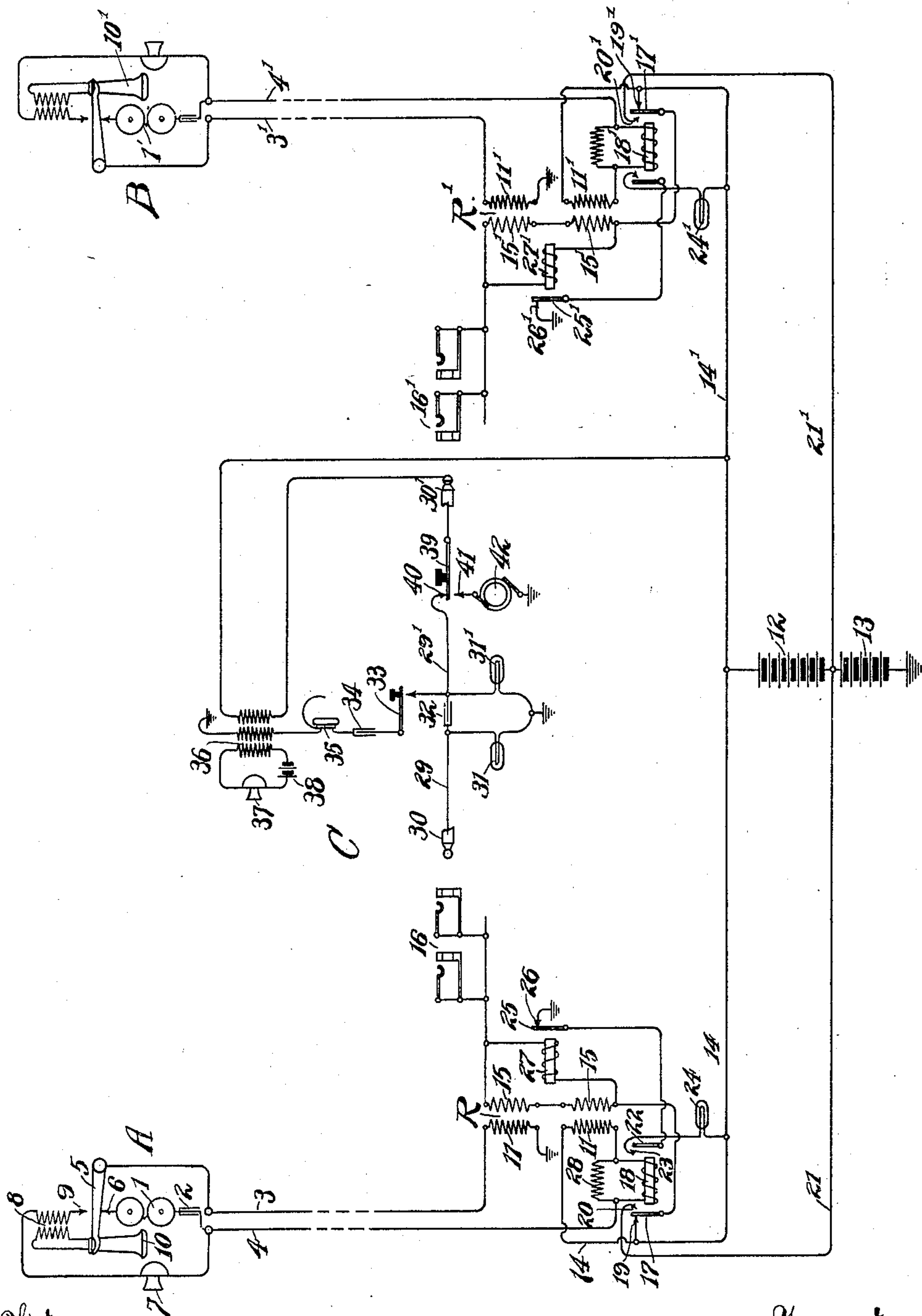


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H. G. WEBSTER.
TELEPHONE SYSTEM.
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TELEPHONE SYSTEM.

