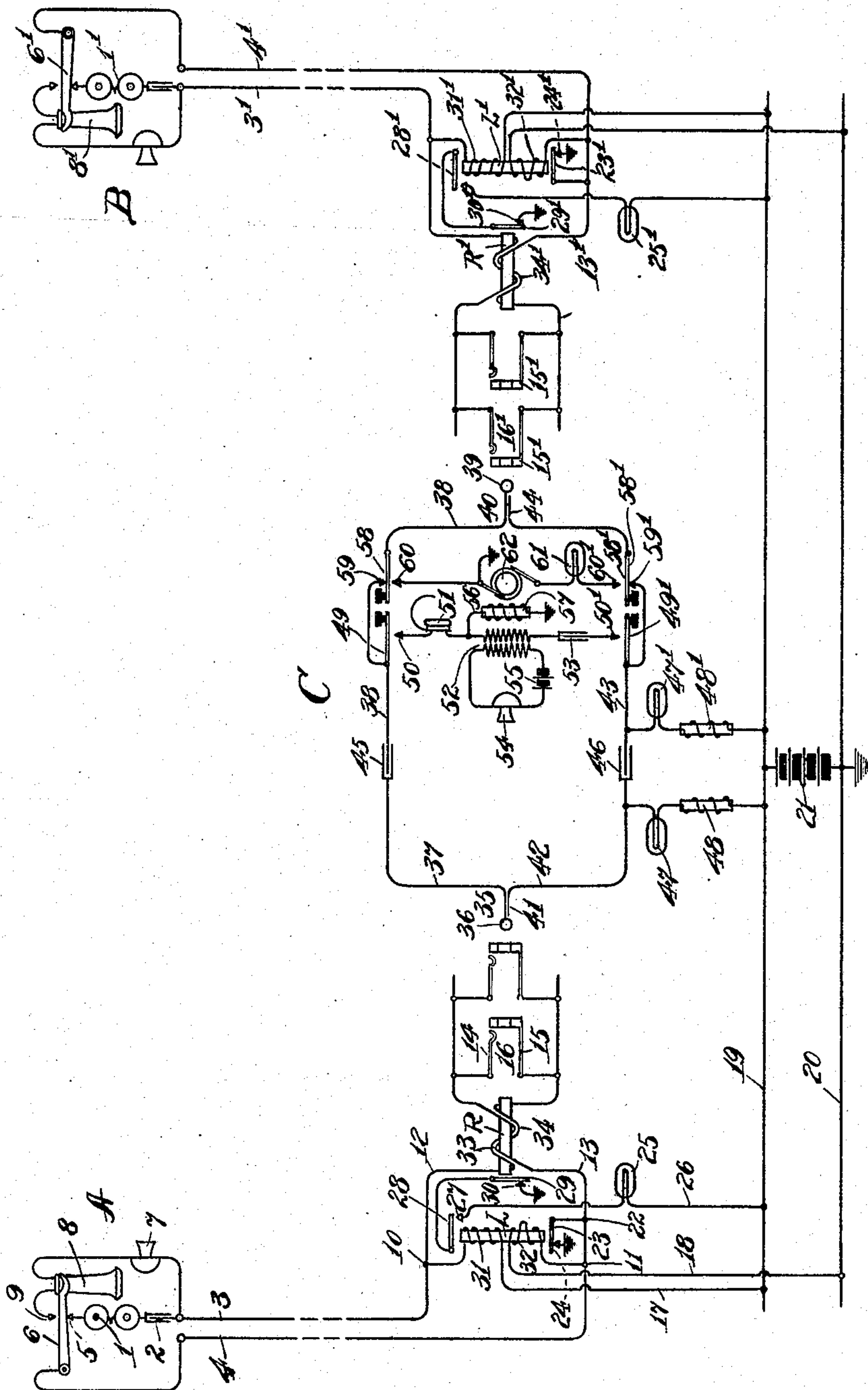


H. G. WEBSTER.
TELEPHONE SYSTEM.

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TELEPHONE SYSTEM.

