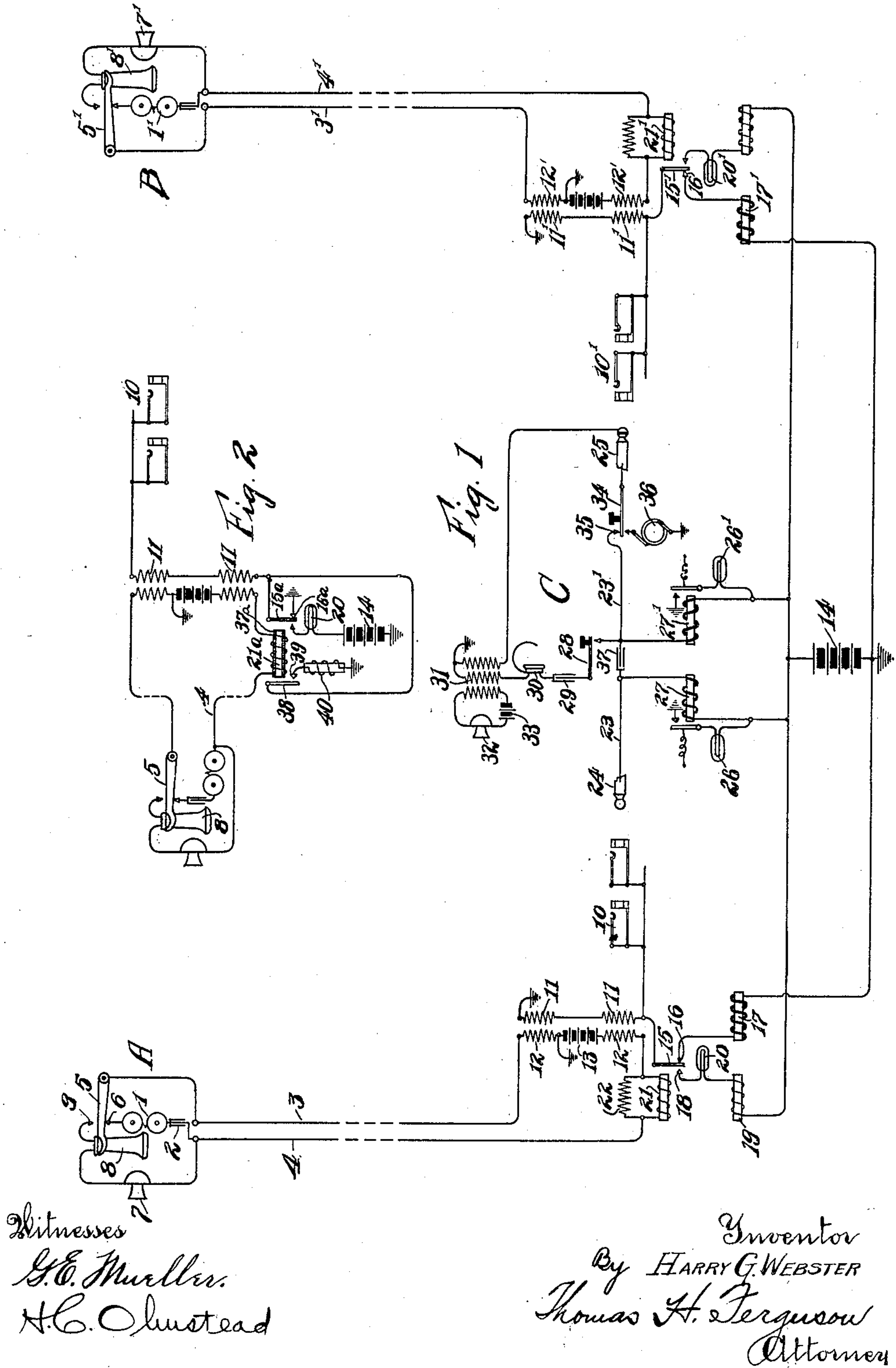


No. 897,238.

PATENTED AUG. 25, 1908.

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



UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

No. 897,238.

Specification of Letters Patent.

Patented Aug. 25, 1908.

Application filed March 5, 1906. Serial No. 304,226.

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 a new and useful Improvement 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 united for conversation through the agency of repeating coils, interposed between the lines and their connection terminals, and a link-circuit for interconnecting said terminals.

The principal object of the invention is to produce a novel system of this type, in which the repeating coil windings are employed not only in the performance of the usual speech transmitting functions, but also in the control of the usual line and supervisory signals.

