

F. M. SLOUGH.
TELEPHONE SYSTEM.
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2 SHEETS—SHEET 1.

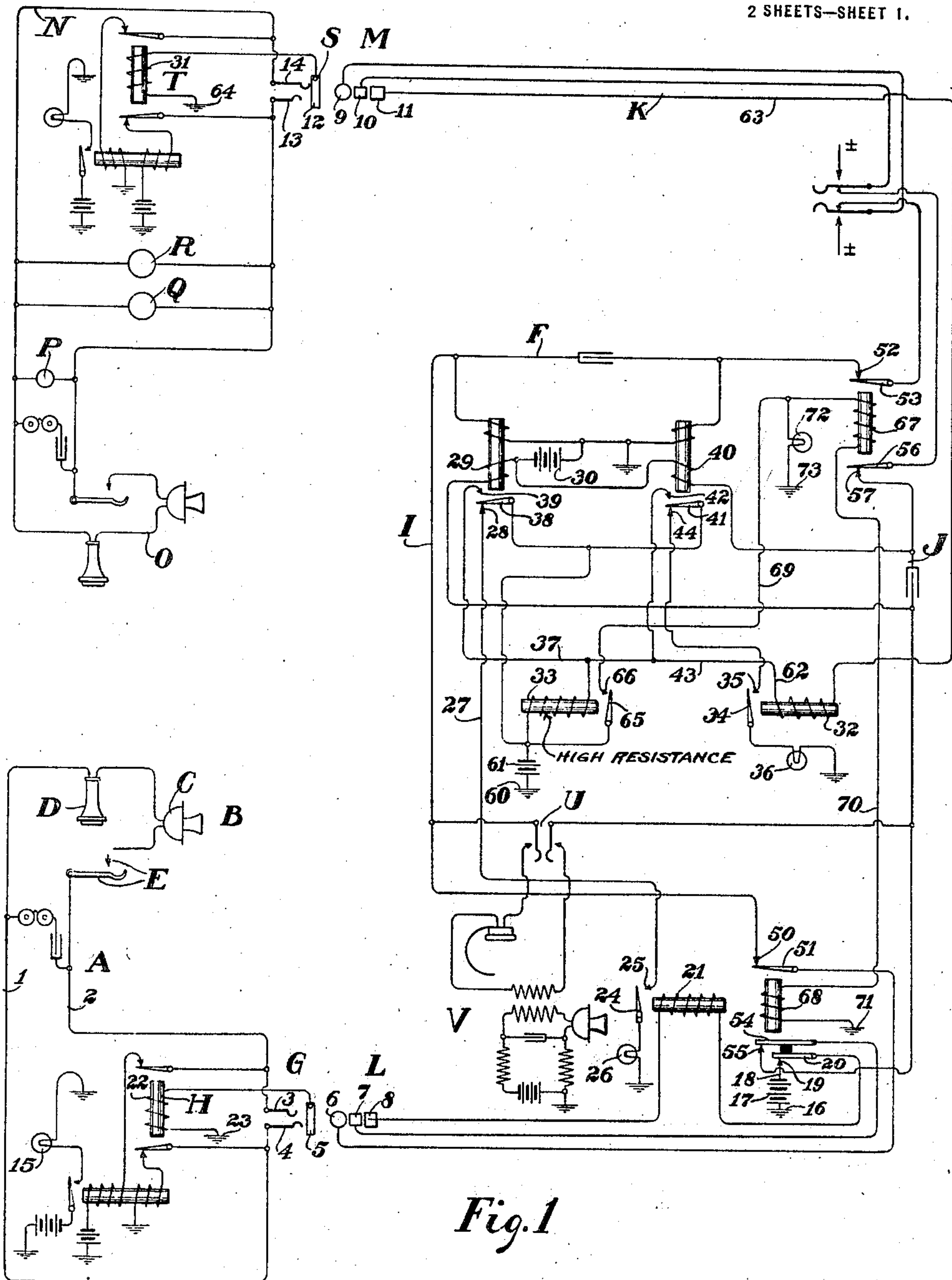


Fig. 1

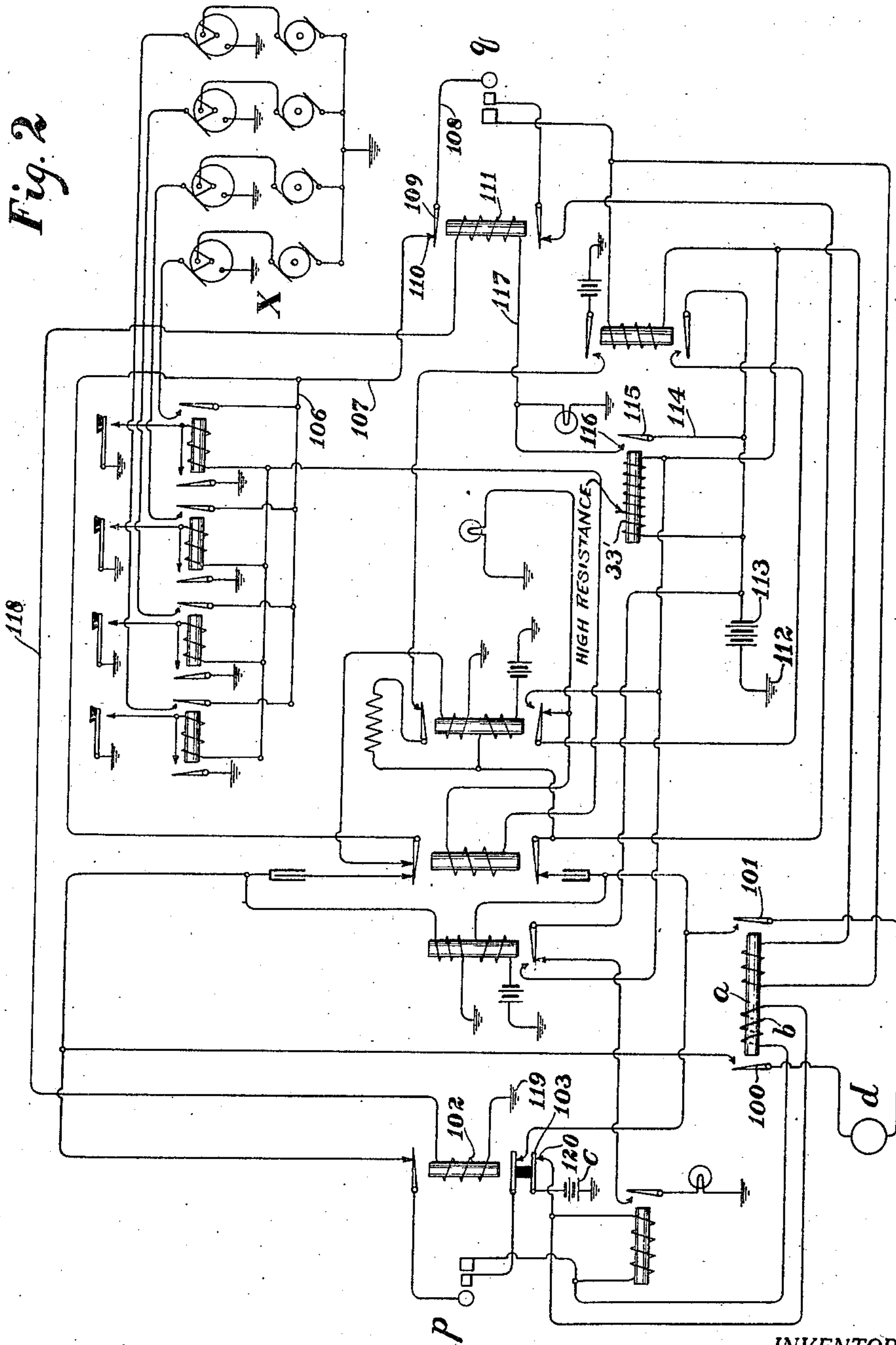
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2 SHEETS—SHEET 2.

Fig. 2



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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

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To all whom it may concern:

Be it known that I, FRANK M. SLOUGH, a citizen of the United States, residing at Elyria, in the county of Lorain and State of Ohio, have invented certain new and useful Improvements in Telephone Systems; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to telephone systems, and more especially to central energy systems, in which a plurality of telephone lines lead from subscribers' stations to a main station where apparatus is provided to connect such lines together. In general, cord circuits are employed for connecting the lines together, the lines and the cords being provided with complementary switching apparatus to connect the ends of the cords to the lines. After the termination of the conversation, the operator is automatically signalled of the termination, but frequently the disconnections are not made immediately, owing either to the inattention or the engagement of the operator. During this period, the lines are tied up to the cord, preventing their use for other connections.

One of the objects of my invention is to provide means for releasing the lines from the cord employed in a conversation as soon as that conversation has terminated.

Another object is to provide means for accomplishing this first named object and placing such means under the control of the switching apparatus employed for connecting the cord to a line.

Another object is to accomplish the above named objects in a practical and simple way, without the introduction of objectionable apparatus or apparatus uncertain in its operation.

Another object of my invention is to accomplish the first named object in such a way that the calling subscriber may control the automatic disconnection of the cord from the line, even though the called subscriber does not respond.

Another object of my invention is to accomplish the first named object, placing the control of the automatic disconnecting apparatus under either subscriber, independently of the other.

Another object of my invention is to provide what has come to be known as "secret listening" in connection with the automatic disconnecting apparatus, placing the secret listening controlling apparatus under the control of the automatic disconnecting apparatus, so as to prevent the return of the operator's set to the cord after the disconnection is made.

