

No. 827,787.

PATENTED AUG. 7, 1906.

E. R. CORWIN.
TELEPHONE SYSTEM.
APPLICATION FILED DEC. 15, 1904.

2 SHEETS—SHEET 1.

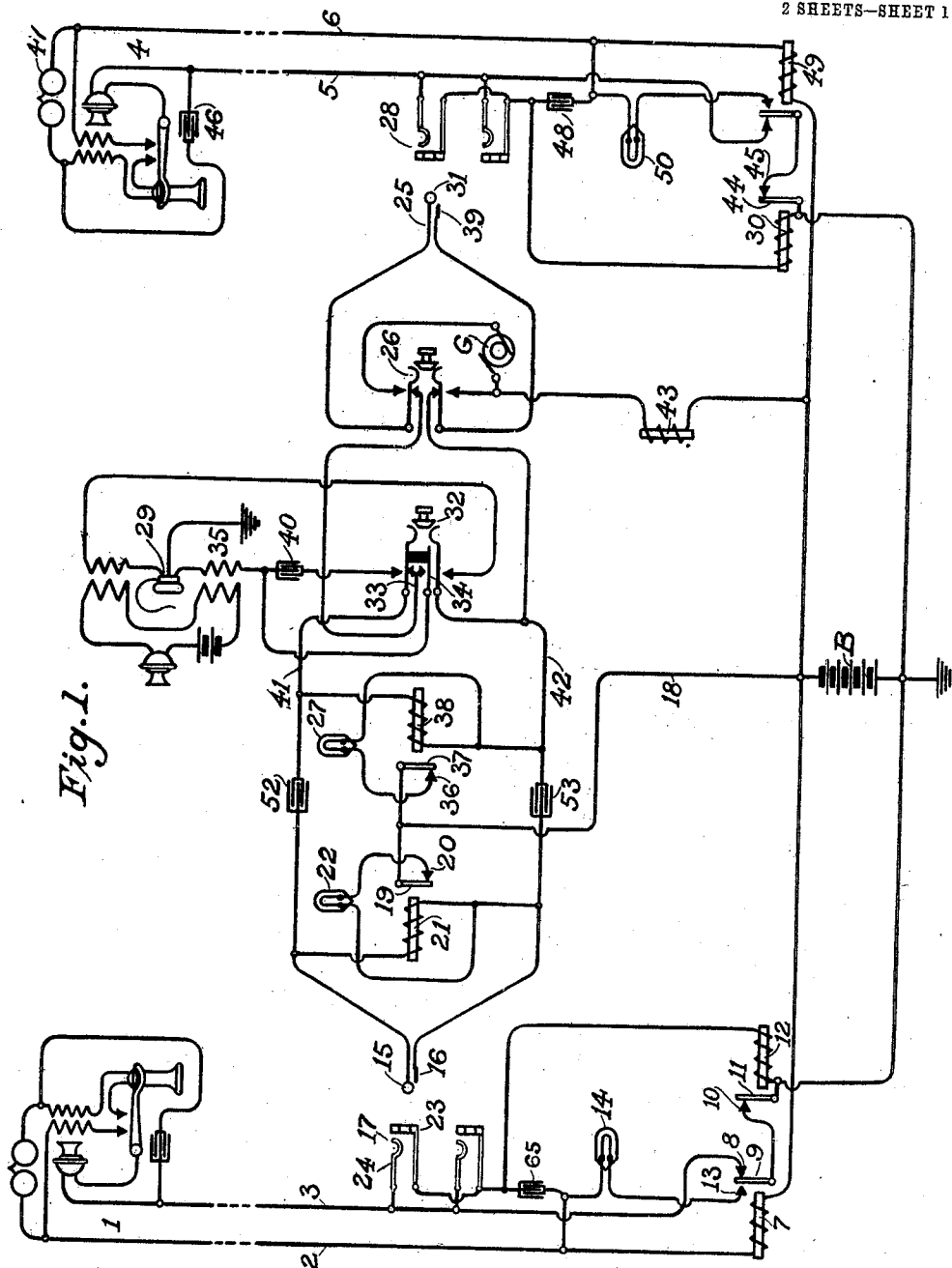


Fig. 1.

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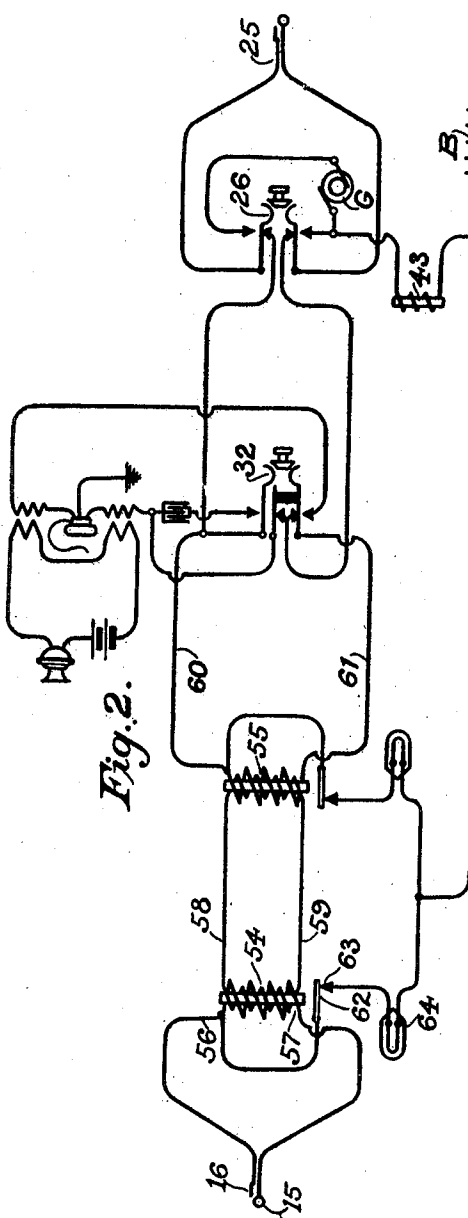


Fig. 2.

