No. 897,242. PATENTED AUG. 25, 1908.

H. G. WEBSTER.

TELEPHONE SYSTEM.

APPLICATION FILED JULY 19, 1906. RENEWED JULY 6, 1908.

2 SHEETS—SHEET 1.

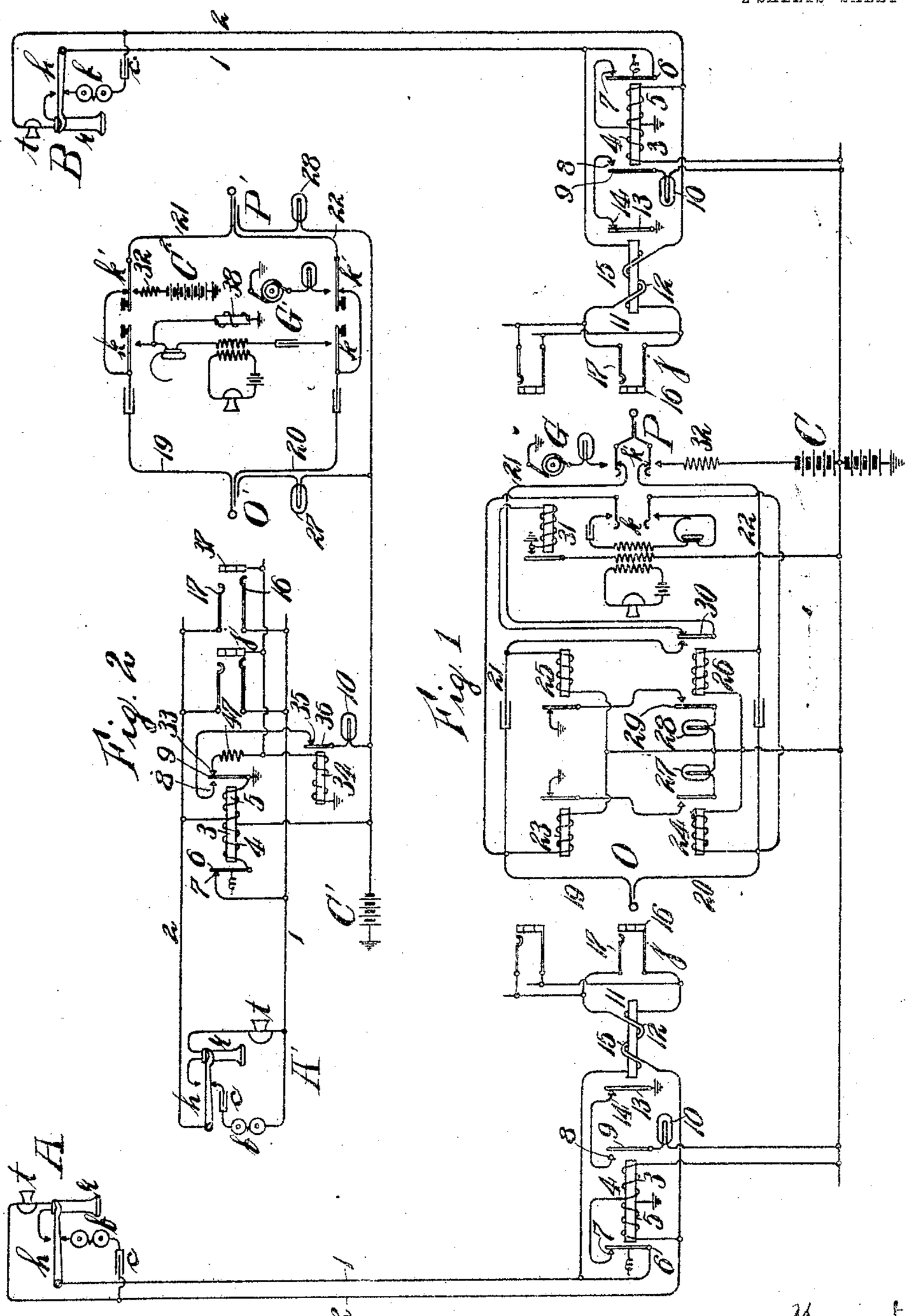


Fig. 1

Fig. 2

Witnesses
Geo. E. Muller
H. C. Olmstead.

Inventor
Harry G. Webster
by Thomas H. Ferguson
Attorney

No. 897,242. PATENTED AUG. 25, 1908.

H. G. WEBSTER.

TELEPHONE SYSTEM.

APPLICATION FILED JULY 19, 1906. RENEWED JULY 6, 1908.

