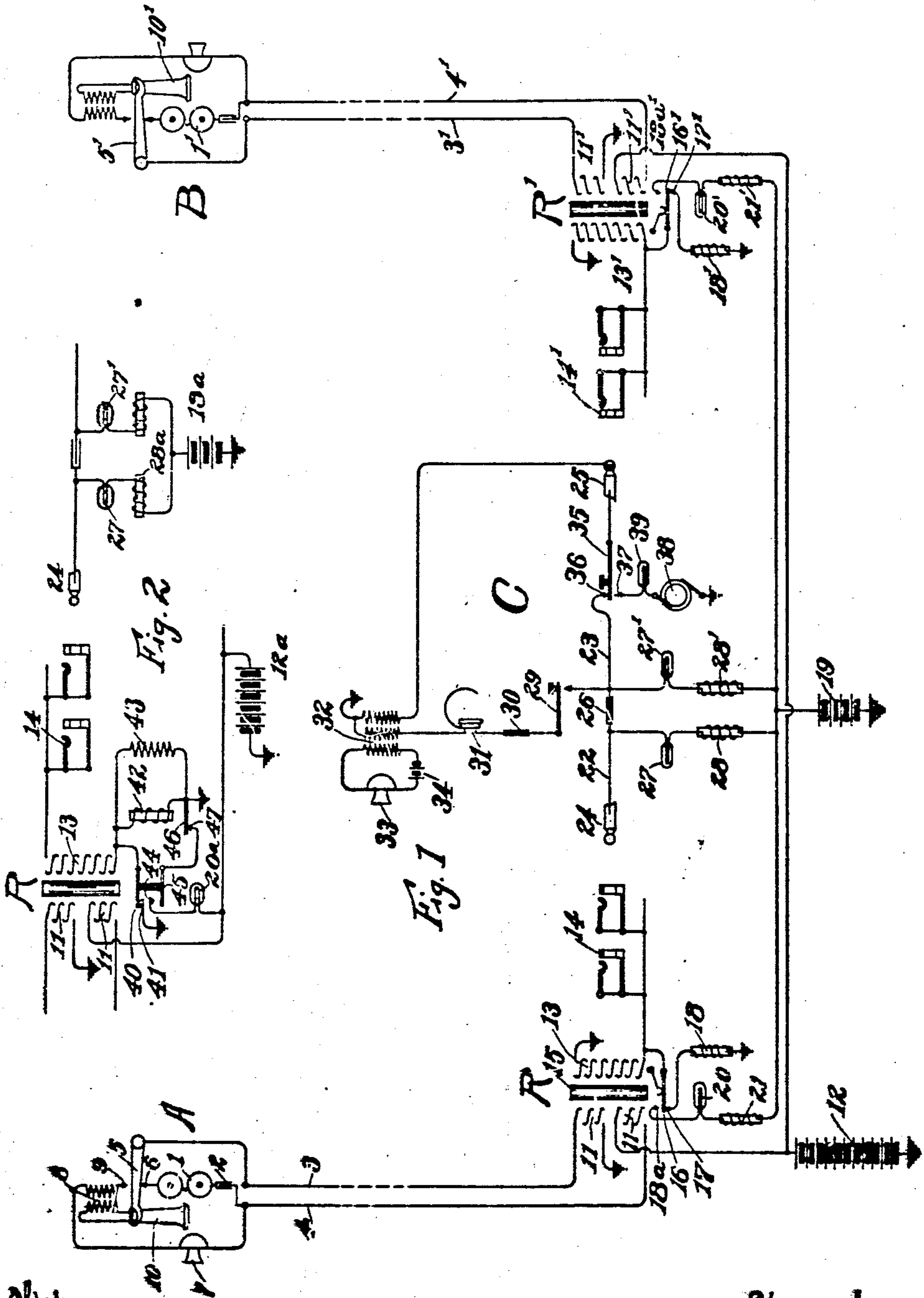


No. 897,240.

PATENTED AUG. 25, 1908.

H. G. WEBSTER.
TELEPHONE SYSTEM.
APPLICATION FILED MAR. 5, 1906.



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TELEPHONE SYSTEM.

No. 897,240.