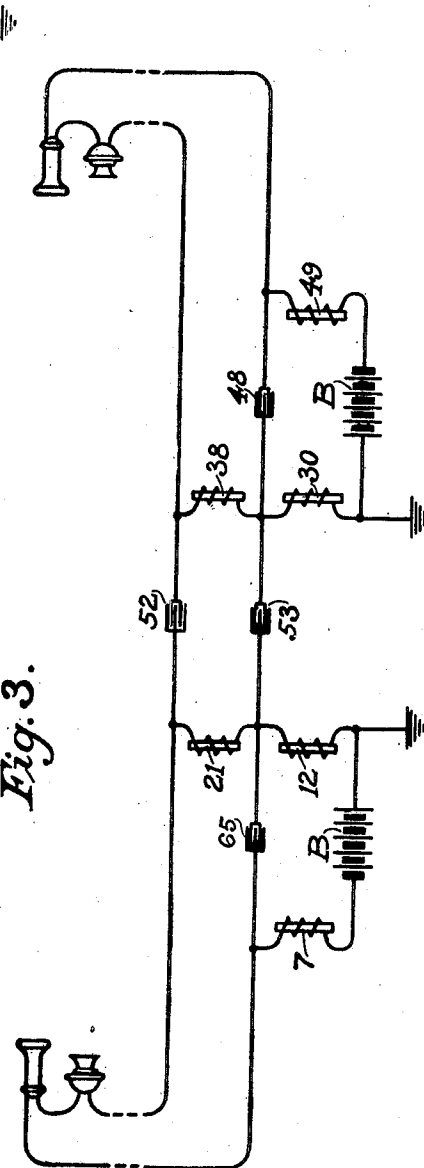


Fig. 3.

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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

No. 827,787.

Specification of Letters Patent.

Patented Aug. 7, 1906.

Application filed December 15, 1904. Serial No. 236,958.

To all whom it may concern:

Be it known that I, ELMER R. CORWIN, a citizen of the United States of America, and a resident of Chicago, county of Cook, and State of Illinois, have invented a new and useful Improvement in Telephone Systems, of which the following is a specification.

My invention relates to that class of telephone systems in which signals are set before the operators at a manual switchboard by the removal of the receiver of the subscriber's telephone from its hook, energy being thus supplied to the line for all purposes of signaling and speech transmission from a source in the central office, and in which the line, if desired, may be terminated in a plurality of line-jacks in a multiple switchboard at the central office.

In many standard systems in use at the present time of the general type which I have just indicated the cord and plug circuits of the switchboard are of three conductors. In my system I limit these conductors to two. In many systems involving supervisory lamp-signals associated with the plugs of the cord-circuit either a strand in the cord is utilized to energize the lamp upon the plug being placed in use and a relay is associated with the cord-circuit and the lamp-circuit to open the latter upon the answer of the called subscriber, or two sets of relays are employed, two for each lamp, one serving to place the lamp in action upon the connection of a plug with the line and the other to extinguish it upon the answer of the called subscriber. In my system but one relay per supervisory-lamp is required, this receiving its energy in series with the line associated with it, and yet in such a manner as not to interfere by the inductance which it contains with the proper transmission of speech over the line, as is true in other systems in which a series-relay is involved as a function of the cord-circuit.

My invention is illustrated in the accompanying drawings, in which—

Figure 1 illustrates a pair of lines and a cord-circuit adapted to connect them. Fig. 2 illustrates an alternative form of cord-circuit for use with such lines; and Fig. 3 illustrates in a schematic manner the connection of two stations through their lines and the cord-circuit shown in Fig. 1.

Similar characters refer to similar parts throughout the several views.

Referring now to Fig. 1, 1 is a station on a calling-line formed of the limbs 2 and 3. 4 is a station on a called line formed of the limbs 5 and 6. Upon the removal of the receiver at station 1 from its hook, current will flow from the battery B, through the line-relay 7, over the limb 2, through station 1 to the central office on limb 3, through the contact-piece 8 to the armature 9 of the relay 7, through the contact-piece 10 to the armature 11 of the relay 12 to ground. The relay 7 will thus be energized and by a construction which adapts the armature 9 to make contact with the piece 13 before breaking from the piece 8 a circuit will be closed through the line-lamp 14 before the ground is removed from the limb 3 at the point 8. Current will then flow from the battery B, through the relay 7, the lamp 14 via 13, 9, 10, and 11 to ground. This illuminating the lamp 14 will be a signal to the operator that a call requires to be answered, as the lamp 14 is adapted to be brought to a proper signaling brilliancy by the voltage of the battery B, while in series with the winding of the relay 7. The operator in answering by inserting the plug composed of the elements 15 and 16 into a jack, as 17, of the calling-line will energize the relay 12 by current from the battery B over the conductor 18 via the armature 19 and the contact 20 of the relay 21, through the lamp 22, the sleeve 16 of the plug, the sleeve 23 of the jack 17 or another quite like it, similarly connected to and through the winding of the relay 12 to ground. By attraction of its armature 11 this relay will break contact between it and the point 10, which will extinguish the line-lamp 14. It will be observed that unless a plug is in a spring-jack of the calling-line, as 17, the attraction of the armature 9 has left no path for the current to flow over the line after the setting of the line-signal until the answering of the call by the operator, when this current may again flow through the line, being, as before, from the battery B, through the relay 7, over the limb 2, through the telephone and to the office on the limb 3, but now passing from this limb by contact of the spring 24 of the jack 17 to the tip 15 of the answering-plug, through the relay 21,