2 SHEETS—SHEET 2.

Fig. 4.

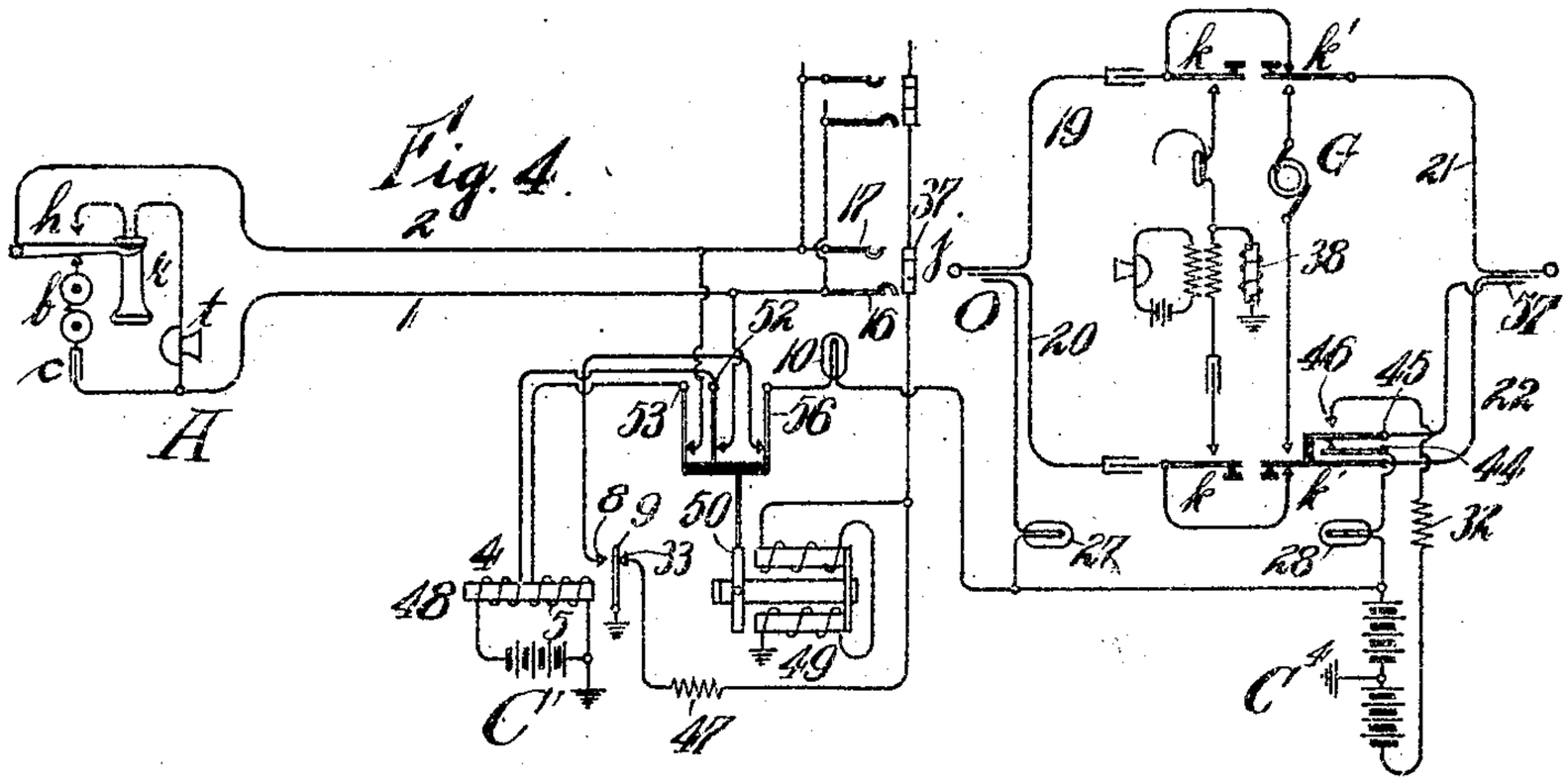
