding.

60. In a telephone exchange system, a telephone line extending from a substation to a central office, a source of current at the central office, a pair of electromagnet windings constituting the sole path for the supply of talking current to said telephone line, a separate armature for each of said electromagnet windings, each armature being controlled solely by the magnetic effect of the associated electromagnet winding and signaling mechanism jointly controlled by said armatures.

61. In a telephone exchange system, a telephone line extending from a substation to the central office, a source of current at the central office, a pair of electromagnet windings constituting the sole path for the supply of talking current to said telephone line, an armature responsive to the magnetic effect of each electromagnet winding, but unresponsive to the magnetic effect of the other electromagnet winding.

62. In a telephone system, in combination, a calling telephone line and a called telephone line each extending from a substation to a central office, a spring-jack for each line, a cord circuit having an answering plug and a calling plug connecting said lines, a pair of relays and a source of current in a bridge across the talking circuit of the called line, one of said relays being actuated solely by current flowing over a circuit closed by the insertion of the calling plug into the jack of the called line, and the other actuated upon the response of the called subscriber,

and a signal controlled by the joint action of said relays.

63. In a telephone system, in combination, a pair of voice-current conductors, a condenser in each conductor, two pairs of relays and a source of current in bridge between said conductors, one bridge on either side of said condensers, a central office switch in the circuit of one relay of each pair, a substation switch in the circuit of the other relay of each pair, and signaling mechanism controlled by the magnetic effects of said relays.

64. In a telephone system, in combination, a pair of voice-current conductors, a condenser in each conductor, two pairs of electromagnets and a source of current in bridge between said conductors, a central office switch in the circuit of one electromagnet of each pair, a substation switch in the circuit of the other electromagnet of each pair, and switching mechanism controlled by said electromagnets.

65. In a telephone system, in combination, a pair of voice-current conductors, a condenser in each conductor, a pair of electromagnet windings and a source of current in a bridge between said conductors, a central office switch in the circuit of one electromagnet winding, a substation switch in the circuit of the other electromagnet winding, and switching apparatus controlled by said electromagnet windings.

66. In a telephone exchange system, the combination of a calling telephone line and a called telephone line, each extending from a substation to a central office, a cord circuit comprising a pair of voice-current conductors for connecting said lines for conversation, a condenser in each voice-current conductor, two pairs of electromagnet windings and a source of current in a bridge between said conductors, one pair on each side of said condensers, contacts of an answering plug in the circuit of one electromagnet winding of one pair, a calling substation switch in the circuit of the other electromagnet winding of said pair, contacts of a calling plug in the circuit of one electromagnet winding of the other pair, a called substation switch in the circuit of the other electromagnet winding of the second pair, and switching mechanism controlled by each electromagnet winding.

67. In a telephone exchange system, the combination of a calling telephone line and a called telephone line, each extending from a substation to a central office, each free from permanent grounds outside the central office, a cord circuit comprising a pair of voice-current conductors for connecting said lines for conversation, a condenser in each voice-current conductor, a charging current source, a third conductor, two pairs of relays at the central office, one relay of one pair being energized over the calling tele-

phone line, and the other relay of said pair being energized over a portion of the talking circuit of the calling line and said third conductor, and one relay of the other pair being energized over the called telephone line, and the other relay of said second pair being energized over a portion of the talking circuit of the called line and said third conductor.

68. In a telephone system, a calling and a called subscribers' station, a pair of voice-current conductors connecting said stations, inductive means included in each of said voice-current conductors, a pair of relays and a charging current source in a bridge across the conductors leading from the called station, an operator's switch and a subscriber's switch for controlling said relays, and a signal jointly controlled by said relays.

69. The combination with a pair of telephone lines, of an inductive device through which the same are adapted to be united for conversation, a charging source of electricity and a pair of relays adapted to be bridged between the two limbs of each of said lines, one pair of relays being individual to one of said lines and the other pair being individual to the other line, switches at the substations and at the central station for controlling the circuit through said relays, and a signal controlled by the conjoint action of each pair of relays, substantially as described.

70. The combination with telephone lines extending from subscribers' stations to an exchange, of a cord circuit at the exchange provided with two strands for forming connections between two telephone lines, a pair of relays corresponding to each end of the cord circuit and included in bridge thereof, a source of current for inclusion in circuit with each of said pairs of relays, a supervisory signal for each pair of relays and jointly controlled thereby, switching apparatus for controlling the operation of the relays, and a condenser included in each cord strand between the connections of the relays therewith.

71. The combination with telephone lines extending from substations to jacks at an exchange, of a cord circuit at the exchange provided with two strands for forming connections between subscribers' lines, a pair of relays corresponding to each end of the cord circuit and included in bridge thereof, a source of current for energizing said relays, a supervisory signal for each pair of relays and jointly controlled thereby, switching mechanism at the substations for controlling the operation of one of each pair of relays, means including a jack and a cord circuit plug inserted in the jack, whereby a closed circuit is established through the remaining

relay of each pair which is independent of the operative position of the substation apparatus, and a condenser included in each cord strand between the connections of the relays therewith.