thence by the sleeve 16 of the plug and the bushing 23 of the jack 17 to ground through the relay 12. It will be seen that this series of elements includes all three relays 7, 12, and 21. These are all of such nature as to be energized by series current through the line, the telephone, and themselves and will be affected as has been particularly described above. Contact between elements 19 and 20 of the relay 21 will be broken, extinguishing the lamp 22, signifying that the calling subscriber is at his telephone. In addition such a portion of the total voltage of the battery will exist and the difference of potential between the bushing 23 (and others connected to it) and the earth as is controlled by the drop of potential through the relay 12. This will provide conditions for a busy test later to be described. Upon learning the number of the called subscriber the operator will insert the other plug of the cord-circuit (designated as a whole 25) in an accessible jack of the called line, will ring by means of the ringing-key 26, and upon the answering of the called subscriber, this being shown by the extinguishment of the lamp 27, will abandon the connection for conversation until such time as the relighting of the lamps 22 and 27 shall indicate the fact that both parties to the conversation have hung up their receivers, whereupon she will disconnect the plugs from the jacks. Preliminary, however, to inserting the plug 25 into the jack, as 28 of the called line, formed of limbs 5 and 6, the operator will make the usual busy test by touching the tip of the plug 25 to the exposed bushing of the jack desired to be taken. If that jack is one of a line elsewhere connected with a potential above that of the earth, it will be found busy, and a click will be observed in her telephone. This will be because the ground connection with the operator's telephone-receiver 29 enables her to perceive the presence of such test-potentials, the circuit when such a click is heard being as follows: If the subscriber whose line is being tested has his receiver from the hook, current will be flowing through the relay 30, connected to ground from the test-bushings of the line. The potential existing at the touched test-bushing will cause current to flow from the tip 31 of the plug 25 through the ringing-key in the manner usual in such circuits, and, as the listening-key 32 is operated at that time, through the contact 33, the spring 34, through the induction-coil winding 35, and the operator's receiver 29 to ground. If the subscriber whose line is being tested is not at his telephone, the test-potential necessary to exist at the bushing of the jack of his line will not be established by a flow of current through his receiver, but will exist by current from the battery B over the conductor 18, through the contact of the piece 36 with the armature 37 of the relay 38, thence via the

lamp 27, through conductor 42 and the ringing-key to the sleeve 39, thence to the various test-bushings of the called line, and to ground at the relay 30. In the description of this path, beginning with the conductor 18, it is to be understood that the various numerals indicate homologous parts in a distant cord-circuit which is causing the called line to be busy. It will be seen that under the two sets of conditions which may cause the called line to busy test the same result is achieved, and whenever one of them does not exist the other will, and no unguarded interval will exist at any time. During the operated condition of the listening-key 32 not only will the test conditions described between the tip 31 and the plug 25 and the ground connection of her receiver exist, but the operator's telephone-circuit as a whole will be bridged in series with the condenser 40 across the conductors 41 and 42 of the cord-circuit. It will be observed that the release of the listening-key 32 connects the limbs 41 and 42 of the cord-circuit directly through to the terminals of the plug 25 for unimpeded conversation, although during the operation of the key such conversation could have taken place through the additional path, including the condenser 40, one of which only exists per operator's set. The ringing-key 26, which is of the usual type, adapted to connect the terminals of the ringing-generator G to the conductors 31 and 39 of the plug 25, also is connected, through impedance-coil 43, with the live pole of the battery B. When such connection is made by the operation of the ringing-key 26, current will flow from the battery B through the coil 43 via the sleeve 39 of the plug 25, over the conductor from the jack-bushing to and through the relay 30 to ground. This, by breaking the contact between the armature 44 and its point 45, will isolate the limb 5 of the line from any connection with the battery or the ground and will thus permit ringing-current to pass over the line through the condenser 46 and the ringer 47 at the called station, again to the central office over the limb 6, through the condenser 48, again to the ringing-generator at its opposite conductor. There will thus be no tendency to set a false signal before the distant operator by an act of ringing on the part of any operator upon any line, as whatever motions might be caused on the part of the armature of the relay 49, due to accidental conditions of potential, the circuit of the lamp 50 is open at the contact 45.