Specification of Letters Patent.

Patented Aug. 25, 1908.

Application filed March 5, 1906. Serial No. 301,228.

To all whom it may concern:

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

The present invention relates to manual telephone systems generally, and more particularly to that type in which the various telephone lines extending to the central office are inductively, rather than conductively, united for conversation through the agency of repeating coils interposed between the lines and their respective terminals.

The principal object of the invention is to provide a simplified system of this type, which will be economical to manufacture, easy to install, and efficient in operation. To this end, I employ a novel arrangement of circuits and apparatus for controlling the line and supervisory signals, and combine the repeating coil and line relay in a single structure.

The nature and objects of the invention will more fully appear upon reference to the following detailed description taken in connection with the accompanying drawings, and the scope of the invention will be particularly indicated in the appended claims.

In said drawing, Figure 1 illustrates diagrammatically a telephone system constituting one species of the present invention, and Fig. 2 illustrates a portion of a similar diagram constituting a second species of the invention.

Referring to said drawing in detail, A and B designate two substations which are connected to a central office C by suitable telephone lines.

The equipment at substation A, which may be of any preferred type, is here shown as comprising a call-bell 1 in series with a condenser 2 included in a normally closed bridge of the telephone line limbs 3-4 by the engagement of the switch-hook 5 with the contact 6. A second bridge normally open, including the transmitter 7 and one winding of the induction coil 8, is closed at the contact 9 by the switch-hook 5 whenever the receiver 10, which is included in a local circuit with the other winding of the induction coil 8, is removed therefrom. The line circuit is completed at the central office through

a high potential source of battery current 12 and the winding 11 of the repeating coil R. The winding 11 is shown in two sections, one of which is connected between the line limb 3 and the grounded pole of the battery, and the other of which is connected between the line limb 4 and the live pole of the battery. The other winding 13 of the repeating coil relay R is included in a branch between the jacks 14 and ground. Both windings 11 and 13 are wound upon the core 15 of the relay, but are shown separated therefrom for clearness. The jacks 14 are also normally connected to ground through a branch in parallel to the winding 13 including the repeating coil relay contacts 16-17 and a resistance 18, here shown as an impedance. The alternate contact 18^a of the relay, when engaged, connects the jacks 14 with the live pole of a low potential battery 19 through the line lamp 20 and a resistance 21, here shown also as an impedance.

The equipment and the connections thus far described with reference to substation A are duplicated in connection with substation B, and the corresponding parts are there indicated by similar primed characters.

At the central office, the jacks of different lines are adapted to be connected by a link-circuit comprising the strands 22-23 uniting the answering plug 24 and the calling plug 25. These strands are separated by the usual condenser 26, which will permit the passage of voice currents but prevent the passage of battery current. Supervisory lamps 27 and 27', each in series with an impedance 28-28', are connected between the live pole of the battery 19 and the link-circuit strands 22 and 23, respectively. The usual listening-key 29 is provided for closing a branch from the strand 23 to ground through the condenser 30, operator's receiver 31, and the secondary winding of an induction coil 32. The primary winding of the induction coil 32 is included in a local circuit with the operator's transmitter 33 and the battery 34, while a tertiary winding of the induction coil is connected between the tip or testing contact of the calling plug 25 and ground. The strand 23 is also provided with a ringing-key 35 which normally engages a fixed contact 36 to maintain the continuity of the strand 23, but which may be depressed into engagement with a fixed contact 37 to connect the

live pole of the ringing generator 38 through the usual resistance lamp 39 to the calling plug 25.

In the operation of the system, a party at substation A, desiring to converse with a party at substation B, removes his receiver from its hook, thereby completing the line circuit over the line limbs 3-4 and through the battery 12 and the winding 11 of the repeating coil relay R. The closing of this circuit energizes the relay R sufficiently to attract its armature contact 16 against the tension of the opposing spring into engagement with the fixed contact 18^a, thereby completing a path for current through the line lamp 20 to illuminate the latter, as a signal to the operator that connection is desired. The line lamp circuit extends from the live pole of the battery 19, through impedance 21, line lamp 20, relay contacts 18^a-16, repeating coil winding 13, to ground. The flow of current through the latter winding, however, is insufficient to cause the return of the armature contact 16 to its normal position. Upon observing the call signal, the operator will insert her answering plug 24 into one of the jacks 14 and depress her listening-key 29 to learn the wishes of the calling party.