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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 generally to telephone systems, and more particularly to that class, known as "two-wire" systems, in which the two limbs of any telephone line may be extended through the multiple switchboard to the two line limbs of a second telephone line to establish connection for conversational purposes.

The present invention has to do particularly with the circuits and apparatus by which signals are transmitted between the subscribers and operator, and by which the operative conditions of connected lines may be readily determined by the latter.

The principal object of the invention is to provide a novel "two-wire" system in which the usual supervision may be obtained without the employment of relays in association with the link-circuit. To this end, I preferably connect each supervisory signal directly in circuit between the source of current and a contact of the corresponding connecting plug of the link-circuit, and associate with the usual line relay a resistance so arranged that it may be cut into and out of circuit with the co-acting terminals of the multiple jacks, so that, when the operator inserts a plug into a jack, a circuit is completed either through or around the resistance, according to the position of the switch-hook at the associated substation—the inclusion of the resistance in circuit preventing, and its exclusion permitting, the display of the supervisory signal.

In carrying out my invention along these lines, I have devised certain circuit arrangements which are not limited in their use to "two wire" systems, but are capable of a more general application.

The character of the invention will be more fully understood upon reference to the following detailed description, taken in connection with the accompanying drawing and its scope will be particularly pointed out in the appended claims.

In the drawing, which illustrates diagrammatically a system constructed in accordance with the present invention, A and B represent two substations united by telephone

lines to the central office. The equipment at substation A, which may be of any preferred type, is shown in the present instance as comprising a call-bell 1 and a condenser 2, permanently connected in series in a normally closed bridge between the limbs 3 and 4 of the telephone line. This bridge is normally closed at the contact 5 by the switch-hook 6. A normally open bridge between the line limbs includes the transmitter 7 and the receiver 8. This bridge is normally open at the contact 9. The condenser 2 in the normally closed bridge prevents the flow of battery current, but freely passes the alternating current used in actuating the call-bell 1. As is customary, the removal of the receiver 8 interrupts this bridge and closes the bridge through the transmitter and receiver. The line limbs 3 and 4 extend to the points 10 and 11 at the central office, from which they are extended, on the one hand, by conductors 12 and 13 to contacts 14 and 15 of suitable jacks 16; and on the other, by the conductors 17 and 18 to the live conductor 19 and grounded return 20, which are in turn connected to the live and grounded terminals of the battery 21. A path to ground is also provided from the point 22 in the conductor 13, by way of the relay contacts 23 and 24. The usual call signal 25, which is preferably an incandescent lamp, is included in a bridge 26 between the live conductor 19 and ground. This bridge is normally broken at the relay contacts 27—28, and normally closed at the contacts 29—30.

The conductor 17, which connects the live side of the battery to the line limb 3, includes the winding 31 of a line relay L, which controls the contacts 23—24 and 27—28. The conductor 18, which connects the line limb 4 with the grounded side of the battery, includes a resistance, here shown as an impedance 32 arranged to balance the impedance provided by the relay winding 31 and preferably obtained by a winding on the core of the relay L differentially arranged so as not to interfere with the energization produced by the winding 31. The contacts 29—30 are the contacts of the cut-off relay R, whose energizing windings 33 and 34 are connected in the extension conductors 12 and 13, respectively. The relay R, whose windings are included in the talking circuit when the line 3—4 is connected for conversation, must be rendered non-inductive. This

may be done in any preferred manner. In the present instance, I have shown one means for accomplishing this, which consists in providing the relay with "twin" windings—in other words, winding the two conductors side by side about the core throughout their entire length.

The circuits and apparatus, thus far described in connection with substation A, are duplicated in connection with substation B and are there designated with similar primed characters.