Referring now to Fig. 3 and comparing therein the reference characters which it contains with similar reference characters in Fig. 1, a clear idea may be gained of the circuit relations which exist during the time of conversation. Inasmuch as it is the office of the relays 21 and 38 to respond to a flow of direct

current for the control of the supervisory signals, they must be of such dimensions electrically and mechanically as will enable them to indicate with decisiveness whether or not the receivers of the calling and called subscribers are on or off their hooks. This, however, is a function of direct current flowing through the relays in question. The alternating or otherwise fluctuating currents produced by speech at the substations need not flow through these relays, and the best conditions of transmission are secured when they do not. A sufficient impedance in the relays 21 and 38 for a very large prevention of short-circuiting voice-currents may be accomplished, together with a low resistance to direct currents, by a sufficiently generous design involving the use of enough iron and copper. The condensers 52 and 53, being relatively transparent to voice-currents, permit conversation between the connected stations.

Fig. 2 illustrates an alternative arrangement of apparatus in a cord-circuit adapted to be used with the line-circuits shown in Fig. 1. All that has been described with reference to the listening-key 32 and its relation to the operator's telephone-circuit, the ringing-key 26 and its relation to the giving of a signal to the called subscriber apply equally to the arrangement here shown. The condensers 52 and 53 and the relays 21 and 38 are omitted, however, from this circuit, their offices being served by the repeating-coils 54 and 55. The repeating-coil 54 has two windings, one of them composed of the conductor (indicated as 56 and 57) outside of the coil, being connected to the terminals 15 and 16 of the answering-plug. The other winding of the repeating-coil 54 (indicated as 58 and 59) is connected directly in series with one of the windings of the coil 55. The second winding of the latter coil makes exit as the conductors 60 and 61. The winding connecting the conductors 56 and 57 in the coil 54 establishes such a bridge upon the calling-subscriber's line as is established in Figs. 1 and 3 by the relay 21, and the winding connected to the conductors 60 and 61 stands in a similar relation to the line of the called subscriber. As there is no other path, such as that through the condensers 52 and 53 in the other figures, all current circulating in the calling-line must pass through the winding of the repeating-coil 54. In so far as these currents are direct they will energize the core of the repeating-coil, attracting the armature 62, and opening at the point 63 the circuit of the lamp 64, so that during all the time of conversation no path will be provided from the battery B through the lamp 64 to the sleeve 16 of the answering-plug, and thus over the path previously described to permit the illumination of the signal. The closure of the armature 62 upon the point 63 at

the termination of the conversation will permit the lamp 64 to give a disconnect-signal. In so far as currents passing through the winding of the repeating-coil 54 are alternating or fluctuating in character they will induce currents in the winding not in series with the line, will cause these to flow in the path containing conductors 58 and 59, and thus in turn induce currents in the winding in series with the conductors 60 and 61, these constituting a series portion of the called line.

The mechanical construction of the relay-armature 9 shall be such that it responds promptly to controlling changes of energy in its core 7, while the mechanical construction of relay-armature 11 shall be such that it responds sluggishly to controlling changes in its core 12. Armature 9 thus becomes a quick armature and armature 11 a slow armature. The necessity for this arrangement of armature speeds arises from the condition of circuits permitting the relighting of the signal-lamp 14 after the withdrawal of the connecting-plug if contact 10 11 should close before contact 9 13 has opened. With this arrangement of armature speeds the sequence of events following the disconnection of the plug from the jack is as follows: Quick armature 9 makes contact 8 9, then breaks contact 9 13. Then slow armature 11 makes contact 10 11, and all parts remain in their normal position.

While I have herein shown and particularly described specific connections for the condensers in the line-circuits and particular forms of signaling circuits and devices, I do not wish to be limited in all embodiments of the invention to the precise apparatus specifically illustrated.

It is obvious that various changes may readily be made in the system of the invention herein shown without departing from the spirit of my invention.

Having thus described my invention, what I claim is—

1. In a telephone system, the combination with two telephone-substations and their connecting-lines, of relays and condensers so arranged as to give a conversation condition in which the line-relay, cut-off relay and supervisory relay in series with each other and with the line and substation equipment furnish path for current-supply for that line to which the relays pertain, and in which path for the fluctuating speech-currents passing from line to line is furnished through condensers but not through any winding of any relay, substantially as described.

2. In a telephone system, the combination with two telephone-substations and their connecting-lines, of relays and condensers so arranged as to give a conversation condition in which the line-relay, cut-off relay and supervisory relay, in series with each other and with the line and substation equipment

furnish path for current-supply for that line to which the relays pertain, the line and cut-off relays being permanently parts of the equipment of the line, and the supervisory equipment being a part of the equipment of the cord-circuit used to connect the lines, and in which path the fluctuating speech-currents passing from line to line is furnished through condensers but not through any winding of any relay, substantially as described.

3. In a telephone system, the combination of a telephone-line, a line-relay adapted to give a visual signal when the circuit of said line is closed at the substation and as long as no plug is inserted in any jack of the line, a cut-off relay adapted to efface the visual signal when a plug is inserted in a jack of the line, the windings of the two relays being permanently connected to one of the conductors of the line, a condenser inserted in the conductor of the line between the point of connection of the line-relay and the point of connection of the cut-off relay, and a ground upon the remaining conductor of the line through a contact of the cut-off relay, substantially as described.

4. In a telephone system, the combination of a telephone-line having line and cut-off relays, with a cord-circuit plug having a supervisory relay, giving a circuit for the supply of current to the line, through the line-relay, cut-off and supervisory relays, the two members of the line and the telephone-substation, all of the parts named being in series with each other, substantially as described.