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

Figure 1 of said drawing is a diagram of a system constructed in accordance with the present invention and illustrating one species thereof; Fig. 2 is a diagram of a portion of a similar system, illustrating a second species of the invention.

In these views, like characters refer to like parts.

Referring in detail to the drawing, 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 and included in a normally closed bridge of the telephone line limbs 3—4 by the engagement of the switch-hook 5 with the fixed contact 6. A second bridge, normally open and including the transmitter 7 and receiver 8, is closed at the contact 9 by the switch-hook 5 whenever the receiver is removed therefrom. At the central office, the line is inductively connected to the jacks 10 by means of a repeating coil having its winding 11, shown in two sections, conductively united between the jacks and ground, and its winding 12, also shown in

two sections, connected in circuit with the line limbs and an intervening battery 13 having its negative pole connected to ground. The jacks 10, which comprise spring and testing contacts, are normally connected to the grounded side of the battery 14 through the line relay contacts 15—16 and a relatively low resistance, here shown as impedance 17. An alternate line relay contact 18 permits the connection of the jacks to the live pole of the battery by way of the relatively high resistance, here shown as impedance 19, and the line signal lamp 20. The line relay 21 has its winding included directly in the line limb 4 and is rendered non-inductive in any suitable manner, as by the non-inductive resistance 22 connected in parallel therewith.

The equipment and 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 link-circuit, by which connection is established between lines for conversation, comprises a single strand 23—23', connected between the answering plug 24 and the calling plug 25. Supervisory lamps 26—26' are controlled by relays 27—27', whose windings are connected between the live pole of the battery 14 and the strand sections 23 and 23' respectively. The usual listening-key 28 is provided to connect the strand section 23' to ground through the condenser 29, operator's receiver 30 and the secondary winding of an induction coil 31. The primary winding of this coil is included in a local circuit in series with the operator's transmitter 32 and the battery 33. This coil is also provided with a tertiary winding which is connected between the tip or testing contact of the calling plug 25 and ground. A ringing-key lever 34 normally engages the contact 35 to maintain the continuity of the strand section 23' and may be depressed to bring the calling generator 36 into circuit with the calling plug 25. The sections of the link-circuit strands are separated by a condenser 37 which permits the passage of voice currents, but prevents the passage of battery current.

In the operation of the system, a party at substation A, desiring to converse with a party at substation B, removes his receiver 8 from its switch-hook 5, thereby completing a circuit for the flow of current from the bat-

tery 13, over the telephone line limbs and through the winding of the line relay 21. This brings the armature contact 15 of said relay into engagement with the contact 18 and thereby completes a circuit from the live pole of the battery 14, through the impedance 19, line lamp 20, relay contacts 18—15, repeating coil winding 11 to ground, thereby causing the lamp 20 to light, as an indication to the operator that connection is desired. Upon observing this signal, the operator will insert the answering plug 24 into one of the jacks 10 and depress her listening-key 28 to determine the wishes of the calling party. The act of inserting the plug 24 into the jack will complete a path for current in shunt to the line lamp 20, from the live pole of the battery, through the winding of the relay 27, the strand section 23, plug 24, jack 10, to the winding 11 of the repeating coil. This will bring the line lamp 20 and the winding of the supervisory relay 27 in parallel branches in series with the repeating coil winding 11 and the battery 14, and sufficient current will be thereby shunted from the lamp 20 to prevent its further display as a signal. Upon depressing the listening-key 28, the operator will complete a secondary circuit from ground at the repeating coil winding 11, through said winding, the jack 10, plug 24, strand section 23, condenser 37, listening-key 28, condenser 29, receiver 30, second winding of induction coil 31, to ground, and over this circuit learn the wishes of the calling party. Upon learning that connection is desired with the line 3'—4', the operator will touch the tip contact of the plug 25 against the testing contact of one of the jacks 10' to determine the idle or busy condition of the line. In case the line is busy, it will be apparent from the circuits previously traced that potential will exist on the jacks 10' above that of ground; and consequently, as soon as the tip contact of the plug 25 is touched thereto, there will be a momentary flow of current from said contact to ground through the tertiary winding of the induction coil 31, which will produce the usual "click" in the operator's receiver 30, as an indication to her that the line is busy. If the line is found to be idle, she will insert the plug 25 into the jack 10' and thereby complete a circuit from the live pole of the battery 14, through the winding of the supervisory relay 27', the strand 23', ringing-key contacts 35—34, plug 25, jack 10 to the winding 11' of the repeating coil associated with the line 3'—4'—the circuit then dividing and passing to ground, by one branch including the winding 11' of said repeating coil, and by another branch including the line relay contacts 15'—16' and the impedance 17'. The resistance of the repeating coil winding 11' being considerably in excess of that of the impedance 17', the greater portion of the current will flow