Another object of my invention is to place the control of the ringing current under the called subscriber, and especially to place both the automatic disconnecting apparatus and the ringing apparatus under the control of the calling subscriber.

Other objects of my invention and the invention itself will be better understood from a description of the particular embodiments of my invention illustrated in the drawings.

Fig. 1 illustrates diagrammatically a simplified form of circuit.

Fig. 2 is a diagram illustrating a more complicated form of circuit.

Referring now to the embodiments of my invention illustrated in the drawing and first to that illustrated in Fig. 1, at A I show a telephone line. B indicates a substation connected on this line, the substation set including a transmitter C, a receiver D and switch E controlled by the weight of the receiver. This form of apparatus is well known and needs no particularly description. The line is connected by conductors 1 and 2 to the main station F, where it terminates in a switch element G, here shown as a jack, consisting of a plurality of contacts 3, 4 and 5. The line apparatus of the line A is illustrated at H and consists of a well-known form of line and cut-off relays. This apparatus constitutes no part of my invention and any suitable form may be used. At the station F connecting apparatus is employed for connecting the lines together, here shown as a cord circuit, the talking strands of which are illustrated at I and J. In the form shown a third strand is employed and illustrated at K. The strands of the cord circuit terminate in switching elements complementary to the switching elements employed on the line and illustrated, for example, at G on the calling line. In the form shown the switching elements on the cord circuit consist of plugs illustrated at L and M. The plug L consists of a plu-

ality of contacts, shown at 6, 7, and 8 and in the plug M at 9, 10 and 11.

Any suitable number of substations may be connected on any of the telephone lines.

5 On the line N, I have illustrated four substations at O, P, Q and R. Each substation is provided with a talking and signaling set, such as illustrated diagrammatically at O. The line N leads to the central station and
10 terminates thereat in a suitable switching element, such as a jack S, here shown as consisting of the contacts 12, 13 and 14. The line signaling and cut-off apparatus is illustrated at T.

15 A description of the operation will probably better describe the apparatus and its purposes than a detailed description of each piece of apparatus and its functions:

Assuming that the subscriber at B desires
20 to communicate with the subscriber at O, the receiver D is removed from the switch-hook, whereupon the switch E is closed and the lamp 15 operated in the usual manner. Seeing the operation of the lamp 15, the operator at F inserts the plug L into the jack G,
25 connecting one end of the cord to the calling line. A circuit will be completed from 16—through 17—18—19—20—relay 21—8—5—22—to ground at 23, completing a circuit and energizing the relays 21 and 22.
30 The relay 22 cuts off the line signal and line relay from the line in the usual manner. Relay 21 closes the switch 24—25 and completes the circuit of the supervisory signaling lamp 26 through a conductor 27 to a
35 back contact 28 of the tip supervisory relay 29. This relay will be energized, owing to the fact that the substation circuit at B is closed, a circuit being traced from the battery 30—through the left hand end of the
40 talking strands of the cord circuit and over the calling subscriber's line. The operator operates the listening springs U, connecting her telephone set V to the talking
45 strands and communicates with the subscriber at B, learning that it is the subscriber at O that is wanted. After testing the line and assuming that it is found idle, the plug M is inserted into the jack S, completing a circuit through the relays 31, 32
50 and 33. Relay 31 cuts off the line signal and line relay from the called line. The relay 32 attracts the armature 34, closing a switch 34—35 and completing the circuit of the supervisory lamp 36, which burns as long as
55 the called line is open. Relay 33 will not be energized at this time, since the relay 29 has been energized, completing a shunt 37 through the contacts 38—39 around the
60 winding of the relay 33.

I make the relay 33 of higher resistance, in order that the relays 31 and 32 may be de-energized when the winding of the relay 33 is connected in the circuit of the relay 31,
65 and also in order that the battery potential

on the sleeve 12 of the jack S may be sufficiently reduced so that the line to which this jack belongs will not test busy when tested by any operator in the telephone exchange. Both of these objects will effected,
70 because the higher resistance of this relay connected unshunted in circuit with winding 31 and sleeve 12 will reduce the current flow through this circuit.