5. In a telephone system, the combination of two telephone-lines each having line and cut-off relays, with a cord-circuit having two supervisory relays, forming circuits, when connected, for supply of current to each line from a common current source through the line and cut-off relays of that line, the supervisory relay pertaining to that line's plug, the two members of that line and the substation-telephone of that line, all in series with each other, substantially as described.

6. In a telephone system, the combination of two telephone-lines each having line and cut-off relays, with a cord-circuit having two supervisory relays, forming a circuit, when connected, for supply of current to each line from a common current source through the line and cut-off relays of that line, the supervisory relay pertaining to that line's plug, the two members of that line and the substation of that line, all in series with each other, and forming a circuit, when connected, for the passage of fluctuating speech-currents from line to line through condensers but not through the winding of any relay, substantially as described.

7. In a telephone system, the combination of a telephone-line with multiple jacks; a

cord-circuit adapted to connect with one of said jacks; a first busy-test circuit extending from ground through a battery, a battery-conductor 18, a supervisory signaling device 27, one of the talking-conductors 42 of the cord pair, and the sleeve of the plug, to the test-ring of the jack, and extending thence to ground through the winding of a cut-off relay permanently connected between the test-rings and ground; and a second busy-test circuit extending from ground through a battery, a winding of a relay 49, the limbs of the line and the substation-telephone, the jack, the tip of the plug, the two talking-conductors of the connected cord and a bridged supervisory relay, and the sleeve of the plug, to the test-ring of the jack, and extending thence as in said first busy-test circuit to ground through the winding of a cut-off relay permanently connected between the test-rings and ground; said two busy-test circuits being alternative, the first being complete when the circuit between the line-limbs at the substation-telephone is open and the second being complete when the circuit between the line-limbs at the substation-telephone is closed, substantially as described.

8. In a telephone system having telephone-lines with multiple jacks, the combination of a busy-test circuit a portion of which at all times is formed by the circuit from the test-ring of the multiple jacks of a line through the cut-off relay to ground, said busy-test circuit being completed prior to the answering of the called subscriber through circuits local to the telephone central office, and after the answering of the called subscriber through circuits involving the two limbs of the telephone-line and the telephone-substation apparatus, substantially as described.

9. In a telephone system having telephone-lines with multiple jacks, the combination of a busy-test circuit a portion of which at all times is formed by the circuit from the test-rings of the multiple jacks of a line through the cut-off relay to ground, said busy-test circuit being completed prior to the answering of the called subscriber by a circuit entirely local to the central office and including one of the conductors of the connecting cord-circuit, with means by which upon the answering of the called subscriber the busy-test circuit is changed automatically to be completed through the two conductors of the connecting cord-circuit, the supervisory relay, the two limbs of the line, the substation-telephone and the line-relay, substantially as described.

10. In a telephone system having telephone-lines with multiple jacks, the combination of a busy-test circuit a portion of which at all times is formed by the circuit from the test-rings of the multiple jacks of a

line through the cut-off relay, said busy-test circuit being completed prior to the answering of the called subscriber by a circuit entirely local to the central office and including
 5 one of the conductors of the connecting cord-circuit, with means by which upon the answering of the called subscriber the busy-test circuit is changed automatically to be completed through the two conductors of
 10 the connecting cord-circuit, the supervisory relay, the two limbs of the line, the substation-telephone, and the line-relay, substantially as described.

11. In a telephone system with multiple
 15 jacks, the combination of a busy-test circuit existing prior to the answering of the called subscriber, said circuit comprising one of the conductors of the connecting cord pair, the cut-off relay and other connecting parts,
 20 with means operative upon the answering of the called subscriber by which said busy-test circuit is destroyed and a current-supply circuit established for the substation-telephone through the line-relay, the two limbs of the
 25 line and the substation-telephone, the two conductors of the connecting-plug and its supervisory relay and the cut-off relay of the line, said current-supply circuit forming also a busy-test circuit for said line's multiple
 30 jacks, substantially as described.

12. In a telephone system having telephone-lines with multiple jacks, the combination of a telephone-line and substation-telephone, the multiple jacks of said telephone-line, a line-relay, a cut-off relay, a
 35 plug adapted to connect with any one of said multiple jacks, circuits associated with said plug, and a busy-test circuit existing when said plug is inserted into any one of said
 40 multiple jacks, said busy-test circuit being at all times partly in a circuit from said multiple jacks through said cut-off relay, and adapted to be completed either through said
 45 circuits associated with said plug, or through said line-relay, telephone-line and substation-telephone and the said circuits associated with the said plug, alternatively, substantially as described.

13. In a telephone system having telephone-lines with multiple jacks, the combination of a telephone-line and substation-telephone, the multiple jacks of said telephone-line, a line-relay, a cut-off relay, a
 50 plug adapted to connect with any one of said multiple jacks, circuits associated with said plug, a busy-test circuit existing when said plug is inserted into any one of said multiple
 55 jacks, said busy-test circuit being at all times formed partly of a circuit from said multiple jacks through said cut-off relay, and adapted to be completed when the substation telephone-circuit is open through said circuits
 60 associated with said plug, and means adapted to change said busy-test circuit automatically when the substation-telephone circuit is

closed to be completed through the line-relay, the telephone-line and substation-telephone, and the circuits associated with said plug, substantially as described.