The interconnecting means at the central office comprises the usual link or cord circuit, provided with an answering plug 35, whose tip contact 36 is connected by strands 37—38 to the tip contact 39 of a calling plug 40, and whose sleeve contact 41 is connected by strands 42—43 to the sleeve contact 44 of the plug 40. The strands 37—38 and 42—43 are separated by the usual condensers 45—46, which permit the passage of voice currents, but prevent the flow of battery current. The supervisory signals, which are preferably incandescent lamps, 47—47', are permanently connected between the live pole of the battery 21 and the strands 42 and 43 respectively, the former including in circuit an impedance 48 and the latter a similar impedance 48'. The calling end of the link circuit is provided with the usual listening key whose levers 49—49' may be depressed into engagement with the contacts 50—50' to complete a bridge between the strands 38—43, including the operator's receiver 51 and the secondary winding of an induction coil 52 and a condenser 53. The primary winding of the induction coil 52 is included in a local circuit in series with the operator's transmitter 54 and a battery 55. The bridge is directly connected to ground at a point between the receiver 51 and the secondary winding by a branch 56 including an impedance 57. This end of the link-circuit is also provided with the usual ringing key whose levers 58—58' normally engage the fixed contacts 59—59' to maintain the continuity of the strands 38 and 43 respectively, but may be depressed into engagement with the fixed contacts 60—60' to complete a bridge between said strands, including the resistance lamp 61 and the calling generator 62 whose pole adjacent to the fixed contact 60 is grounded.

In the operation of the system, a party at substation A, desiring to converse with a party at substation B, removes his receiver 8, thereby closing the normally open bridge at his station between the telephone line limbs 3 and 4. The closing of this bridge completes a circuit from the live pole of the battery 21 through conductor 19, conductor 17 including the winding 31 of the line relay L, line limb 3 through the substation, line limb 4, at first to ground by way of the relay

contacts 23 and 24, and later to ground by way of the conductor 18 including the impedance 32. The closing of the first circuit sufficiently energizes the relay L to break the grounded connection at 23—24, thus establishing the second circuit above described, and simultaneously to close the bridge 26 through the call lamp 25 at the contacts 27—28, thus causing the display of the call lamp 25, as an indication to the operator that a connection is desired. Upon observing the display of the call signal 25, the operator will insert plug 35 into the answering jack 16 associated with the calling line and depress her listening key 49—49' to place her receiver in bridge of the link-circuit to determine the wishes of the calling party. The insertion of the plug will complete a circuit from the live pole of the battery 21, through the impedance 48, the supervisory lamp 47, the strand 42, plug and jack contacts 41—15, the conductor 13 including the winding 34 of the cut-off relay R, the conductor 18 including impedance 32, to the grounded return 20. The flow of current through the winding 34 of the cut-off relay will sufficiently energize the latter to separate the contacts 29 and 30, thus extinguishing the call lamp 25 and removing its control from the party at substation A. However, by reason of the resistance 32 in this circuit, the flow of current is insufficient to cause the supervisory lamp 47 to light. It will also be noted that at this time, a path in shunt to the supervisory signal 47 is closed at substation A. This path extends from the live pole of the battery 21, through conductor 19, conductor 17 including the winding 31 of the relay L, line limbs 3 and 4 to the point 11. The resistance to the flow of battery current offered by the impedance 32, which in practice is preferably greater than the combined resistance of the impedance 48, supervisory lamp 47 and the winding 31 of the cut-off relay R, is sufficiently large to extinguish the supervisory lamp 47 when included in circuit with it, irrespective of the closing of the shunt path through the substation just traced, but obviously, if desired, it may be made sufficiently small to require the additional closing of the shunt path, in order to extinguish the lamp. Upon learning that connection is desired with substation B, the operator will depress the listening key 49—49', and touch the tip contact 39 of the calling plug 40 to the contacts 15' of one of the jacks 16' associated with the line 3'—4', to determine its idle or busy condition. If the line is idle, the potential of the contact 15' will be that of ground, by reason of the grounded connection at the contacts 23—24, and the potential of the tip 39 will also be that of ground, by reason of the grounded connection 56. However, if the line is busy, the