When the called subscriber responds, the
75 relay 40 will be energized from the battery over the right hand end of the cord circuit and the line of the called subscriber. This relay will attract the armature 41, closing a switch 41—42 and completing a second
80 shunt 43 about the winding of the relay 33. The switch 41—44 will be opened, retiring the supervisory signal 36. The conversation having continued to a termination, the
85 subscribers hang up their receivers, interrupting the continuity of the lines and de-energizing the relays 29 and 40, interrupting the shunts about the relay 33, which is energized over a circuit 60—61—33—62—32—
90 63—11—12—31—64. As stated, the introduction of the resistance 33 in this circuit reduced the current to such an extent that the relays 31 and 32 released their
95 armatures, restoring the called line relay and line and supervisory signals to normal conditions. The relay 33, however, was energized, attracting its armature 65, closing a switch 66 in a circuit including the
100 electromagnets 67 and 68, which circuit is traced as follows: 60—61—65—66—69—67—70—68—71, and a second circuit through the disconnect lamp 72 to ground
105 73. The operation of this lamp indicates to the operator that the automatic disconnection has taken place. The relay 67 was energized over this circuit, attracting its
110 armatures 53 and 56 and opening the switches 52—53 and 56—57, each shown in the talking strand of the cord circuit, and disconnecting the plug M from the intermediate
115 portion of the cord circuit. The relay 68 was also energized, attracting its armatures 51, 54 and 20, opening the switches 50—51 and 54—55 and disconnecting the plug L from the intermediate
120 portion of the cord circuit. The switch 19—20 was also opened in the circuit of the relay 21, whereupon the line relay and signaling apparatus of the calling line was restored to normal. In this condition both lines are
125 released and may be used for other connections and the battery potential of the contact 12 of jack S being greatly reduced by the interposition of the high resistance relay 33 in its circuit, the line will not test
130 busy. Also, as the circuit of the corresponding contact 5 of the jack G is opened at 19—20 the calling line will also indicate a non-busy condition upon being called.

Assuming that the called subscriber at O 130

never responds and that the subscriber B for some reason, such as impatience, hangs up his receiver, under these circumstances the automatic disconnecting apparatus will be operated, since the shunt 43 will never have been closed about the relay 33, owing to the failure of the called subscriber to answer and the shunt 37 completed will be interrupted when the calling line is opened.

Referring now to Fig. 2, I have illustrated at *a* a differential relay controlling the connection of the operator's set to the cord circuit and the disconnection of the same therefrom. This apparatus is previously known and is not a portion of my invention. When the plug *p* is inserted into the jack of the calling line, a circuit is completed through the winding *b* of the relay *a* and the battery *c*, energizing the magnet *a* and attracting the armatures 100 and 101 and connecting the operator's set *d* to the cord circuit. I place the relay *a* under the control of the automatic disconnecting apparatus, for example, by placing a switch 103 under control of relay 102, so that the switch 103 in the circuit of the winding *b* will be interrupted when the automatic disconnecting apparatus is operated; otherwise, the operator's set would be reconnected to the calling line as soon as the called subscriber hung up. At X I have illustrated sources of energy for supplying energy to operate the substation signaling apparatus. Such apparatus is connected to the line over suitable conductors, such as 106, 107 and 108. These are placed under control of the automatic disconnecting apparatus, by placing a switch 109—110 under control of the relay 111. This is especially advantageous in systems employing automatic ringing, because when the calling subscriber hangs up, which he sometimes does without waiting for the called subscriber to answer, the automatic ringing current is automatically removed from the line. This will be accomplished in the system illustrated in Fig. 2 as follows:

When the relay 33' is energized in the way described in Fig. 1, a circuit will be completed as follows: 112—113—114—115—116—117—111—118—102—119, energizing the relays 111 and 102, disconnecting the plugs *p* and *q* from the intermediate portion of the cord circuit, disconnecting the source of ringing current X from the plug *q* at 109 and 110 and interrupting the circuit of the winding *b* of the magnet *a* at 103—120.

I do not wish to be limited to the details of the embodiments of my invention illustrated, these being shown simply for the purpose of describing the invention.

I claim:—

1. In a telephone system, the combination of a main station, a plurality of substations,

telephone lines connecting the substations to the main station and terminating in jacks at the main station, a cord circuit at the main station terminating in plugs adapted to be inserted in said jacks for connecting the lines together, a low resistance relay associated with one of the lines, a high resistance relay associated with the cord circuit, a source of current, means including a plug and jack switch for connecting said relays in circuit with said source of current, means for effectively eliminating said high resistance relay from said circuit, means operative at the close of the conversational period to include said high resistance relay in circuit with said low resistance relay whereby said low resistance relay is de-energized and means controlled by said high resistance relay to release the intermediate portions of the cord from said plugs operative when said relay is included in said circuit.

2. In a telephone system, the combination of a main station and a plurality of substations, telephone lines for connecting the substations to the main station, a cord circuit at the main station for connecting telephone lines together, means controlled by the substation sets for automatically isolating the talking strands of the cord circuit from the lines, supervisory signaling apparatus in the cord circuit controlled by the called subscriber and means operative independently of said supervisory signaling apparatus controlling said interrupting means.

3. In a telephone system, the combination of a main station and a plurality of substations, telephone lines for connecting the substations to the main station, a cord circuit at the main station for connecting telephone lines together, supervisory signaling apparatus connected to the strands of the cord controlled by the called subscriber and means operative independently of said supervisory apparatus for automatically disconnecting the plugs of the cords from the intermediate portion thereof when the subscribers whose substation sets have been connected to the cord have been restored to normal.