No. 897,241.

Specification of Letters Patent.

Patented Aug. 25, 1908.

Application filed March 5, 1906. Serial No. 304,229.

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. In such systems, the telephone lines form conductively independent circuits, and an intermediate circuit connects these telephone line circuits for conversation through the agency of repeating coils.

One feature of my invention consists in including the supervisory lamps directly in bridge of this intermediate circuit. I have found that such a bridge, although substantially devoid of impedance, will not materially interfere with speech transmission over the circuit, provided the latter is substantially free from resistance and impedance. By providing the windings of the repeating coils, which are included in this intermediate circuit, with relatively few turns, it is possible to accomplish this result. With this arrangement, the potential induced in this intermediate circuit is relatively low, and consequently the possibility of cross talk is greatly reduced.

Another feature of my invention consists in a novel arrangement of circuits and apparatus, capable of use with such an intermediate talking circuit, for the control of the line and supervisory signals.

These and other features and objects of the invention will more fully appear 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.

In the drawing, which illustrates diagrammatically a telephone system embodying the features of the present invention, A and B designate 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 and including the transmitter 7 and a 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. At the central office, the circuit of the line limbs is completed through the winding 11 of the repeating coil R and the batteries 12 and 13. One section of the winding 11 connects the line limb 3 with the grounded side of the battery 13, while the other section connects the line limb 4 with the live pole of the battery 12 by a conductor 14, the batteries being thus connected in series between the sections of the winding. The other winding 15 of the repeating coil R, also shown in two sections, is permanently included in a branch extending from the line jacks 16 to the armature contact 17 of the line relay 18. This branch is normally completed to the live pole of the battery 12 by way of the line relay contact 19 and the conductor 14. Upon the attraction of the armature contact 17 into engagement with the contact 20, this branch is completed by way of the conductor 21 to the live pole of the battery 13. From this, it will be seen that current of different potentials will be supplied to the jacks 16 in accordance with the operative condition of the line relay contacts. The line relay 18 is provided with a second armature contact 22 which is adapted, upon the energization of the relay, to engage a fixed contact 23, normally to complete a circuit from the live pole of the battery 12 through the line lamp 24 to ground, by way of the normally closed contacts 25 and 26 of the cut-off relay 27. The line relay 18 has its winding directly included in the line limb 4 and is consequently provided with some means for rendering the relay non-inductive so as to prevent interference with speech transmission over the line. In the present instance, this is accomplished by means of a non-inductive shunt 28. The cut-off relay 27 has its winding connected in parallel with the winding 15 of the repeating coil R.

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.

Upon reference to the two stations, it will be seen from the matter thus far described that the apparatus at each station is included in a line circuit extending through the winding 11, or 11', of the repeating coil R, or R', and the batteries 12 and 13, and that these line circuits are adapted to be inductively united by an intermediate circuit which is adapted to be completed between the jacks 16—16' by a link-circuit comprising a single strand made up of the sections 29—29', uniting the answering and calling plugs 30 and 30' respectively. The supervisory lamps 31 and 31', which are preferably the usual incandescent electric lamps, are connected respectively between ground and the strand sections 29 and 29'. These sections are separated by the usual condenser 32 which will permit the passage of voice currents, but will prevent the passage of battery current. The usual listening-key 33 is provided. This key controls a branch leading from the strand section 29' to ground through a condenser 34, the operator's receiver 35 and the secondary winding of an induction coil 38. The primary winding of the induction coil is included in a local circuit in series with the operator's transmitter 37 and the battery 38. The tertiary winding of the induction coil 36 is connected between a testing tip contact on the calling plug 30' and the live pole of the battery 12. The strand 29' is also provided with a ringing-key 39 which normally engages the contact 40 to maintain the continuity of the strand, but is adapted to be depressed into engagement with the contact 41 to connect the live pole of the ringing generator 42 to the calling plug 30'.