through the branch including the latter and the current flow will be sufficient to energize the supervisory relay 27' sufficiently to close the circuit of the supervisory lamp 26' to cause its display. The operator will then depress the listening-key lever 34 and complete a primary circuit for the flow of ringing current through the plug 25, jack 10' and repeating coil winding 11' to ground. The alternating current, transmitted over this circuit, will induce a flow of current in the secondary circuit including the repeating coil winding 12', the line limbs 3'—4' and the call-bell 1' at the substation B, to operate the latter. As previously indicated, the supervisory lamp 26' will be lighted in response to the insertion of the plug 25 into the jack 10'. As soon, however, as the receiver 8' at substation B is removed from its switch-hook 5', the line relay 21' will be energized sufficiently to attract its armature contact 15' and thereby interrupt the low resistance path for current through the branch including the impedance 17' and cause the extinguishment of the lamp 26'. Although the branch through the line lamp 20' is closed, said lamp will not be lighted because the path through the supervisory relay 27' and the plug and jack contacts, which is in shunt thereto, will be closed at this time. The lamps 26 and 26' will remain dark during conversation; but as soon as either subscriber hangs up his receiver, the corresponding lamp will be illuminated and the illumination of both lamps will be a signal to the operator to take down the connection.

In the species of the invention illustrated in Fig. 2, the line relay 21^a has its winding connected directly in the line limb 4 as in Fig. 1, but is rendered non-inductive by means of a copper shell 37^a surrounding its core, instead of by the non-inductive winding 22 of Fig. 1. In this instance, the normal branch to ground and the repeating coil winding 11 are connected in series instead of in parallel, as in the previous figure. This normal connection to ground is controlled by the line relay contacts 15^a—16^a as in the previous case, and the line lamp 20 and the battery 14 are adapted to be included in circuit with the repeating coil winding 11 upon the energization of the line relay 21^a. This relay is also provided with additional normally open contacts 38—39 which control a branch through the high resistance or impedance 40. In the operation of this form of the invention, the energization of the line relay 21^a, due to the removal of the receiver from its switch-hook, closes a circuit for the line lamp 20 from the live pole of the battery 14, through the relay contacts 15^a, 38 and 39 and the impedance 40. This energization also connects the impedance 40 in series with the winding 11 of the repeating coil, so that, upon the subsequent insertion of the answering plug

into a jack, the flow of current through the supervisory relay 27 will be insufficient to cause the closure of its contacts and the consequent illumination of the supervisory lamp 26. The insertion of the plug in answering a call also closes a path in parallel to the line lamp 20 while leaving the impedance 40 in the main portion of the circuit in series with the parallel branches thus shunting sufficient current from the line lamp to extinguish it. However, in making a call, the insertion of the plug into the jack will complete a circuit for the supervisory relay through the winding 11 of the repeating coil to ground by way of the line relay contacts 15^a—16^a, thus omitting the impedance 40 and consequently permitting enough current to flow to cause the supervisory relay contacts to close and the associated supervisory lamp to light. The subsequent removal of the receiver alters this circuit by including the impedance 40 and thereby extinguishing the supervisory lamp. In other respects, the operation of this form of the invention is the same as that described in connection with Fig. 1.

In proportioning the resistances, that of the supervisory relays and the impedances 17 and 17' is relatively low, as indicated diagrammatically by the thick line windings, while the resistance of the impedances 19—19' of Fig. 1 and 40 of Fig. 2 is considerably larger, as indicated by the thinner line windings. The repeating coil windings may also be of considerable resistance.

In practice, the different batteries obviously may be one and the same, and the different connections to ground may be made to a common office return, and other alterations and modifications may be made in the matter disclosed without departing from the spirit and scope of the invention. It should also be noted that, in practicing my invention, in many instances simple ohmic resistances, instead of the impedances here shown, may be employed. I, therefore, have used the term, "resistance," in the claims in its broader sense to include mere ohmic resistance and impedance, and have otherwise aimed, by the terms of the appended claims, to cover the various possible alterations and modifications coming within the scope of the invention.