14. In a telephone system having telephone-lines with multiple jacks, the combination of a telephone-line and substation-telephone, multiple jacks connected with
 70 said telephone-line, test-rings forming parts of said multiple jacks, a cut-off relay, circuits from the said test-rings to and through the
 75 said cut-off relay, a line-relay, a plug adapted to connect with any one of said multiple jacks, a plug-circuit of two conductors connected to said plug, a bridged supervisory
 80 relay and a signal device, and a busy-test circuit when said plug is inserted into any one of said multiple jacks, a portion of said busy-test circuit being at all times formed by the
 85 circuit from the test-rings of said multiple jacks to and through the cut-off relay, said busy-test circuit being adapted to be completed when the substation-telephone circuit is open through the signal device and one of
 90 the said two conductors of said plug-circuit, and adapted to be completed when the substation-telephone circuit is closed through the line-relay, the telephone-line and substation-telephone and the circuits associated
 95 with said plug, substantially as described.

15. In a telephone system, the combination of a telephone-line and substation-telephone, multiple jacks connected with said telephone-line, a plug adapted to connect
 100 with any one of said jacks, circuits associated with said plug comprising two conductors and a bridged supervisory relay, a line-relay adapted to give a visual signal when the substation-telephone circuit is closed, a cut-off
 105 relay adapted to efface the line-signal when the plug is inserted into any jack of the telephone-line, and a source of current, the line and cut-off relays being permanently connected to the telephone-line and adapted to
 110 connect said line permanently to said source of current and adapted when said plug is inserted into any one of said jacks to complete a circuit for current from said source through
 115 said telephone-line and substation-telephone and said circuits associated with said plug, comprising two conductors and a bridged supervisory relay, substantially as described.

16. In a telephone system, the combination of the battery B, relay 49, the two limbs of a telephone-line, the substation-telephone,
 120 relay 38 and relay 30, all being connected in series and adapted to provide a path for current from battery B to and through the substation-telephone, with a condenser 48 connected about that portion of said circuit
 125 which contains the battery B and the relays 49 and 30, substantially as described.

17. In a telephone system, the combination of two substation-telephones and two telephone-lines connected therewith, each
 130

having three relays, one relay as 21 or 38 of each line being of high impedance and the two remaining relays of each line being connected in series with each other, with the high-impedance relay and with the line, with two condensers 52 and 53 connecting the two lines at the terminals of the high-impedance relays, and with a condenser as 48 or 65 for each line connected about the two remaining relays of each line, adapted to form a speech-transmission circuit between the two substation-telephones through the four condensers but not through the winding of any relay, substantially as described.

18. In a telephone system, the combination of two substation-telephones and two telephone-lines connected therewith, each having a source of current and three relays, one relay as 21 or 38 of each line being of high impedance and the two remaining relays of each line being connected in series with each other, with the high-impedance relay and with the line, with two condensers 52 and 53 connecting the two lines at the terminals of the high-impedance relays, and with a condenser as 48 or 65 for each line connected about the two remaining relays and the source of current of each line, adapted to form a speech-transmission circuit between the two substation-telephones through the four condensers but not through the winding of any relay, substantially as described.

19. The combination in a telephone system, of a telephone-line of two limbs, a substation-telephone, two relays connected permanently to the two limbs of said line, multiple jacks connected with said telephone-line, test-rings connected with said multiple jacks, a plug adapted to connect with said multiple jacks, conductors associated with said plug, a signal device connected with said plug, a source of electric potential, a test-circuit when the substation-telephone circuit is open and said plug is connected with one of said multiple jacks adapted to give test-current from said battery through said signal device and conductors of said plug to the test-rings of the multiple jacks, a test-circuit when the substation-telephone is closed, and said plug is connected with one of said multiple jacks, adapted to give test-current from said battery through one of said relays, the two limbs of said line, the substation-telephone and the conductors associated with said plug to the test-rings of the jacks, and means adapted to change the test condition from the one test-circuit to the other as the substation-telephone circuit may be opened or closed, substantially as described.

20. The combination in a telephone system of a telephone-line of two limbs, a substation-telephone, two relays connected permanently to the two limbs of said line, multiple jacks connected with said telephone-line, test-rings connected with said multiple jacks,

a plug adapted to connect with said multiple jacks, conductors associated with said plug, a source of electric potential, a test-circuit when the substation telephone circuit is open and said plug is connected with one of said multiple jacks adapted to give test-current from said battery through conductors of said plug to the test-rings of the multiple jacks, a test-circuit when the substation-telephone is closed and said plug is connected with one of said multiple jacks adapted to give test-current from said battery through one of said relays, the two limbs of said line, the substation-telephone and the conductors associated with said plug to the test-rings of the jacks, and means adapted to change the test condition from one test-circuit to the other as the substation-telephone circuit may be opened or closed, substantially as described.

21. A telephone-exchange system including a plurality of telephone-lines extending from substations to an exchange, connecting means at the exchange for uniting lines in conversation, line and supervisory or disconnect signal circuits, and condensers in talking sides of said telephone-lines serving to separate said signaling-circuits.

22. A telephone-exchange system including a plurality of telephone-lines extending from substations to an exchange, connecting means at the exchange for uniting lines for conversation, line-signal and cut-off relay circuits, and condensers in talking sides of said telephone-lines serving to separate said line-signal and cut-off relay-circuits.