The insertion of the plug 24 will complete a second path for current from the live pole of the battery 19, through winding 13 of the repeating coil in parallel to that through the impedance 21, line lamp 20, and relay contacts 18^a-16. This path includes the impedance 28, supervisory lamp 27, strand 22, plug 24, and jack 14. The closing of this path in shunt to the line lamp 20 will, by reason of the winding 13, prevent sufficient current from flowing through the lamp 27 to cause its illumination. At this time, both lamps 20 and 27 will, therefore, remain dark. Upon depressing the listening-key 29, the operator's talking circuit, through the secondary winding of the induction coil 32, will extend from ground at said coil through said secondary winding, the operator's receiver 31, the condenser 30, ringing-key 29, condenser 26, strand 22, plug 24, jack 14, repeating coil winding 13 to ground. This circuit, being inductively related to the subscriber's circuit over the line limbs 3-4, will enable conversation to be held between the operator and the subscriber connected with said line. Upon learning the wishes of the calling party, the operator will then touch the tip contact of the calling plug 25 against the testing contact of one of the jacks 14' to determine the idle or busy condition of the line 3'-4'. If said line is busy, there will be a potential at the test contact of the jack above that of ground by reason of the connection of one of the multiple jacks with the live pole of the battery 19 through the connected link-circuit at another operator's position. Under such conditions, the

engagement of the tip contact of the plug 25 with the testing contact of the jack will cause a momentary flow of current through the tertiary winding of the induction coil 32 and a resultant "click" in the operator's receiver, as an indication to her that the line is busy. If the line is found idle, the operator will insert the plug 25 into the jack 14' and depress her ringing-key 35 to close a circuit from the live pole of the calling generator 38, through the lamp 39, ringing-key contacts 37, 35, plug 25, jack 14' and repeating coil relay winding 13' to ground. The passage of alternating current over this circuit will induce a similar current flow over the line limbs 3'-4' to actuate the call-bell 1' at substation B. Upon the insertion of the plug 25 into the jack 14', the circuit will be completed from the live pole of the battery 19, through impedance 28', supervisory lamp 27', strand 23, plug 25, jack 14', and thence to ground by two paths—one through the relay winding 13' and the other by way of relay contacts 16'-17' and impedance 18'. By reason of the relatively low resistance of this latter branch, enough current will flow through supervisory lamp 27' to cause its illumination. It will remain thus illuminated until the call at substation B is answered by the removal of the receiver 10' from its switch-hook 5'. This latter act will close a circuit through high potential battery 12 and the winding 11' of the repeating coil relay R' to cause the separation of the relay contacts 16'-17' and the engagement of the former with the alternate contact 18^{a'}. This will break the branch including the low resistance of the impedance 18' and leave the circuit of the supervisory lamp 27' completed only through the winding 13' in parallel to the line lamp 20'. As previously indicated, this will cause the extinguishment of both line and supervisory lamps. With the parties thus connected, the supervisory lamps 27-27' will remain extinguished until, at the end of conversation, the receivers 10-10' are hung up. As soon as this takes place, the armature contacts of the repeating coil relays will return to their normal position, thereby interrupting the circuit of the line lamps and causing the illumination of the supervisory lamps, as an indication to the operator to disconnect.

In the form of the invention illustrated in Fig. 2, a somewhat different circuit arrangement is employed in the control of the line and supervisory lamps. In this case, the high potential battery 12^a is connected in series with the sections of the winding 11 of the repeating coil relay as in Fig. 1, and the other winding 13 is similarly connected to the line jacks 14, but the connection of the latter to ground is normally by way of the normally closed contacts 40-41 and, when said con-

tacts are separated, by way of the winding of the cut-off relay 42 which is rendered non-inductive by means of a non-inductive shunt 43, to avoid interference with speech transmission. Line lamp 20^a in this instance is connected to the high potential battery 12^a and its circuit is provided with two break points—one controlled by the repeating coil contacts 44—45, and the other by the cut-off relay contacts 46—47. In other respects, the system is substantially the same as that disclosed in Fig. 1.