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 for 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 line signal, an electrically actuated link-circuit signal, means for actuating said latter signal by closing a cir-

cuit through one of the repeating coil windings, and a single line relay for controlling said line signal and for including said resistance in series with said repeating coil winding and said connection terminal to cause the effacement of said link-circuit 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 for 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 line signal, an electrically actuated signal associated with said link-circuit, means for actuating said link-circuit signal by closing a circuit through one of the repeating coil windings, and a single line relay for controlling said line signal and for including said resistance in series with said repeating coil winding and said connection terminal to cause the effacement of said signal.

3. A telephone system comprising a plurality of lines extending from substations to a central office, connection terminals for said lines, a repeating coil for 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 signaling means connected to the link-circuit in bridge of the talking circuit, means for actuating said signaling means to cause the display of its signal by closing a circuit through one of the repeating coil windings, and means for including said resistance in series with said repeating coil winding to cause the effacement of said signal.

4. 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 for making connection to said terminal to establish a conversational circuit, a resistance conductively associated with said terminal, line and link-circuit signals, means normally operative upon the connection of said link-circuit to said terminal to supply current over a circuit including one of the repeating coil windings to cause the actuation of said link-circuit signal, and a single relay under the control of the subscriber for controlling said line signal and including said resistance in said circuit in series with said connection terminal to reduce the current flow sufficiently to return said signal to its normal condition.

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 for inductively uniting said line to said terminal, a link-circuit for

making connection to said terminal to establish a conversational circuit, electrically actuated line and link-circuit signals, means normally operative upon the connection of
 5 said link-circuit to said terminal to supply current over a circuit including one of the repeating coil windings to cause the actuation of said link-circuit signal, a resistance conductively associated with said terminal, and
 10 a single line relay for controlling said line signal and for connecting said resistance in series with said repeating coil winding and said terminal to reduce the current flow in said supply circuit sufficiently to return said signal to its normal condition.

6. A telephone system comprising a plurality of lines extending from substations to a central office, connection terminals for said lines, a repeating coil for inductively uniting
 20 each line to its terminal, a link-circuit for completing a connecting circuit between any two telephone lines, an electrically actuated signaling means connected to the link-circuit in bridge of the talking circuit, means normally operative upon the connection of said
 25 link-circuit to a terminal to supply current over a circuit including one of the windings of the connected repeating coil to cause the actuation of said signaling means to cause
 30 the display of its signal, a resistance conductively associated with said terminal, and means for including said resistance in series with said repeating coil winding to reduce the current flow in said supply circuit sufficiently to return said signal to its normal condition.

7. A telephone system comprising a telephone line extending from a substation to a central office, a connection terminal for said
 40 line, a repeating coil for uniting said line to said terminal, a link-circuit for making connection to said terminal to establish a conversational circuit, an electrically actuated signal associated with the line, an electrically
 45 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 one of the repeating coil windings
 50 normally to cause the display of said link-circuit signal, a single line relay under the control of the subscriber for closing a circuit over the telephone line normally to display said line signal, a resistance conductively associated with said terminal, means operated
 55 by said line relay to include said resistance in series with said repeating coil winding and said connection terminal to place the display of said link-circuit signal beyond the control of the operator, and means operated by the
 60 closing of the operator's circuit to place the display of the line signal beyond the control of the subscriber.

8. A telephone system comprising a telephone line extending from a substation to a

central station, a connection terminal for said line, a repeating coil for inductively uniting said line to said terminal, a link-circuit for making connection to said terminal to establish a conversational circuit, a source of
 70 current, two electrically actuated signals, means controlled from one station operative under the normal condition of the system to close a circuit of definite resistance to cause the display of one of said signals and operative
 75 under another condition to close a path in shunt to the other signal to prevent its display, and means controlled from the second station operative under the normal condition of the system to close a circuit to cause the
 80 display of the latter signal and operative under another condition to increase the normal resistance of the actuating circuit of the former signal to prevent its display.

9. A telephone system comprising a telephone line extending from a substation to a central station, a connection terminal for said line, a repeating coil for inductively uniting said line to said terminal, a link-circuit for making connection to said terminal to establish a conversational circuit, a source of
 85 current, two electrically actuated signals, means controlled from one station operative under the normal condition of the system to close a circuit of definite resistance through one of the repeating coil windings to cause the display of one of said signals, and operative
 90 under another condition to complete a path in shunt to the other signal to prevent its display, and means controlled from the second station operative under the normal condition of the system to close a circuit to cause the display of the latter signal and operative
 95 under another condition to increase the normal resistance of the actuating circuit of the former signal to prevent its display.