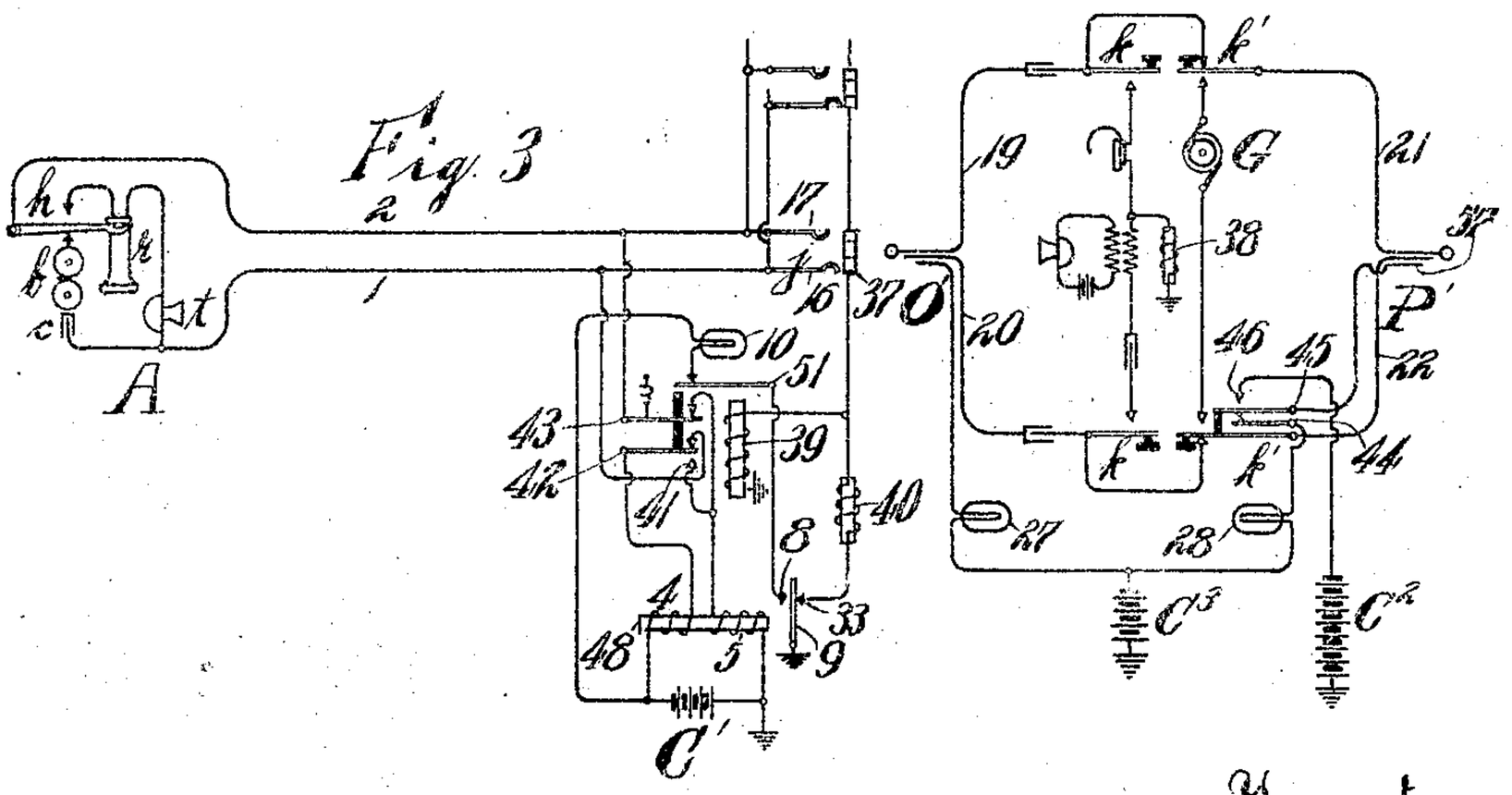