23. A telephone-exchange system including a plurality of telephone-lines extending from substations to an exchange, connecting means at the exchange for uniting lines in conversation, line and supervisory or disconnect signal circuits, condensers in talking sides of said telephone-lines serving to separate said signaling-circuits, and cut-off relays for the telephone-lines each adapted for inclusion, by said connecting means, in a supervisory or disconnect signal circuit.

24. A telephone-exchange system including a plurality of telephone-lines extending from substations to an exchange, connecting means at the exchange for uniting lines in conversation, line and supervisory or disconnect signal circuits including relays, and condensers in talking sides of said telephone-lines serving to separate said signaling-circuits.

25. A telephone-exchange system including a plurality of telephone-lines extending from substations to an exchange, connecting means at the exchange for uniting lines for conversation, line-signal and cut-off relay circuits including relays, and condensers in talking sides of said telephone-lines serving to separate said line-signal and cut-off relay circuits.

26. A telephone-exchange system includ-

ing a plurality of telephone-lines extending from substations to an exchange, connecting means at the exchange for uniting lines in conversation, line and supervisory or disconnect signal circuits, said line-signal circuits including line-relays, and condensers in talking sides of said telephone-lines serving to separate said signaling-circuits.

27. A telephone-exchange system including a plurality of telephone-lines extending from substations to an exchange, connecting means at the exchange for uniting lines for conversation, line-signal and cut-off relay circuits, said line-signal circuits including line-relays, and condensers in talking sides of said telephone-lines serving to separate said line-signal and cut-off relay circuits.

28. A telephone-exchange system including a plurality of telephone-lines extending from substations to an exchange, connecting means at the exchange for uniting lines in conversation, line and supervisory or disconnect signal circuits, said line-signal circuits including line-relays, condensers in talking sides of said telephone-lines serving to separate said signaling-circuits, and cut-off relays for the telephone-lines each adapted for inclusion, by said connecting means, in a supervisory or disconnect signal circuit.

29. A telephone-exchange system including a plurality of telephone-lines extending from substations to an exchange, connecting means at the exchange for uniting lines in conversation, line and supervisory or disconnect signal circuits each including a relay, and condensers in talking sides of said telephone-lines serving to separate said signaling-circuits.

30. A telephone-exchange system including a plurality of telephone-lines extending from substations to an exchange, connecting means at the exchange for uniting lines in conversation, line and supervisory or disconnect signal circuits each including a relay, condensers in talking sides of said telephone-lines serving to separate said signaling-circuits, and cut-off relays for the telephone-lines each adapted for inclusion, by said connecting means, in a supervisory or disconnect signal circuit.

31. A telephone-exchange system including a plurality of telephone-lines extending from substations to an exchange, connecting means at the exchange for uniting lines in conversation, a line-signal circuit and an additional signal-controlling circuit for each telephone-line and connected with the same talking side of the telephone-line, and a condenser in said talking side of each telephone-line located between the connections of the corresponding circuits with the corresponding talking side of the corresponding telephone-line.

32. A telephone-exchange system including a plurality of telephone-lines extending

from substations to an exchange, connecting means at the exchange for uniting lines in conversation, a line-signal circuit and an additional signal-controlling circuit including a cut-off relay for each telephone-line and connected with the same talking side of the telephone-line, and a condenser in said talking side of each telephone-line located between the connections of the corresponding circuits with the corresponding talking side of the corresponding telephone-line.

33. A telephone-exchange system including a plurality of telephone-lines extending from substations to an exchange, connecting means at the exchange for uniting lines in conversation, a line-signal circuit including a relay and an additional signal-controlling circuit for each telephone-line and connected with the same talking side of the telephone-line, and a condenser in said talking side of each telephone-line located between the connections of the corresponding circuits with the corresponding talking side of the corresponding telephone-line.

34. A telephone-exchange system including a plurality of telephone-lines extending from substations to an exchange, connecting means at the exchange for uniting lines in conversation, a line-signal circuit including a relay and an additional signal-controlling circuit including a cut-off relay for each telephone-line and connected with the same talking side of the telephone-line, and a condenser in said talking side of each telephone-line located between the connections of the corresponding circuits with the corresponding talking side of the corresponding telephone-line.

35. A telephone-exchange system including a plurality of telephone-lines extending from substations to an exchange, connecting means at the exchange for uniting lines in conversation, line and supervisory or disconnect signal circuits, and condensers in talking sides of said telephone-lines serving to separate said signaling-circuits, said circuits corresponding to each telephone-line including a source of current common thereto.

36. A telephone-exchange system including a plurality of telephone-lines extending from substations to an exchange, connecting means at the exchange for uniting lines for conversation, line-signal and cut-off relay circuits, and condensers in talking sides of said telephone-lines serving to separate said line-signal and cut-off relay circuits, said circuits corresponding to each telephone-line including a source of current common thereto.

37. A telephone-exchange system including a plurality of telephone-lines extending from substations to an exchange, connecting means at the exchange for uniting lines in conversation, line and supervisory or disconnect signal circuits, condensers in talking sides of said telephone-lines serving to separate

rate said signaling-circuits, and cut-off relays for the telephone-lines each adapted for inclusion, by said connecting means, in a supervisory or disconnect signal circuit, said circuits corresponding to each telephone-line including a source of current common thereto.