In the operation of this system, the removal of the switch-hook at the substation, in order to initiate a call, supplies current to the repeating coil relay winding 11 from the battery 12^a to cause said relay to attract its armature contacts 40 and 45—by the former, to break the normal connection from the repeating coil relay winding 13 to ground, and by the latter, to close the circuit of the line lamp 20^a to cause its illumination. In answering a call, the insertion of the plug 24 into the jack 14 completes a circuit for the supervisory lamp 27 from the live pole of the battery 19^a, through the impedance 28^a, supervisory lamp 27, plug 24, jack 14, repeating coil relay winding 13, winding of the cut-off relay 42, to ground. By reason of the resistance of this circuit, due to the inclusion of the winding of the cut-off relay 42, the current flow through the supervisory lamp 27 is insufficient to cause its illumination. This current flow, however, is sufficient to cause the cut-off relay 42 to separate its contacts 46—47, thereby to extinguish the line lamp 20^a. In the act of calling a subscriber, the insertion of the plug 24 into the jack closes a circuit for the supervisory lamp 27 similar to that just traced, but connecting to ground by way of the repeating coil relay contacts 40 and 41 instead of by way of the cut-off relay winding 42. This direct ground allows sufficient current to flow through the supervisory lamp to cause its display. Its extinguishment is brought about by the subsequent answering of the subscriber, which causes a separation of the relay contacts 40 and 41, thereby including the winding of the cut-off relay 42 in circuit with the supervisory lamp and causing its extinguishment.

In both forms of the invention, the arrangement is such that, at no time, can the operator cause a change in the normal condition of the repeating coil relay contacts, nor can she hold the relay armatures attracted. In other words, the movements of the armatures of these relays are under the sole control of the subscribers.

Obviously, certain modifications and alterations may be made in the matter herein disclosed without departing from the spirit and scope of my invention. For example, the various connections to ground may be made to a common office return; the bat-

teries shown separately may be one and the same and the low potential connections made at suitable points. Likewise, in other instances, ohmic resistance may be used instead of the impedances illustrated. I, therefore, use the term, "resistance," in the accompanying claims in its broader sense to include not only ohmic resistance, but also impedance, and otherwise aim to cover by the terms of the claims the various possible variations and combinations.

What I claim as new, and desire to secure by Letters Patent of the United States is:—

1. A telephone system comprising a telephone line extending from a substation to a central office, a connection terminal for said line, a repeating coil relay controlled solely by the subscriber having windings inductively uniting said line to said terminal, a link-circuit for making connection to said terminal to establish a conversational circuit, a resistance conductively associated with said terminal, an electrically actuated signal and connections with said repeating coil relay contacts and said resistance whereby said resistance is utilized in the control of said signal.

2. A telephone system comprising a telephone line extending from a substation to a central office, a connection terminal for said line, a repeating coil relay controlled solely by the subscriber having windings inductively uniting said line to said terminal, a link-circuit for making connection to said terminal to establish a conversational circuit, a resistance conductively associated with said terminal, an electrically actuated signal associated with said link-circuit, and connections with said repeating coil relay contacts and said resistance whereby said resistance is utilized in the control of said signal.

3. A telephone system comprising a plurality of lines extending from substations to a central office, connection terminals for said lines, repeating coil relays controlled solely by the subscribers having windings inductively uniting each line to its terminal, a link-circuit for completing a connecting circuit between any two telephone lines, a resistance conductively associated with said terminal, an electrically actuated signal connected to the link-circuit in bridge of the talking circuit, and connections with said repeating coil relay contacts and said resistance whereby said resistance is utilized in the control of said signal.

4. A telephone system comprising a plurality of lines extending from substations to a central office, connection terminals for said lines, repeating coil relays controlled solely by the subscribers having windings inductively uniting each line to its terminal, a link-circuit for completing a connecting circuit between any two telephone lines, a resistance conductively associated with each terminal,

an electrically actuated signal connected to the link-circuit in bridge of the talking circuit, and means for cutting said resistance into and out of circuit with said signal to cause the effacement and display of the latter according to the operative positions of the repeating coil relay contacts.