Fig. 3



Witnesses
Geo. E. Mueller
H. C. Olmstead.

Inventor
Harry G Webster
by Thomas H. Ferguson
Attorney

UNITED STATES PATENT OFFICE.

HARRY G. WEBSTER, OF CHICAGO, ILLINOIS, ASSIGNOR TO MILO G. KELLOGG, OF CHICAGO, ILLINOIS.

TELEPHONE SYSTEM.

No. 897,242. Specification of Letters Patent. Patented Aug. 25, 1908.

Application filed July 19, 1906, Serial No. 326,871. Renewed July 6, 1908. Serial No. 442,247.

To all whom it may concern:

Be it known that I, HARRY G. WEBSTER, residing in Chicago, county of Cook, and State of Illinois, have invented new and useful Improvements in Telephone Systems, of which the following is a specification.

My invention relates to telephone exchange systems and more particularly to systems of that type in which current for transmission and signaling is supplied to the substation from a central source through the windings of an electromagnet, this magnet being connected with the telephone line normally and during conversation. This electromagnet is preferably a relay magnet and serves to partially control the signals associated with the line.

The principal object of the invention is to provide novel means whereby the winding or windings of the electromagnet may be disconnected from the line when a ringing signal is to be actuated at the substation, thus preventing the shunting of the ringing current through the magnet winding or the display of false signals through the energization of the magnet by the ringing current.

Further objects of my invention will be apparent from the following description.

In accordance with my invention I associate with each line circuit a so-called "double-acting" relay. Relays of this type are characterized by the fact that their contacts have two operative positions other than normal, the two positions being controlled by energizing currents of different value or character. This relay is utilized when actuated by what may be called its normal energization, to control at one point the circuit of a calling signal from the subscriber, and it may be also utilized to control the display of a supervisory signal after connection is made to a spring-jack of the line. When the ringing signal is to be actuated at the substation, means are provided for securing an abnormal energization of the relay and in response to this abnormal energization, the relay controls contacts which serve to interrupt the normal battery connection of the line limbs, and thus leave one or both line limbs free from earth connections and preventing any interference from this cause with the signal.

The invention will be more fully understood from the accompanying drawings forming a part of this specification in which

Figure 1 illustrates two subscribers lines organized in accordance with a preferred form of my invention. These lines are shown as terminating at a central office and there associated with appropriate cord connecting apparatus. In this diagram, the double-acting relay also serves as a line relay to cause the display of a signal at the central office when circuit is closed at the substation. Fig. 2 is a diagram illustrating a modification of Fig. 1 in which the double-acting line relay serves also to control the display of a supervisory signal, and in which the spring-jacks or connection terminals for the line are provided with three contact pieces instead of two as in Fig. 1. Fig. 3 illustrates a modification of the structure of Fig. 2 in which the ordinary line relay is provided, and in which a double-acting cut-off relay in a local circuit serves normally to control the circuit of the line signal and abnormally to control the connections of the line relay to the line limbs. Fig. 4 illustrates a structure different from that of Fig. 3 in that the double-acting relay is a polarized relay and is operated by currents of opposite polarity rather than by currents of different strength as in Fig. 3.

Like characters refer to corresponding parts in the several figures.

Referring to Fig. 1, A and B indicate the two substations which are connected to the central office by suitable telephone lines. The equipment at the substations, which may be of any preferred type, is here shown as comprising a condenser *c* and a ringing signal or call bell *b* normally in bridge of the line limbs and a receiver *r* and transmitter *t* in an alternate bridge of the line limbs adapted to be closed at the upper contact of the hook switch *h*. At the central office a relay 3 is provided having two windings. Its contacts are so arranged that when the relay is energized by a relatively weak current, a circuit will be closed at armature 9 and contact 8, but the connection indicated at armature 6 and contact 7 will remain uninterrupted. When the relay is energized by a relatively strong current, both sets of contacts will be actuated and winding 4 thus disconnected from limb 1 of the line. When the subscriber at substation A desires to initiate a call and removes his receiver from its switch hook, current will flow from the intermediate terminal of battery C through winding 4,