10. 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 for making connection to said terminal to establish a conversational circuit, a source of current, electrically actuated
 110 supervisory and line signals, means operative upon the connection of said link-circuit to said terminal under the normal condition of the system to complete a circuit of definite resistance to cause the display of said supervisory signal and under another condition to complete a path in shunt to said line signal to prevent its display, and means controlled by the subscriber operative under the normal condition of the system to close
 115 a circuit to cause the display of the line signal and operative under another condition to increase the normal resistance of the actuating circuit of the supervisory signal to prevent its display.

11. A telephone system comprising a tele-

phone 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 for making connection to said terminal to establish a conversational circuit, a source of current, electrically actuated supervisory and line signals, means operative upon the connection of said link-circuit to said terminal under the normal condition of the system to complete a circuit of definite resistance through one of the repeating coil windings to cause the display of said supervisory signal and under another condition to complete a path in shunt to said line signal to prevent its display, and means controlled by the subscriber operative under the normal condition of the system to close a circuit to cause the display of said line signal and operative under another condition to increase the normal resistance of the actuating circuit of the supervisory signal to prevent its display.

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 source of current, signals included respectively in normally open circuits with said source of current, one of the repeating coil windings being included in one of said circuits and in one only, a resistance included in the other of said circuits, means under the control of the operator to normally close one of said circuits to display its included signal, and means under the control of the subscriber to close said other circuit and to connect said resistance in series with said repeating coil winding, normally to display the signal in the latter circuit and abnormally to efface the signal included in the former circuit.

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 source of current, line and supervisory signals included respectively in separate circuits with said source of current, one of the repeating coil windings being included in the supervisory signal circuit and in that only, a resistance included in the line signal circuit, means under the control of the operator to normally close the supervisory signal circuit to cause the display of said signal, and means under the control of the subscriber to close said line signal circuit and to connect said resistance in series with said repeating coil winding, normally to display said line signal and abnormally to efface the supervisory signal.

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 signal in a circuit with one of the repeating coil windings normally open at the plug and terminal, a resistance, a line signal in a second circuit including said resistance and excluding said repeating coil winding, means operative upon the connection of said plug to said terminal to normally close the supervisory signal circuit to cause the display of said signal, and means under the control of the subscriber to close the line signal circuit and to connect said resistance in series with said repeating coil winding, normally to display said line signal and abnormally to efface said supervisory signal.

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 signal included in a normally open circuit with one of the repeating coil windings, a resistance, a second signal in a second normally open circuit including said resistance and excluding said repeating coil winding, means for closing the former circuit normally to cause the display of the included signal and abnormally to efface the other signal, and means for closing the latter circuit and for inserting said resistance into the former circuit normally to cause the display of the signal included in the latter circuit and abnormally to efface the other signal.

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 supervisory signal included in a normally open circuit with one of the repeating coil windings, a resistance, a line signal in a second normally open circuit including said resistance and excluding said repeating coil winding, means under the control of the operator for closing the former circuit normally to cause the display of the supervisory signal and abnormally to efface the line signal, and means under the control of the subscriber for closing the latter circuit and for inserting said resistance into the former circuit normally to cause the display of the line signal and abnormally to efface the supervisory signal.

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 supervisory signal in a circuit with one of the repeating coil windings normally open at the plug and terminal, a resistance, a line signal in a second normally open circuit including said resistance and excluding said repeating coil winding, means operative upon the connection of said plug to said terminal normally to cause the display of the supervisory signal and abnormally to efface the line signal, and means under the control of the subscriber for closing said second circuit and for inserting said resistance into said former circuit normally to cause the display of the line signal and abnormally to efface the supervisory signal.

18. A telephone system comprising a telephone line extending from a substation to a central office, a connection terminal in 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 line relay, a supervisory signal in a circuit with one of the repeating coil windings normally open at the plug and terminal, a resistance, a line signal in a second circuit normally open at the line relay contacts including said resistance and excluding said repeating coil winding, means operative upon the connection of said plug to said terminal normally to cause the display of said supervisory signal and abnormally to efface the line signal, means under the control of the subscriber for energizing said line relay to close said second circuit and to insert resistance into said former circuit normally to cause the display of said line signal and abnormally to efface said supervisory signal.

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

HARRY G. WEBSTER.

Witnesses:

A. H. DYSON,
GEO. E. MUELLER.