5. A telephone system comprising a telephone line extending from a substation to a central office, a connection terminal for said line, a repeating coil relay having windings inductively uniting said line to said terminal, a link-circuit for making connection to said terminal to establish a conversational circuit, a resistance conductively associated with said terminal, an electrically actuated signal, means normally operative upon the connection of said link-circuit to said terminal to supply current over a circuit through one of the repeating coil windings to cause the actuation of said signal, and means actuated by said repeating coil relay contacts under the control of the subscriber to include said resistance in said circuit to reduce the current flow therein sufficiently to return said signal to normal.

6. A telephone system comprising a telephone line extending from a substation to a central office, a connection terminal for said line, a repeating coil relay having windings inductively uniting said line to said terminal, a link-circuit for making connection to said terminal to establish a conversational circuit, means for energizing said repeating coil relay to cause a movement of the relay armature from its normal position, said movement being under the sole control of the subscriber an electrically actuated signal having its circuit normally closed at one point upon the movement of said relay armature, and means operative upon the connection of the said link-circuit to said terminal to interrupt the circuit of said signal at another point.

7. A telephone system comprising a telephone line extending from a substation to a central office, a connection terminal for said line, a repeating coil relay having windings inductively uniting said line to said terminal, a link-circuit for making connection to said terminal to establish a conversational circuit, an electrically actuated line signal having its energizing circuit controlled by the relay contacts, means for energizing said relay to cause a change in the normal relative position of its contacts, said contacts being solely controlled by the subscriber and means operative upon the connection of said link-circuit to said terminal to interrupt the circuit of said line signal.

8. A telephone system comprising a telephone line extending from a substation to a central office, a connection terminal for said line, a repeating coil relay solely controlled by the subscriber having windings inductively uniting said line to said terminal, a

link-circuit for making connection to said terminal to establish a conversational circuit, means for energizing said relay to cause a movement of its armature, an electrically actuated line signal having its energizing circuit closed in response to such movement, means under the control of the operator for effacing said signal by interrupting its energizing circuit.

9. A telephone system comprising a telephone line extending from a substation to a central office, a connection terminal for said line, a repeating coil relay solely controlled by the subscriber having windings inductively uniting said line to said terminal, a link-circuit for making connection to said terminal to establish a conversational circuit, means for energizing said relay to cause a movement of its armature by completing a circuit through one of the repeating coil relay windings, a signal displayed in response to such armature movement, and means under the control of the operator for effacing said signal by closing a circuit through the other repeating coil relay winding.

10. A telephone system comprising a telephone line extending from a substation to a central office, a connection terminal therefor, a repeating coil relay having windings inductively uniting said line to said terminal, a link-circuit for making connection to said terminal to establish a conversational circuit, a line signal normally displayed upon the closure of the contacts of said relay, means under the control of the subscriber for closing a circuit over the telephone line and through one of the repeating coil relay windings to close the relay contacts, the movement of said contacts being under the sole control of the subscriber, an electrically actuated signal associated with the link-circuit, means operative upon the connection by the operator of said link-circuit to said terminal to supply current over a circuit including the other repeating coil relay winding normally to cause the display of said link-circuit signal, a resistance conductively associated with said terminal, means operated by the closing of the subscriber's circuit to utilize said resistance to place the display of said link-circuit signal beyond the control of the operator, and means operated by the closing of the operator's circuit to place the display of the line signal beyond the control of the subscriber.

11. A telephone system comprising a telephone line extending from a substation to a central office, a connection terminal for said line, a repeating coil relay solely controlled by the subscriber having windings inductively uniting said line to said terminal, a link-circuit for making connection to said terminal to establish a conversational circuit, a line signal controlled by the relay contacts, means under the control of the subscriber to

energize said relay to cause the display of said signal, a signal associated with said link-circuit, means operative upon the connection of said link-circuit to said terminal normally to display said link-circuit signal by closing a circuit through one of said repeating coil relay windings, a resistance conductively associated with said terminal, and means under the control of the subscriber for effacing said signal by including said resistance in said circuit.