4. In a telephone system, the combination of a main station and a plurality of substations, telephone lines for connecting the substations to the main station, a cord circuit at the main station for connecting telephone lines together, supervisory signaling apparatus connected to the strands of the cord controlled by the calling subscriber and means operative independently of said supervisory apparatus for automatically disconnecting the plugs of the cords from the intermediate portion thereof when the subscribers whose substation sets have been connected to the cord have been restored to normal.

5. In a telephone system, the combination of a main station and a plurality of substations, telephone lines connecting the substations to the main station, a cord circuit at the main station for connecting said lines together, plug and jack switching means for connecting the cord to telephone lines, means for disconnecting said plugs from the intermediate portions of the cord circuit, electromagnetic means controlling said disconnecting means, a circuit for said electromagnetic means, means controlled by the calling subscriber for effectively eliminating said electromagnetic means from said circuit and means controlled by the called subscriber for effectively eliminating said means from said circuit, each of said eliminating means being inoperative to eliminate said electromagnetic means from said circuit when the talking bridge at the substations is interrupted.

6. In a telephone system, the combination of a main station, a plurality of substations, telephone lines connecting the substations to the main station, a cord circuit at the main station for connecting said lines together, means for automatically interrupting the talking strands of the cord circuit, electromagnetic means controlling said interrupting means, a circuit for said electromagnetic means, means controlled by the called subscriber for effectively eliminating said electromagnetic means from said circuit, said eliminating means being inoperative to eliminate said electromagnetic means from said circuit when the talking bridge at the calling subscriber's station is interrupted.

7. In a telephone system, the combination of a main station, a plurality of substations, telephone lines connecting the substations to the main station, a cord circuit at the main station for connecting said lines together, means for automatically interrupting the talking strands of the cord circuit, electromagnetic means controlling said interrupting means, a circuit for said electromagnetic means, means controlled by the calling subscriber for effectively eliminating said electromagnetic means from said circuit, said eliminating means being inoperative to eliminate said electromagnetic means from said circuit when the talking bridge at the called subscriber's station is interrupted.

8. In a telephone system, the combination of a main station, a plurality of substations, telephone lines connecting the substations to the main station terminating in switch elements at the main station, a cord circuit at the main station for connecting telephone lines together terminating in switch elements adapted to co-operate with the switch elements in which the subscriber's lines terminate, means for disconnecting the switch elements of the cord from the intermediate

portion of the cord, a device controlling said means, a circuit for said device and means for effectively eliminating said device from said circuit controlled by a subscriber's substation apparatus.

9. In a telephone system, the combination of a main station and a plurality of substations, telephone lines connecting the substations to the main station, a cord circuit for connecting said telephone lines together, means for automatically interrupting the talking strands of the cord circuit, electromagnetic means controlling said interrupting means, a circuit for said electromagnetic means and a shunt about said electromagnetic means controlled by a subscriber.

10. In a telephone system, the combination of a main station and a plurality of substations, telephone lines connecting the substations to the main station, a cord circuit for connecting said telephone lines together, means for automatically interrupting the talking strands of the cord circuit, electromagnetic means controlling said interrupting means, a circuit for said electromagnetic means, a shunt about said electromagnetic means and means under the control of a subscriber controlling said shunt.

11. In a telephone system, the combination of a main station and a plurality of substations, telephone lines connecting the substations to the main station, a cord circuit for connecting said telephone lines together, means for automatically interrupting the talking strands of the cord circuit, electromagnetic means controlling said interrupting means, a circuit for said electromagnetic means, a plurality of shunts about said electromagnetic means each under the control of the subscribers.

12. In a telephone system, the combination of a main station and a plurality of substations, telephone lines connecting the substations to the main station, a cord circuit at the main station for connecting the telephone lines together, supervisory apparatus connected to the strands of the cord circuit controlled by a subscriber, means for interrupting the talking strands of the cord circuit, electromagnetic means controlling said interrupting means, a circuit for said electromagnetic means, a shunt about said electromagnetic means, and a switch including contacts in said shunt controlled by the supervisory apparatus.

13. In a telephone system, the combination of a main station and a plurality of substations, telephone lines connecting the substations to the main station, a cord circuit at the main station for connecting telephone lines together, means for automatically interrupting the talking strands of the cord circuit when the subscriber whose talking apparatus has been connected to the cord circuit has disconnected his talking appa-

ratus therefrom, a talking set at the main station and means controlled by said interrupting means controlling the connection of the operator's set to the talking circuit.

5 14. In a telephone system, the combination of a main station and a plurality of substations, telephone lines connecting the substations to the main station, a cord circuit at the main station for connecting telephone
10 lines together, means for automatically interrupting the talking strands of the cord circuit when the subscriber whose talking apparatus has been connected to the cord
15 circuit has disconnected his talking apparatus therefrom, a talking set at the main station, and means for automatically connecting the operator's set to the telephone
line controlled by said interrupting means.