contact 7, armature 6, limbs 1 and 2 and winding 5, through the ground or return side of the battery. This current is of relatively low voltage and will produce a normal energization of the relay, and the resulting attraction of armature 9 completes a current for lamp 10 through contact 8, and through contact 14 and armature 13 of relay 11, thus indicating to the operator that a connection is desired. Upon insertion of the connecting plug O into the jack *j* of the calling line, current will flow from the intermediate terminal of battery C through relay 24, strand 20 of the cord circuit, contact 16, winding 12 of relay 11, and winding 5 of relay 3 to ground. A current will also flow through relay 23, strand 19, contact 17 of the spring-jack, winding 15 of relay 11, and thence through the line limbs and winding 5 to ground. This current serves to energize relay 11 and the energization of relay 23 serves to prevent the display of the supervisory lamp 27 which would otherwise have its circuit completed at the contacts of relay 24. The energization of relay 11 serves to extinguish lamp 10 by opening its circuit at armature 13 and contact 14, and armature 6 of relay 3 remains in its normal position at this time. The operator actuates her listening key *k* and after learning with what line connection is desired, in this case that of subscriber B, she tests in the usual way. If the line be idle, contact 16 of the jack will be at the potential of the grounded side of the battery and no current flow will result. If the line be busy, the contact 16 then being connected with an active terminal of the battery through the sleeve strand of the connected cord circuit, current will flow when the test is made, from contact 16 through strand 21, armature 30 of relay 26, its normally closed contact and to ground through the common test relay 31, and the resulting energization of relay 31 closes a circuit of battery C through the test winding of the operator's induction coil, thus giving the required indication. Assuming that the line be idle, the operator inserts the connecting plug P and actuates her ringing key *k'*. A circuit may then be traced from the upper terminal of battery C through resistance 32, contact 16, winding 12 and through winding 5 of relay 3 to ground. This current being of higher potential than that which is normally supplied to relay 3, causes the actuation of both of its armature contacts and also energizes relay 11. The actuation of armature 6 disconnects winding 4 of relay 3 from limb 1 of the line, thus leaving that limb free from battery or earth connections, and the energization of relay 11 prevents the display of lamp 10 by the interruption of its circuit at contact 14. A circuit for ringing current may then be traced from generator G through contact 17 of the spring-jack, winding 15, limbs 1 and 2 and to ground through winding 5 of relay 3 or through winding 12, contact 16, resistance 32 and the sections of the battery C. Upon the restoration of the ringing key, current flows from the intermediate terminal of the battery through relay 26, strand 22, contact 16, winding 12 and winding 5 to ground. This current being of relatively small value, armature 6 of relay 3 returns to its normal position and the energization of relay 11 prevents the display of lamp 10. The energization of relay 26 at this time completes the circuit of supervisory lamp 28 at armature 29 and the attraction of armature 30 disconnects the test relay 31 and completes the talking circuit of strand 21. When the subscriber answers, current will flow through relay 25, strand 21, contact 17, winding 15, limbs 1 and 2, and to ground through winding 5 of relay 3, thus energizing the substation transmitter and causing relay 25 to interrupt the circuit of lamp 28. The two subscribers are now united for conversation and when either replaces his receiver, the consequent interruption of the circuit of relay 23 or 25 causes the illumination of the corresponding supervisory lamp and the display of both lamps constitutes the usual disconnect signal. It is to be noted that the relay 11 is indicated as having twin windings and these windings being differentially connected, no undue interference with the transmission of voice currents results therefrom.

The structure of Fig. 2 differs from that of Fig. 1 in that the spring-jacks and connecting plugs are provided with three contact pieces each, instead of two, and in that the operation of the supervisory lamps is controlled by contacts of relay 3 rather than by relays associated with the cord circuit. When the subscriber calls, the ensuing normal energization of relay 3 causes the attraction of armature 9, thus closing a circuit for lamp 10 which may be traced from the active terminal of battery C' through lamp 10, armature 36 and contact 35 of relay 34 and through contact 8 and armature 9 of relay 3. Upon the insertion of an answering plug O', current flows through lamp 27, contact 37 of the spring-jack, and to ground through the winding of relay 34. The resistance of the winding of relay 34 is so proportioned that although the relay is energized, the current flow is not sufficient to cause the illumination of lamp 27. The energization of the relay serves to interrupt the circuit of lamp 10 at armature 36. When the subscriber has finished conversation and replaces his receiver, the resulting deënergization of relay 3 allows armature 9 to engage contact 33, thus completing a lower resistance circuit to ground for lamp 27 through resistance 47 and the resulting current is sufficient to illuminate lamp 27. The value of resistance 47 is such that when connection is made to a spring-jack of the line to

call the subscriber, the electrical potential at contact 37 will be sufficiently raised to give the necessary busy test. When it is desired to call the subscriber, the calling plug P′ is inserted into the spring-jack and the ringing key k' is actuated and circuit is thus completed from battery C^2 through resistance 32, strand 21, contact 17 and winding 5 to ground. Battery C^2 being of relatively greater voltage than C′, the relay is at this time energized to its greatest capacity and the consequent attraction of armature 6 disconnects winding 4 from limb 1, thus leaving limb 1 clear for ringing current from generator G′. When the ringing key is restored, the relay 3 assumes its normal position, the supervisory lamp 28 being then lighted by current flowing through resistance 47 and relay 34, and when the subscriber answers, the attraction of armature 9 causes the extinguishment of supervisory lamp 28 and the energization of relay 34 prevents the display of the line lamp 10.