potential of the contact 15' will be above that of ground, by reason of its connection with the live side of the battery through the contact 15' of the jack at which connection is made with the line, and through the sleeve strand of the connected link-circuit. This potential will then cause a momentary flow of current over the tip strand 38 to ground by way of the listening key lever 49, contact 50, operator's receiver 51 and the branch 56, thus producing a "click" in the receiver, as an indication to the operator that the line is busy. If the line is found to be idle, the operator will insert the plug 40 into the jack 16', thereby closing a circuit from the live pole of the battery 21, through the impedance 48', supervisory lamp 47', sleeve strand 43, plug and jack contacts 44 and 15', conductor 13' including the winding 34' of the cut-off relay R', and contacts 23'—24' to ground. The current through the winding 34' will sufficiently energize the cut-off relay R' to separate the contacts 29'—30' and thereby remove the call signal 25' from the control of the subscriber at substation B. It will be noted that this circuit does not include the impedance 32' and consequently enough current is allowed to flow to cause the supervisory lamp 47' to light. The operator will then depress the ringing key 58—58' to include the ringing generator 62 in bridge of the strands 38—43, which are now connected to the line limbs 3'—4', and thereby send calling current through the call-bell 1'. As soon as the receiver 8' at the substation B is removed from its switch-hook 6', a path for battery current through this substation is closed, and the line relay L' is sufficiently energized to attract its contacts 23' and 28' by a circuit including relay winding 31' and the impedance 32', similar to that previously traced in connection with the relay L. The attraction of the contact 23' breaks the circuit through the supervisory lamp 47' and brings the impedance 32' into circuit, thus, together with the closing of the shunt path through the substation B, cutting down the current flow through the lamp 47 sufficiently to extinguish it, thereby indicating to the operator that the called party has answered. With the parties thus connected, the lamps 47 and 47' will remain dark. However, upon either party hanging up his receiver, the associated supervisory lamp will light; and the lighting of both lamps 47 and 47' will be a signal to the operator to disconnect.

Obviously, in carrying out my invention, the impedances 32—32' may be varied in resistance throughout a considerable range, as previously indicated; they may also be located differently than herein disclosed and in such location may not require the present differential arrangement of windings. Obviously, also, the batteries 21 and 55 may be

one and the same, and the various grounds may be replaced by a common return. Likewise, other alterations and modifications may be made in the specific matter herein disclosed, without departing from the spirit and scope of the invention. I therefore do not wish to be limited to the specific matter disclosed, but aim to cover, by the terms of the appended claims, all such alterations and modifications.

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 in two limbs from a substation to a central office, a two contact connection terminal having its contacts permanently conductively united to said line limbs, a two strand link-circuit and a two contact connecting plug for connecting said strands to said line limbs, means for holding conversation over said strands and limbs, an electric lamp permanently connected in circuit with one of the contacts of said plug, means under the control of the operator for closing a circuit local to the central office to light said lamp, and means normally associated with said telephone line and under the control of the subscriber for varying the line circuit connections to modify the resistance of said local circuit to extinguish said lamp.

2. A telephone system comprising a telephone line extending in two limbs from a substation to the central office, a two contact connection terminal having its contacts permanently conductively united to said line limbs, a two strand link-circuit and a two contact connecting plug for connecting said strands to said line limbs, means for holding conversation over said strands and limbs, an electric lamp permanently connected in circuit with one of the contacts of said plug, means operative upon the connection of said link-circuit to said line to close a circuit local to the central office to light said lamp, and means normally associated with said telephone line and under the control of the subscriber for varying the line circuit connections to modify the resistance of said local circuit to extinguish said lamp.