15 15. In a telephone system, the combination of a main station, a calling and a called line terminating at said station, a subscriber on each of said lines, a cord circuit having separate talking and operating strands at the main station, plug and jack switching means
20 for connecting said talking and operating strands to each of the lines, supervisory means in the answering end of the cord, including a supervisory relay, automatic means
25 for operatively disconnecting all of the strands of the cord from the calling line when the calling subscriber's station apparatus is retired, said automatic disconnect
30 means being initially controlled by the supervisory relay and subsequently maintained by switching means for connecting one of
35 the strands of cord to the called line.

16. In a telephone system, the combination of a main station, a calling line terminating at the main station in a switchboard
40 jack, a calling subscriber's substation set upon the calling line, a called line terminating at the substation in a switchboard jack, a called substation set upon the called line, a cord circuit at the main station including
45 separate talking and operating strands, plugs at the main station in which the cord circuit terminates and which are adapted to be inserted into the jacks of the calling and
the called line to establish communication
50 between the calling and the called subscriber over the lines and the talking strands of the cord circuit, relay mechanism at the main station having contacts in the talking
and operating strands associated with the
55 calling line, supervisory means in the answering end of the cord circuit including a supervisory relay, a circuit for the first named relay controlled by said supervisory
relay, a third relay in the operating strand
60 of the calling end of the cord also controlling the circuit of said first named relay, a circuit for the third named relay local to the main station and including contacts of the
jack of the called line and the calling plug.

65 17. In a telephone system, the combina-

tion of a main station and a plurality of substations, telephone lines leading from said substations to the main station, a cord circuit having separate talking and operating
70 strands at the main station for connecting two telephone lines together, co-operating switching means for connecting the cord circuit to the telephone lines, means for operatively disconnecting all of the strands
75 leading to the answering switching means from the corresponding strands of the cord circuit, said means maintained under the sole control of the switching means at the other end of the cord and a disconnect signal operated at the time of disconnection, likewise
80 maintained.

18. In a telephone exchange system, subscribers' lines having switching terminals, operators' connecting circuits having co-operating switching terminals, said operators' connecting
85 circuits including two talking strands and a third strand, and means controlled by the subscribers through said circuits for disconnecting both talking strands from both subscribers and disconnecting
90 said third strand from one of said subscribers without disconnecting it from the other.

19. In a telephone system, the combination of a main station, a plurality of substations, telephone lines for connecting the substations to the main station, a cord circuit at the main station for connecting telephone
95 lines together, plug and jack switching means for connecting the cord circuit to the telephone lines, a source of current, a cut-off relay in a line circuit, a high resistance relay in the cord circuit, current conductors including a plug and jack connecting the high
100 resistance relay and the cut-off relay in circuit with said source of current and means to prevent the energization of one of said relays while the other is energized.

20. In a telephone system, the combination of a main station, a plurality of substations, telephone lines for connecting the substations to the main station, a cord circuit at the main station for connecting telephone
110 lines together, plug and jack switching means for connecting the cord circuit to the telephone lines, a cut-off relay in the line circuit, a high resistance relay in the cord circuit in circuit with said cut-off relay and means to prevent the actuation of one of said
115 relays while the other is actuated.

21. In a telephone system, the combination of a main station, a plurality of substations, telephone lines for connecting the substations to the main station, a cord circuit at the main station for connecting telephone
120 lines together, plug and jack switching means for connecting the cord circuit to the telephone lines, line signal apparatus normally connected to the line, a cut-off relay controlling said line signal apparatus, a high
130

resistance relay associated with the cord circuit, means for supplying energy to said relays and subscriber controlled apparatus for causing the de-energization of the cut-off relay and the energization of the high resistance relay.

22. In a telephone system, the combination of a main station, a calling line leading to the main station, a called line leading to the main station, substation apparatus on said lines, a source of current associated with said system, a cord circuit at the main station having separate talking and operating strands, plug and jack switching means for connecting each end of the cord to a telephone line, apparatus for automatically disconnecting all of the talking strands of the cord circuit from one of the connected lines, means including a calling subscriber's set controlling said automatic disconnecting apparatus, said automatic interrupting apparatus being inoperative until the calling subscriber retires, and mechanism under the control of the plug and jack switching means associated with the other connected line for maintaining said automatic interrupting apparatus until the plug of the last mentioned plug and jack switching means is withdrawn from the corresponding jack.

23. In a telephone system, the combination of a main station, a calling and a called line terminating at said station, a subscriber on each of said lines, a cord circuit having separate talking and operating strands at the main station, plug and jack switching means for connecting said talking and operating strands to each of the lines, supervisory means in the answering end of the cord, including a supervisory relay, automatic means for operatively disconnecting all of the strands of the cord from the calling line when the calling subscriber's station apparatus is retired, said automatic disconnect means being initially controlled by the supervisory relay and subsequently maintained by switching means for connecting an operating strand of the cord to the called line.