Fig. 3 is a diagrammatic illustration of a structure differing from that of Fig. 2 in that a double-acting relay 39 is substituted for relay 34 of the former diagram, the line relay 48 being of ordinary construction. When the subscriber calls, current flowing through windings 4 and 5 of relay 48 and through armature contacts 42 and 43 of relay 39, closes the circuit of lamp 10 at armature 9, contact 8 and through armature 51. Upon the insertion of the answering plug, current will flow from battery C^3 through lamp 27, contact 37 and through winding of relay 39 to ground. This current is of relatively small value and suffices only to cause the attraction of armature 51, thus extinguishing the lamp 10. When the subscriber is to be called, the actuation of ringing key k' completes a circuit for battery C^2 which may be traced from the upper terminal of the battery through contact 46 and lever 45 of the ringing key, and thence through contact 57 of the plug, contact 37 of the jack and to ground through the winding of relay 39. Battery C^2 being of relatively high voltage, the ensuing energization of relay 39 is sufficient to cause the complete attraction of armature 51. This action prevents the display of line lamp 10, disconnects the windings 4 and 5 of relay 48 from the line limbs at armature contacts 42 and 43 and the engagement of contact 42 with contact 41 completes a circuit for windings 4 and 5 to hold armature 9 out of engagement with contact 33 and thus prevent resistance 40 from shunting relay 39. It is also to be understood that when the ringing key is actuated, current from generator G will momentarily flow through windings 4 and 5, thus breaking the circuit through resistance 40 during the initial energization of relay 39. Upon the restoration of the ringing key, contacts 42 and 43 assume their normal positions and the current which then flows from battery C^3 through lamp 28, contact 44, lever 45, plug contact 57, jack contact 37 and through resistance 40 and relay 39, is sufficient to illuminate lamp 28 and causes the partial attraction of armature 51. When the subscriber answers, the resulting energization of relay 48 interrupts the path for current through resistance 40 and thus extinguishes lamp 28, as in Fig. 2.

Fig. 4 differs from Fig. 3 in that a polarized relay 49 is provided in place of the double-acting relay 39. This relay is normally energized by current from the upper terminal of battery C^4, the current then being in the proper direction to cause the upper end of armature 50 to move to the right, thus interrupting the circuit of lamp 10 at contact 56. When the ringing key is actuated in calling a subscriber, current then flows from the lower terminal of battery C^4 and causes the upper end of armature 50 to move to the left, thus, disconnecting windings 4 and 5 of relay 48 from limbs 1 and 2, at contacts 52 and 53. The control of the line lamp and supervisory lamp is otherwise as described in connection with Fig. 3.

It is to be understood that the illustrations of the double-acting relays in the several figures are diagrammatic illustrations only, and that any preferred mechanical structure may be employed. It is also to be understood that the several batteries illustrated may be arranged as one common battery having several connection terminals or in any way desired, and that the several grounds indicated may be connections to the office return. It will also be apparent that the ringing signal at the substation may consist of any suitable electrical device other than the call bell b, and that many alterations and modifications of my invention may be made without departing from its spirit, and I therefore, do not wish to be limited to the precise structures illustrated.

That which I consider as new and novel and desire to secure by Letters Patent of the United States, is:—

1. A telephone exchange system comprising a telephone line extending from a substation to the exchange, a telephone transmitter and a ringing signal at the substation, a source of ringing current at the exchange, a switch for connecting said ringing source to the line, a signal indicator at the exchange partially controlled from the substation, an energizing circuit for the transmitter completed through a normal connection of the line, and means for interrupting said normal connection during the connection of said ringing source.

2. A telephone exchange system comprising a telephone line extending from a substation to the exchange, a telephone transmitter and a ringing signal at the substation, a

source of ringing current at the exchange, a switch for connecting said ringing source to the line, a signal indicator at the exchange partially controlled from the substation, an energizing circuit for the transmitter completed through a normal connection of the line, and a relay for interrupting said normal connection during the connection of said ringing source.

3. A telephone exchange system comprising a telephone line extending from a substation to the exchange, a telephone transmitter and a ringing signal at the substation, a source of ringing current at the exchange, a switch for connecting said ringing source to the line, a signal indicator at the exchange partially controlled from the substation, an energizing circuit for the transmitter completed through a normal connection of the line, and a double-acting relay for interrupting said normal connection during the connection of said ringing source.

4. A telephone exchange system comprising a telephone line extending from a substation to the exchange, a telephone transmitter and a ringing signal at the substation, a source of ringing current at the exchange, a switch for connecting said ringing source to the line, a signal indicator at the exchange partially controlled from the substation, an energizing circuit for the transmitter completed through a normal connection of the line, and a cut-off relay for interrupting said normal connections during the connection of said ringing source.

5. A telephone exchange system comprising a telephone line extending from a substation to the exchange, a telephone transmitter and a ringing signal at the substation, a source of ringing current at the exchange, a switch for connecting said ringing source to the line, a signal indicator at the exchange partially controlled from the substation, an energizing circuit for the transmitter completed through a normal connection of the line, and a double-acting cut-off relay for interrupting said normal connection during the connection of said ringing source.