3. A telephone system comprising a telephone line extending in two limbs from a substation to a central office, a two contact jack having its contacts permanently conductively united to said line limbs, a link-circuit, a connecting plug adapted to be inserted in said jack to connect said line and link circuit, means for holding conversation over said line and link-circuit, an electrically actuated signal permanently included in circuit with a talking contact of said plug, means operative upon establishing connection between said plug and line terminal to close a circuit local to the central office through said terminal and plug contact normally to cause the display of said signal, and means normally asso-

ciated with said telephone line and under the control of the subscriber for varying the line circuit connections to modify the resistance of said local circuit to efface said signal.

4. A telephone system comprising a telephone line extending in two limbs from a substation to a central office, a two contact jack having its contacts permanently conductively united to said line limbs, a link-circuit, a connecting plug adapted to be inserted in said jack to connect said line and link-circuit, means for holding conversation over said line and link-circuit, an electric lamp permanently included in circuit with a talking contact of said plug, means operative upon establishing connection between said plug and line terminal to close a circuit local to the central office through said terminal and plug contact normally to light said lamp, and means normally associated with said telephone line and under the control of the subscriber for varying the line circuit connections to modify the resistance of said local circuit to extinguish said lamp.

5. A telephone system comprising a telephone line extending from a substation in two limbs to a central office, a two contact connection terminal therefor having its contacts permanently conductively united to said limbs, a two strand link-circuit and two contact connecting plug for establishing connection therewith, means for holding conversation over said line and link-circuit, an electrically actuated signal permanently included in circuit with a contact of said plug, means operative upon establishing connection between said plug and line terminal to close a circuit local to the central office through said terminal and plug contact normally to cause the display of said signal, and means normally associated with said telephone line and under the control of the subscriber for varying the line circuit connections to modify the resistance of said local circuit to extinguish said lamp.

6. A telephone system comprising a telephone line extending from a substation in two limbs to a central office, a two contact connection terminal therefor having its contacts permanently conductively united to said limbs, a two strand link-circuit and two contact connecting plug for establishing connection therewith, means for holding conversation over said line and link-circuit, an electric lamp permanently included in circuit with a contact of said plug, means operative upon establishing connection between said plug and line terminal to close a circuit local to the central office through said terminal and plug contact normally to light said lamp, and means normally associated with said telephone line and under the control of the subscriber for varying the line circuit connections to modify the resistance of said local circuit to extinguish said lamp.

7. A telephone system comprising a telephone line extending in two limbs from a substation to a central office, a two contact jack having its contacts permanently conductively united to said line limbs, a link-circuit, a connecting plug adapted to be inserted in said jack to connect said line and link-circuit, means for holding conversation over said line and link-circuit, an electrically actuated signal associated with said link-circuit, means under the control of the operator for closing a circuit over a portion of the talking circuit and through said signal to cause its display, a resistance, a relay normally associated with said telephone line for modifying said circuit by including said resistance in circuit with said signal to cause a corresponding effacement of said signal and means under the control of the subscriber for actuating said relay.

8. A telephone system comprising a telephone line extending from a substation to a central office, a link-circuit for making connection to said line, means for holding conversation over said line and link circuit, an electrically actuated line signal, an electrically actuated signal associated with said link-circuit, means under the control of the operator for closing a circuit over a portion of the talking circuit and through said link-circuit signal to cause its display, a resistance at the central office, a relay for normally controlling said line signal and for modifying said circuit by including said resistance in circuit with said link circuit signal and means under the control of the subscriber for actuating said relay.

9. A telephone system comprising a telephone line extending from a substation to a central office, a link-circuit for making connection to said line, means for holding conversation over said line and link-circuit, an electrically actuated line signal, an electrically actuated signal associated with said link-circuit, means under the control of the operator for closing a circuit over a portion of the talking circuit and through said link-circuit signal to cause its display, a resistance at the central office, a relay for normally controlling said line signal and for modifying said circuit by including said resistance in circuit with said link-circuit signal to cause a corresponding effacement of said signal, means under the control of the subscriber for actuating said relay, and a second relay under the control of the operator for removing said line signal from the control of the subscriber.