24. A telephone system comprising subscribers' lines having switching terminals, link conductors having co-operating switching terminals, line signals for said lines, cut-off relays for said line signals, a local circuit associated with each end of said link conductors, each local circuit including a co-operating pair of switching terminals, one of said cut-off relays and a source of current, and means controlled by one of the subscribers for decreasing the flow of current to a predetermined positive value in one of said local circuits to release one of said cut-off relays, whereby the subscribers may regain control of their line signals.

25. A telephone exchange system including telephone lines extending from substations

to an exchange, a cord circuit to connect said substations and comprising separate talking and operating strand circuits individual to the respective cord circuit for calling and called lines, a disconnect signal circuit associated with said cord circuit during an established connection therewith and closed by the opening of said talking and operating strand circuits under the combined control of both calling and called substations.

26. In a telephone system comprising subscribers' lines terminating at a central office, link conductors thereat having co-operating switching terminals, line signals for said lines, cut-off relays for said line signals, a local circuit associated with each end of said link conductors, each including a co-operating pair of said switching terminals, one of said cut-off relays, a source of current and another relay and apparatus controlled by the subscribers in the operation of their switch hooks for increasing and decreasing the flow of current through said local circuits, said cut-off relays restoring the line signals to the control of the subscribers when said apparatus is operated to decrease the current in the local circuits.

27. A telephone system comprising subscribers' lines terminating in a central office, line signals thereat for said lines, link conductors at said office for interconnecting said lines, a pair of relay windings associated with the one end of said link conductors, one of which is normally short-circuited when said link conductors are associated with one of said lines, a cut-off relay for the line signal of the said line energized over a circuit including the non-short-circuited winding of said pair of relay windings, and electromagnetic means controlled by the subscriber in the operation of his switch-hook for removing the short circuit of the short-circuited winding of said pair of relay windings for releasing said cut-off relay, whereby said subscriber may regain control of his line signal.

28. In a telephone system, the combination of a main station, a plurality of telephone lines leading thereto, a cord circuit including a third strand for connecting said telephone lines together, switching mechanism for connecting the cord to a line and electromagnetic means without the talking circuit for automatically disconnecting such switching mechanism from the cord circuit when a connected subscriber retired his substation talking set, said last named means controlling the third strand of the cord.

29. A telephone exchange system, including telephone lines extending from substations to an exchange, link connectors to connect said substations and comprising separate talking and operating strand circuits individual to the respective link con-

nectors for calling and called lines, means under the control of apparatus at the calling and called substations to open the talking and operating strand circuits of said link connectors connected to their lines, a high resistance circuit including the magnetic winding of a disconnect relay, and a disconnect signal operated by said relay when said link connector strand circuits of both calling and called sub-stations are so opened.

30. In a telephone system, a main station, a plurality of substations, telephone lines leading from said main station to said substations, line signal apparatus associated with each of said telephone lines at the main station, a cut-off relay associated with each line and adapted to remove said line signal apparatus from the telephone line, a cord circuit at the main station containing separate talking and operating strands, a plug and jack switch for associating the talking strands of the cord circuit with the talking strands of the calling line and for associating the cut-off relay of the line circuit with an operating strand of the cord circuit, a plug and jack switch for associating the talking strands of the cord circuit with the talking strands of the called line circuit and also to associate the cut-off relay of the called line with an operating strand of the cord circuit, a relay in the cord circuit under the control of one of the connected substations, a disconnect relay at each end of the cord circuit adapted to operatively disconnect each of the connected line circuits and each of the cut-off relays from the talking strands and operating strands of the cord circuit, and a high resistance relay in the operating strand leading to one of the plug and jack switches, said high resistance relay being operated when the cut-off relay connected in the same operating strand is operatively disconnected, said high resistance relay controlling a disconnect signal.

31. A telephone system, comprising subscribers' lines having switching terminals, link conductors thereat having co-operating switching terminals, line signals for said lines, cut-off relays for said line signals, an operator's telephone associated with said link conductors, a relay for connecting said operator's telephone to said link conductors, a local circuit associated with each end of said link conductors, each local circuit including a co-operating pair of switching terminals, one of said cut-off relays, a source of current and a winding of said operator's connecting relay and apparatus controlled by the subscribers in the operation of their switch-hooks for increasing the resistance of said local circuit associated with one end of said link conductors, said decreased flow of current permitting the release of said cut-off relays to restore to the subscribers the

control of said line signals and simultaneously disassociating said operator's connecting relay from said cut-off relays.

32. A telephone system comprising subscribers' lines terminating at a central office, link conductors thereat for interconnecting said lines, line signals for said lines, a high resistance relay winding and a second relay winding associated with one of said link conductors, said high resistance relay winding being normally short-circuited when said link conductors are connected with said lines, a cut-off relay for the line signal energized over a circuit including the short-circuited high resistance winding and said second relay winding controlling the connection of an operator's telephone set to the link conductors and means controlled by the operation of a subscriber's switch-hook for removing the short circuit from said high resistance relay winding to release said cut-off relay and said second relay, whereby the subscriber may regain control of his line signal and the operator's set is prevented from being connected by said second relay to the link conductors.