72. In a telephone system, the combination with a telephone line, of branch conductors including a signaling device normally connected with the limbs of said line at the central office, cord circuit strands for extending the limbs of said line, means for severing the said branch conductors when the cord strands are connected with the line, a pair of relays and a source of current in a bridge between the cord circuit strands, and a signal controlled by the conjoint action of said relays.

73. In a telephone system, the combination with a telephone line, of a source of current normally connected in a bridge of the limbs of said line at the central office, a cord circuit having two voice-current conductors adapted to be connected with the conductors of the line, cut-off contacts for the line adapted to sever the circuit of said normal bridge when the cord is connected with the line, a pair of relays for the cord circuit, a third conductor, one of said relays being actuated over the telephone line and the other over a portion of the talking circuit and said third conductor, and a signal controlled by the conjoint action of said relays.

74. In a telephone system, the combination with a telephone line, of a line signaling device and a battery in circuit with the limbs of the line, a cord circuit for connection with the line, means operative upon the connection of the cord with the line for opening the circuit of said battery and signaling device, a pair of relays bridged across the cord circuit and adapted to furnish the path for current to the limbs of the line for transmitter energization, and a signal controlled by the conjoint action of said relays.

75. In a telephone system, the combination with a telephone line, of a source of current and a signal controlling device normally connected between the limbs of the telephone line a cord circuit and plug for connection with the line, means operative upon the connection of the plug with the line for opening the circuit of said signal controlling device and entirely severing the normal connection of said source from the limbs of the line, a pair of relays in a bridge of the cord circuit, one of said relays being actuated over the line and being under the control of the subscriber, and the other over a portion of the talking circuit and being under the control of the central office operator, and a signal controlled by the conjoint action of said relays.

76. In a telephone exchange system, a bi-metallic telephone line extending from a substation to a central office, a line signal associ-

ated with the line at the central office, a pair of link conductors at the central office for connecting the two limbs of said line with another for conversation, a source of current at the central office, a pair of electromagnetically independent electromagnet windings through which current is fed from said source through said link conductors to supply current for conversational purposes to said telephone line, signaling mechanism actuated by said electromagnet windings and means for retiring the line signal upon the connection of the link conductors with the limbs of the telephone line.

77. The combination with a metallic telephone line, of a line signal for said line, an operator's plug and a cord circuit for connection with said line, a source of current and a pair of relays in a bridge across said cord circuit, a third conductor connected with one pole of said source, one of said relays being adapted to be operated over the metallic line when the subscriber's telephone is in use, and the other to be operated by current supplied from said source over a part of the line and said third conductor when the subscriber's telephone is not in use and the operator's plug is connected with the line, and means whereby the connection of the operator's plug with the line retires said line signal, substantially as described.

78. The combination with a telephone line, of a cord circuit for connection therewith, a source of electricity and a pair of relays permanently bridged between the limbs of the talking circuit of said cord circuit, a switch at the substation and a switch at the central station for controlling the circuit through said relays, and a signal adapted to be controlled by the conjoint action of said relays.

79. The combination with a metallic telephone line free from permanent grounds outside the central office, of a charging current source, a third conductor, a pair of relays at the central office each permanently connected with said source, one of said relays being energized over the telephone line and the other over a portion of the talking circuit and the third conductor.

80. The combination with a metallic telephone line, of an operator's plug and a cord circuit, a source of current and a pair of relays permanently bridged across said cord circuit, a third conductor connected with one pole of said source, one of said relays being adapted to be operated over the metallic line when the subscriber's telephone is in use, and the other to be operated over a part of the line and said third conductor when the subscriber's line is not in use and the operator's plug is connected with the line.

81. The combination with a metallic telephone line free from permanent grounds outside the central office, of a charging cur-

rent source, a third conductor, a pair of relays at the central office, one of said relays being energized by current supplied solely from said charging current source over the telephone line, and the other being energized by current supplied solely from the same charging current source over a portion of the talking circuit and the third conductor.

82. In a telephone system, the combination with a telephone line, of a source of electricity at the central office, an operator's plug, and a pair of relays permanently connected with said source of electricity and associated with said plug, one of said relays being energized from the said source of electricity as long as the said operator's plug is connected with said line and over a path having a part coincident with the talking circuit, and the other relay being energized as long as the said operator's plug is connected with the said line and when the subscriber's telephone is in use, and a signal associated with said pair of relays, the circuit of said signal being established by the operation of the first of said relays, and said

signal being rendered inoperative by the operation of the second of said relays.

83. In a telephone system, an operator's cord circuit, a pair of relays permanently connected together and each operated over circuits including portions of the talking circuit, and a supervisory signal having its circuit controlled by the contacts of both said relays, one of said relays being adapted to normally close the circuit and to be energized over the telephone line when the line is in use, whereby the signal is at that time rendered inert and the other relay being adapted to normally open the circuit, whereby when the cord circuit is not connected with the line the signal is inert, and when connected with a line not in use the signal is displayed.

In witness whereof, I hereunto subscribe my name this eleventh day of February A. D., 1901.

NEWTON C. SCHELLENGER.

Witnesses:

HARVEY L. HANSON,
GEORGE L. CRAGG.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."