10. A telephone system comprising a telephone line extending in two limbs from a substation to a central office, a two contact connection terminal having its contacts conductively united to said line limbs, a link-circuit and a two contact connecting plug for making connection to said line, means for

holding conversation over said line and link-circuit, an electrically actuated signal associated with said link-circuit, means under the control of the operator for closing a circuit through said signal to cause its display, a resistance at the central office, a relay normally associated with said telephone line for modifying said circuit by including said resistance in circuit with said signal, means under the control of the subscriber for shunting current from said signal and operating said relay to include said resistance, to efface said signal.

11. A telephone system comprising a telephone line extending in two limbs from a substation to a central office, a two contact connection terminal having its contacts conductively united to said line limbs, a link-circuit and a two contact connecting plug for making connection to said line, means for holding conversation over said line and link-circuit, an electrically actuated line signal, an electrically actuated signal associated with said link-circuit, means under the control of the operator for closing a circuit through said link-circuit signal to cause its display, a resistance at the central office, a relay for normally controlling said line signal and for modifying said circuit by including said resistance in circuit with said link-circuit signal, and means under the control of the subscriber for shunting current from said signal and operating said relay to include said resistance, to efface said link-circuit signal.

12. A telephone system comprising a telephone line extending in two limbs from a substation to a central office, a two contact connection terminal having its contacts conductively united to said line limbs, a link-circuit for making connection to said line, means for holding conversation over said line and link-circuit, an electrically actuated line signal, an electrically actuated signal associated with said link-circuit, means under the control of the operator for closing a circuit through said link-circuit signal to cause its display, a resistance at the central office, a relay for normally controlling said line signal and for modifying said circuit by including said resistance in circuit with said link-circuit signal, means under the control of the subscriber for shunting current from said signal and operating said relay to include said resistance, to efface said link-circuit signal, and a second relay under the control of the operator for removing said line signal from the control of the subscriber.

13. A telephone system comprising a telephone line extending in two limbs from a sub-

station to a central office, a link-circuit for making connection to said line, means for holding conversation over said line and link-circuit, a source of current, a line relay having its winding connected between one limb of said line and one pole of said current source, a resistance connected between said other limb and the other pole of said source, a normal short circuit about said resistance, a signal lamp connected between the first-mentioned pole of said current source and the link-circuit strand adapted for connection to said other line limb, and means at the substation for actuating said line relay to open said short circuit.

14. A telephone system comprising a telephone line extending in two limbs from a substation to a central office, a two contact connection terminal therefor, a two strand link-circuit and two contact connecting plug for establishing connection with said line, a source of current having one pole connected to a third conductor, a line relay having its winding included in circuit between one line limb and the live pole of said source, a resistance included in circuit between the other line limb and said third conductor, a normal short circuit about said resistance controlled by said relay, a signal lamp included in circuit between the live pole of said source and the link-circuit strand adapted for connection to said other line limb, and means at the substation for making and breaking circuit between the line limbs.

15. A telephone system comprising a telephone line extending in two limbs from a substation to a central office, a link-circuit for making connection to said line, means for holding conversation over said line and link-circuit, a source of current having one pole connected to a third conductor, a line relay having its winding included in circuit between one line limb and the live pole of said source, a resistance winding on said relay core included in circuit between the other line limb and said third conductor, a normal short circuit about said resistance winding controlled by said relay, a signal lamp included in circuit between the live pole of said source and the link-circuit strand adapted for connection to said other line limb, and means at the substation for making and breaking circuit between the line limbs.

In witness whereof, I hereunto subscribe my name this 8th day of July A. D., 1906.

HARRY G. WEBSTER.

Witnesses:

A. H. DYSON,
CAROLYN WEBER.