33. A telephone exchange system including telephone lines extending from substations to an exchange, link conductors to connect said substations and comprising separate talking and operating strand circuits individual to the respective link conductors for calling and called lines, a disconnect signal circuit associated with said link conductors during an established connection therewith and closed by the opening of said talking and operating strand circuits under the combined control of both calling and called substations.

34. A telephone exchange system, including telephone lines extending from substations to an exchange, link conductors to connect said substations and comprising separate talking and operating strand circuits individual to the respective link conductors for calling and called lines, means under the control of the calling and called substations to open the talking and operating strand circuits of said link conductors connected to their lines, a disconnect signal circuit associated with said link conductors during an established connection therewith, said disconnect circuit including a high resistance and closed when said line conductor strand circuits of both calling and called lines are opened, and relays in series with said circuit rendered inoperative by said resistance when said link conductor strand circuits of both calling and called lines are so opened.

35. A telephone exchange system, including telephone lines extending from substations to an exchange, link conductors to connect said substations and comprising separate talking and operating strand circuits individual to the respective link conductors

for calling and called lines, means under the control of the calling and called substations to open the talking and operating strand circuits of said link conductors connected to their lines, a disconnect signal circuit associated with said link conductors during an established connection therewith, said disconnect circuit including a high resistance and closed when said link conductor strand circuits of both calling and called lines are opened, and the winding of a ringing relay individual to each link conductor and the winding of a cut-out relay individual to each called line, said relays being rendered inoperative by said resistance when said link conductor strand circuits of both calling and called lines are so opened.

36. A telephone exchange system, including telephone lines extending from substations to an exchange, link conductors to connect said substations and comprising separate talking and operating strand circuits individual to the respective link conductors for calling and called lines, means under the control of apparatus at the calling and called substations to open the talking and operating strand circuits of link conductors connected to their lines, a disconnect signal circuit associated with said link conductors during an established connection therewith, said disconnect circuit including a high resistance and closed when said link conductor strand circuits of both calling and called lines are opened, a disconnect relay, the winding of a ringing relay individual to each link conductor and the winding of a cut-out relay individual to each called line, said ringing and cut-out relays being rendered inoperative by said resistance when said link conductor strand circuits of both calling and called lines are so opened, and said disconnect relay being rendered operative when said link conductor strand circuits of both calling and called lines are so opened.

37. In a telephone exchange system, including telephone lines extending from substations to an exchange, a cord circuit to connect said substations and comprising separate talking and operating strand circuits individual to said cord circuit for calling and called lines, means under the control of the calling and called substations to open the talking and operating strand circuits of said cord circuit connected to their lines, a disconnect circuit associated with said cord circuit during an established connection therewith, said disconnect circuit including a high resistance and closed when said line conductor strand circuits of both calling and

called lines are opened and relays in series with said circuit rendered inoperative by said resistance when said cord strand circuits of both calling and called lines are so opened.

38. A telephone system comprising a telephone line terminating at a central office, a line signal for the line, a link circuit, a cut-off relay associated with the line for controlling the line signal and actuated upon connection of the link circuit with the line, a resistance coil, and means controlled over the telephone line for including the resistance coil in circuit with the cut-off relay to cause the release thereof.

39. In a telephone exchange system, the combination of a subscriber's line having an associated jack and relay, of a cord circuit for interconnecting with the jack, a relay, a resistance coil associated with the cord circuit, the windings of the relays being adapted to be placed in series when the cord circuit interconnects with said jack, and means controlled by the subscriber for including the winding of the resistance coil in series with the relays, the inclusion of the coil serving to disable the relay associated with the line.

40. In a telephone exchange system, the combination of a called subscriber's line having an associated jack and relay, of a cord circuit for interconnecting with said jack, a relay and resistance coil associated with said cord circuit, the windings of the relays being adapted to be placed in series when the cord circuit interconnects with said jack, and means controlled by the called subscriber for including the winding of the resistance coil in series with said relays, the inclusion of said coil serving to disable the relay associated with the line.

41. A telephone system comprising a telephone line terminating at a central office, a line signal for the line, a link circuit, a cut-off relay associated with the line for controlling the line signal and actuated upon connection of the link circuit with the line, a supervisory relay in the link circuit responsive to the opening of the telephone line, and a resistance coil included in circuit with the cut-off relay upon the response of the supervisory relay to cause the release of the cut-off relay.

In witness whereof, I have affixed my signature in the presence of two witnesses this 15th day of October, 1913.

FRANK M. SLOUGH.

Witnesses:

GEO. E. ROBERTS,
R. G. SANDS.