6. A telephone exchange system comprising a telephone line extending from a substation to the exchange, a telephone transmitter and a ringing signal at the substation, a source of ringing current at the exchange, a switch for connecting said ringing source to the line, a signal indicator at the exchange partially controlled from the substation, an energizing circuit for the transmitter completed through a normal connection of the line, and means normally operating to partially control the display of the signal indicator and abnormally operated to interrupt said normal connection during the connection of said ringing source.

7. A telephone exchange system comprising a telephone line extending from a substation to the exchange, a telephone transmitter and a ringing signal at the substation, a source of ringing current at the exchange, a switch for connecting said ringing source to the line, a signal indicator at the exchange partially controlled from the substation, an energizing circuit for the transmitter completed through a normal connection of the line, and a relay normally operating to partially control the display of the signal indicator and abnormally operated to interrupt said normal connection during the connection of said ringing source.

8. A telephone exchange system comprising a telephone line extending from a substation to the exchange, a telephone transmitter and a ringing signal at the substation, a source of ringing current at the exchange, a switch for connecting said ringing source to the line, a signal indicator at the exchange partially controlled from the substation, an energizing circuit for the transmitter completed through a normal connection of the line, and a cut-off relay normally operating to partially control the display of the signal indicator and abnormally operated to interrupt said normal connection during the connection of said ringing source.

9. A telephone exchange system comprising a telephone line extending from a substation to the exchange, a telephone transmitter and a ringing signal at the substation, a source of ringing current at the exchange, a switch for connecting said ringing source to the line, a signal indicator at the exchange partially controlled from the substation, an energizing circuit for the transmitter completed through a normal connection of the line, and means controlled by the actuation of said switch for temporarily interrupting said normal connection during the connection of said ringing source.

10. A telephone exchange system comprising a telephone line extending from a substation to the exchange, a telephone transmitter and a ringing signal at the substation, a source of ringing current at the exchange, a switch for connecting said ringing source to the line, a signal indicator at the exchange partially controlled from the substation, an energizing circuit for the transmitter completed through a normal connection of the line, and a relay controlled at contacts of said switch for temporarily interrupting said normal connection during the connection of said ringing source.

11. A telephone exchange system comprising a telephone line extending from a substation to the exchange, a telephone transmitter and a ringing signal at the substation, a source of ringing current at the exchange, a switch for connecting said ringing source to the line, a signal indicator at the exchange partially controlled from the substation, an energizing circuit for the transmitter com-

pleted through a normal connection of the line, and a double-acting relay controlled at contacts of said switch for temporarily interrupting said normal connection during the connection of said ringing source.

12. A telephone exchange system comprising a telephone line extending from a substation to the exchange, a telephone transmitter and a ringing signal at the substation, a source of ringing current at the exchange, a switch for connecting said ringing source to the line, a signal indicator at the exchange partially controlled from the substation, an energizing circuit for the transmitter completed through a normal connection of the line, and a cut-off relay controlled at contacts of said switch for temporarily interrupting said normal connection during the connection of said ringing source.

13. A telephone exchange system comprising a telephone line extending from a substation to the exchange, a telephone transmitter and a ringing signal at the substation, a source of ringing current at the exchange, a switch for connecting said ringing source to the line, a signal indicator at the exchange partially controlled from the substation, an energizing circuit for the transmitter completed through a normal connection of the line, and a double-acting cut-off relay controlled at contacts of said switch for temporarily interrupting said normal connection during the connection of said ringing source.

14. A telephone exchange system comprising a telephone line extending from a substation to the exchange, a telephone transmitter and a ringing signal at the substation, a source of ringing current at the exchange, a switch for connecting said ringing source to the line, a signal indicator at the exchange partially controlled from the substation, an energizing circuit for the transmitter completed through a normal connection of the line, and means normally operating to partially control the display of the signal indicator and abnormally operated by current in a circuit controlled at contacts of said switch to interrupt said normal connection during the connection of said ringing source.

15. A telephone exchange system comprising a telephone line extending from a substation to the exchange, a telephone transmitter and a ringing signal at the substation, a source of ringing current at the exchange, a switch for connecting said ringing source to the line, a signal indicator at the exchange partially controlled from the substation, an energizing circuit for the transmitter completed through a normal connection of the line, and a relay normally operating to partially control the display of the signal indicator and abnormally operated by current in a circuit controlled at contacts of said switch to interrupt said normal connection during the connection of said ringing source.