12. A telephone system comprising a telephone line extending from a substation to a central office, a repeating coil connected therewith, means for holding conversation over said line through the agency of said repeating coil, a signal lamp in a normally open circuit with one of the repeating coil windings, a signal lamp in a second normally open circuit, a relay having its winding included in the former circuit and its contacts in the latter, means for normally short circuiting the winding of said relay, means for closing the former circuit normally through the short circuit to light the former signal lamp and abnormally through the relay winding to cause the relay to break the latter circuit, and means for removing the short circuit to increase the resistance of the former circuit to prevent the lighting of its lamp and for normally closing the latter circuit to light its lamp.

13. A telephone system comprising a telephone line extending from a substation to a central office, a repeating coil connected therewith, means for holding conversation over said line through the agency of said repeating coil, a signal lamp in a normally open circuit with one of the repeating coil windings, a signal lamp in a second normally open circuit, a relay having its winding included in the former circuit and its contacts in the latter, means for normally short circuiting the winding of said relay, means under the control of the subscriber for closing the former circuit normally through the short circuit to light the former signal lamp and abnormally through the relay winding to cause said relay to break the latter circuit, and means under the control of the subscriber for removing the short circuit to increase the resistance of the former circuit to prevent the lighting of its lamp and for normally closing the latter circuit to light its lamp.

14. A telephone system comprising a telephone line extending from a substation to a central office, a connection terminal for said line, a repeating coil for inductively uniting said line to said terminal, a link-circuit and connecting plug for making connection to said terminal, means for holding conversation over said line and link-circuit, a supervisory lamp in a normally open circuit with one of the repeating coil windings, a line

lamp in a second normally open circuit, a relay having its winding included in the former circuit and its contacts in the latter, means for normally short circuiting the winding of said relay, means operative upon the connection of said plug to said terminal to close the former circuit normally through the short circuit to light the supervisory lamp and abnormally through the relay winding to cause said relay to break the line lamp circuit, and means under the control of the subscriber for removing the short circuit to increase the resistance of the supervisory lamp circuit to prevent the lighting of the supervisory lamp and for normally closing the line lamp circuit to light the line lamp.

15. A telephone system comprising a telephone line extending from a substation to a central office, a repeating coil connected therewith, means for holding conversation over said line through the agency of said repeating coil, a resistance, a signal lamp included in a normally open circuit with said resistance and one of the repeating coil windings, a normal short circuit about said resistance, a second signal lamp included in a second normally open circuit, means for normally closing said former circuit through said short circuit to light the included lamp, and a single set of contacts normally operative to close said second circuit to light its lamp and to remove said short circuit to increase the resistance of the first lamp circuit to prevent the lighting of its lamp.

16. A telephone system comprising a telephone line extending from a substation to a central office, a repeating coil connected therewith, means for holding conversation over said line through the agency of said repeating coil, a resistance, a signal lamp included in a normally open circuit with said resistance and one of the repeating coil windings, a normal short circuit about said resistance, a second signal lamp included in a second normally open circuit, means under the control of the operator for normally closing said former circuit through said short circuit to light the included lamp, and a single set of contacts under the control of the subscriber for normally closing said second circuit to light its lamp and for removing said short circuit to increase the resistance of the first lamp circuit to prevent the lighting of its lamp.

17. A telephone system comprising a telephone line extending from a substation to a central office, a connection terminal for said line, a repeating coil for inductively uniting said line to said terminal, a link-circuit and connecting plug for making connection to said terminal, means for holding conversation over said line and link-circuit, a resistance, a supervisory lamp included in a normally open circuit with said resistance and one of the repeating coil windings, a normal short

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circuit about said resistance, a line lamp included in a second normally open circuit. means operative upon the connection of said plug to said terminal to close the former circuit normally through the short circuit to light the supervisory lamp, and a single set of contacts under the control of the subscriber for normally closing said second circuit to light the line lamp and for removing

said short circuit to increase the resistance of 10 the supervisory lamp circuit to prevent the lighting of its lamp.

In witness whereof, I hereunto subscribe my name this 3rd day of March, A. D., 1906.

HARRY G. WEBSTER.

Witnesses:

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GEO. E. MUELER.