38. A telephone-exchange system including a plurality of telephone-lines extending from substations to an exchange, connecting means at the exchange for uniting lines in conversation, line and supervisory or disconnect signal circuits including relays, and condensers in talking sides of said telephone-lines serving to separate said signaling-circuits, said circuits corresponding to each telephone-line including a source of current common thereto.

39. A telephone-exchange system including a plurality of telephone-lines extending from substations to an exchange, connecting means at the exchange for uniting lines in conversation, line-signal and cut-off relay circuits including relays, and condensers in talking sides of said telephone-lines serving to separate said line-signal and cut-off relay circuits, said circuits corresponding to each telephone-line including a source of current common thereto.

40. A telephone-exchange system including a plurality of telephone-lines extending from substations to an exchange, connecting means at the exchange for uniting lines in conversation, line and supervisory or disconnect signal circuits, said line-signal circuits including line-relays, and condensers in talking sides of said telephone-lines serving to separate said signaling-circuits, said circuits corresponding to each telephone-line including a source of current common thereto.

41. A telephone-exchange system including a plurality of telephone-lines extending from substations to an exchange, connecting means at the exchange for uniting lines for conversation, line-signal and cut-off relay circuits, said line-signal circuits including line-relays, and condensers in talking sides of said telephone-lines serving to separate said line-signal and cut-off relay circuits, said circuits corresponding to each telephone-line including a source of current common thereto.

42. A telephone-exchange system including a plurality of telephone-lines extending from substations to an exchange, connecting means at the exchange for uniting lines in conversation, line and supervisory or disconnect signal circuits, said line-signal circuits including line-relays, condensers in talking sides of said telephone-lines serving to separate said signaling-circuits, and cut-off relays for the telephone-lines each adapted for inclusion, by said connecting means, in a supervisory or disconnect signal circuit, said circuits corresponding to each telephone-line including a source of current common thereto.

43. A telephone-exchange system includ-

ing a plurality of telephone-lines extending from substations to an exchange, connecting means at the exchange for uniting lines in conversation, line and supervisory or disconnect signal circuits each including a relay, and condensers in talking sides of said telephone-lines serving to separate said signaling-circuits, said circuits corresponding to each telephone-line including a source of current common thereto.

44. A telephone-exchange system including a plurality of telephone-lines extending from substations to an exchange, connecting means at the exchange for uniting lines in conversation, line and supervisory or disconnect signal circuits each including a relay, condensers in talking sides of said telephone-lines serving to separate said signaling-circuits, and cut-off relays for the telephone-lines each adapted for inclusion, by said connecting means, in a supervisory or disconnect signal circuit, said circuits corresponding to each telephone-line including a source of current common thereto.

45. A telephone-exchange system including a plurality of telephone-lines extending from substations to an exchange, connecting means at the exchange for uniting lines in conversation, a line-signal circuit and an additional signal-controlling circuit for each telephone-line and connected with the same talking side of the telephone-line, and a condenser in said talking side of each telephone-line located between the connections of the corresponding circuits with the corresponding talking side of the corresponding telephone-line, said circuits corresponding to each telephone-line including a source of current common thereto.

46. A telephone-exchange system including a plurality of telephone-lines extending from substations to an exchange, connecting means at the exchange for uniting lines in conversation, a line-signal circuit and an additional signal-controlling circuit including a cut-off relay for each telephone-line and connected with the same talking side of the telephone-line, and a condenser in said talking side of each telephone-line located between the connections of the corresponding circuits with the corresponding talking side of the corresponding telephone-line, said circuits corresponding to each telephone-line including a source of current common thereto.

47. A telephone-exchange system including a plurality of telephone-lines extending from substations to an exchange, connecting means at the exchange for uniting lines in conversation, a line-signal circuit including a relay and an additional signal-controlling circuit for each telephone-line and connected with the same talking side of the telephone-line, and a condenser in said talking side of each telephone-line located between the connections of the corresponding circuits with

the corresponding talking side of the corresponding telephone-line, said circuits corresponding to each telephone-line including a source of current common thereto.

5 48. A telephone-exchange system including a plurality of telephone-lines extending from substations to an exchange, connecting means at the exchange for uniting lines in conversation, a line-signal circuit including a relay and an additional signal-controlling circuit including a cut-off relay for each telephone-line and connected with the same talking side of the telephone-line, and a condenser in said talking side of each telephone-
10 line located between the connections of the corresponding circuits with the corresponding talking side of the corresponding telephone-line, said circuits corresponding to each telephone-line including a source of current common thereto.

20 49. In a telephone-exchange system, the combination with telephone-lines extending from substations to an exchange, means for

connecting telephone-lines in conversation, signal-circuits corresponding to each telephone line, and a condenser in one side of each of said telephone-lines serving to separate the corresponding signaling-circuits.

50. In a telephone-exchange system, the combination with telephone-lines extending from substations to an exchange, means for connecting telephone-lines in conversation, signal-circuits corresponding to each telephone-line, and a condenser in one side of each of said telephone-lines serving to separate the corresponding signaling-circuits, said signaling-circuits including a common source of current.

Signed by me at Chicago, county of Cook, State of Illinois, in the presence of two witnesses.

ELMER R. CORWIN.

Witnesses:

EVA A. GARLOCK,
DAVID S. HULFISH