16. A telephone exchange system comprising a telephone line extending from a substation to the exchange, a telephone transmitter and a ringing signal at the substation, a source of ringing current at the exchange, a switch for connecting said ringing source to the line, a signal indicator at the exchange partially controlled from the substation, an energizing circuit for the transmitter completed through a normal connection of the line, and a cut-off relay normally operating to partially control the display of the signal indicator and abnormally operated by current in a circuit controlled at contacts of said switch to interrupt said normal connection during the connection of said ringing source.

17. A telephone exchange system comprising a telephone line extending from a substation to the exchange, a ringing signal at the substation, a source of ringing current at the exchange, a switch for connecting said ringing source to the line, a signal controlling electromagnet at the exchange said magnet being individual to the line and in circuit therewith during conversation, and means for interrupting the circuit of said magnet during the connection of said ringing source to the line.

18. A telephone exchange system comprising a telephone line extending from a substation to the exchange, a ringing signal at the substation, a source of ringing current at the exchange, a switch for connecting said ringing source to the line, a signal controlling electromagnet at the exchange said magnet being individual to the line and in circuit therewith during conversation, a central source for supplying talking current to connected substations, and means for preventing the actuation of said magnet by current from said ringing source during the connection of said ringing source to the line.

19. A telephone exchange system comprising a telephone line extending from a substation to the exchange, a ringing signal at the substation, a source of ringing current at the exchange, a switch for connecting said ringing source to the line, a signal controlling electromagnet at the exchange said magnet being individual to the line and in circuit therewith during conversation, and means controlled through the actuation of said switch for interrupting the circuit of said magnet during the connection of said source to the line.

20. A telephone exchange system comprising a telephone line extending from a substation to the exchange, a ringing signal at the substation, a source of ringing current at the exchange; a switch for connecting said ringing source to the line, a signal controlling electromagnet at the exchange said magnet

being individual to the line and in circuit therewith during conversation, a central source for supplying talking current to connected substations, and means controlled through the actuation of said switch for preventing the actuation of said magnet by current from said ringing source during the connection of said ringing source to the line.

21. A telephone exchange system comprising a telephone line extending from a substation to the exchange, a ringing signal at the substation, a source of ringing current at the exchange, a switch for connecting said ringing source to the line, a signal controlling electromagnet at the exchange said magnet being individual to the line and in circuit therewith during conversation, and means controlled at contacts of said switch for interrupting the circuit of the magnet during the connection of said source to the line.

22. A telephone exchange system comprising a telephone line extending from a substation to the exchange, a ringing signal at the substation, a source of ringing current at the exchange, a switch for connecting said ringing source to the line, a signal controlling electromagnet at the exchange said magnet being individual to the line and in circuit therewith during conversation, a central source for supplying talking current to connected substations, and means controlled at contacts of said switch for preventing the actuation of the magnet by current from said ringing source during the connection of said ringing source to the line.

23. A telephone exchange system comprising a telephone line extending from a substation to the exchange, a telephone transmitter and a ringing signal at the substation, a source of ringing current at the exchange, a switch for connecting said ringing source to the line, an energizing circuit for the transmitter completed through a normal connection of the line, and means for interrupting said normal connection during the connection of said ringing source.

24. A telephone system comprising a telephone line extending from a substation to a central office, a line relay having a plurality of windings, means normally under the control of the subscriber for closing a circuit through both of said windings to energize said relay, a line signal displayed in response to such energization, means for disconnecting one of said windings from its line limb by supplying current to the other winding, a cord-circuit, a supervisory lamp associated therewith, resistance devices associated with said line, means for connecting said supervisory lamp in series with parallel branches each including one of said resistance devices, and contacts on said line relay for controlling the continuity of one of said branches, whereby the lighting and extinguishing of said supervisory lamp during the connection of said cord-circuit and line is under the control of the subscriber.

25. A telephone system comprising a telephone line extending from a substation to a central office, a line relay having a plurality of windings, means normally under the control of the subscriber for closing a circuit through both of said windings to energize said relay, a line signal having a circuit normally open only at said relay and therefore displayed in response to such energization, means for disconnecting one of said line relay windings from its line limb by supplying current to the other winding, a cord-circuit, a supervisory lamp associated therewith, a cut-off relay for controlling said line signal circuit, a resistance coil, said cut-off relay and resistance coil being in parallel branches, means for connecting said supervisory lamp in circuit with said cut-off relay and resistance coil, and contacts on said line relay for controlling the continuity of the branch including said resistance coil, whereby the supervisory lamp will be lighted by the closing and extinguished by the opening of said branch.

In witness whereof, I hereunto subscribe my name this 17th day of July 1906.

HARRY G. WEBSTER.

Witnesses:
ALFRED H. DYSON,
GEO. E. MUELLER.