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 and thereby completes the line circuit through the winding of the line relay 18, winding 11 of the repeating coil R and the batteries 12 and 13 in series. The completion of this circuit energizes the relay 18 sufficiently to attract its armature contacts 17 and 22—by the former connecting the low potential battery 13 in circuit with the jacks 16, and by the latter completing the circuit of the line lamp 24 from the live pole of the battery 12 to ground, thereby causing the illumination of said lamp, as an indication to the operator that connection is desired. Upon observing this signal, the operator will insert the answering plug 30 into a jack 16 and thereby complete a circuit from ground, through the supervisory lamp 31, strand section 29, plug 30, jack 16, through the winding 15 of the repeating coil R and the winding of the cut-off relay 27 in parallel, through the line relay contacts 17—20, conductor 21 and battery 13 to ground. The flow of current over this circuit, by reason of the low potential of the battery 13, is insuff-

ficient to cause the illumination of the lamp 31, but is sufficient to cause the separation of the cut-off relay contacts 25—26 to extinguish the line lamp 24. Upon the insertion of the plug 30 into the jack 16, the operator will depress her listening-key 33 and thereby complete a talking circuit from ground at the induction coil 36, through the secondary winding of said coil, the operator's receiver 35, condenser 34, listening-key 33, condenser 32, strand 29, plug 30, jack 16, repeating coil winding 15, line relay contacts 17—20, conductor 21 and battery 13 to ground. Over this circuit and the line circuit in inductive relation thereto, she may converse with the party at substation A to learn his wishes. Upon learning that connection is desired with telephone line 3'—4', she will touch the tip of the calling plug 30' to the testing contact of one of the jacks 16' to determine the idle or busy condition of the line, while maintaining the listening-key 33 depressed. From the circuits previously traced, it will be seen that if the line 3'—4' is busy, a potential will exist at the contact touched, due to the connection over some other link-circuit with the live pole of the battery 13. Since the testing contact of the plug 30' is directly connected to the live pole of the battery 12, there will be a difference in potential between said contact and the testing contact of the jack. Consequently, there will be a current flow through the tertiary winding of the induction coil 36, which will cause a "click" in the operator's receiver 35, as an indication to her that the line is busy. If the line is idle, the potential of the testing contact of the jack will be that due to the connection with the live pole of the battery 12. This connection extends from the live pole of the battery, through the line relay contacts 19'—17', the winding 15' of the repeating coil R', to the jack. Consequently, upon touching the testing contact of the plug 30' thereto, there will be no flow of current and no resultant "click." If it is found, upon making this test, that the line 3'—4' is idle, the operator will insert the calling plug 30' into the jack 16' and depress her ringing-key 39 to operate the call-bell 1' at the substation B. At this point, it may be noted that when the calling plug 30' is inserted into the jack 16', the testing tip contact of the plug passes beyond, and out of engagement with, the spring contact of the jack. The depression of the ringing-key will complete a circuit from the live pole of the generator 42, through the listening-key contacts 41—39, calling plug 30', jack 16', repeating coil winding 15' and the winding of the cut-off relay 27' in parallel, the line relay contacts 17'—19', conductor 14' and batteries 12 and 13 to ground. The alternating current in this circuit will induce a current over the line limbs 3'—4' and

through the call-bell 1' to actuate the latter as a signal at the substation B. Prior to the answering of the call at the substation and after the plug 30' has been inserted into the jack 16', the supervisory lamp 31' will be illuminated by reason of a circuit from ground, through said lamp, strand 29', plug 30', jack 16', repeating coil winding 15' and the winding of the cut-off relay 27' in parallel, line relay contacts 17'—19', conductor 14', batteries 12 and 13 to ground. By reason of this connection to the batteries 12 and 13, the current through the lamp 31' is sufficient to cause its illumination, and it will remain in this condition until the receiver 10' at the substation B is removed from its hook. The flow of current from this high potential source is also sufficient to separate the cut-off relay contacts 25' and 26', thereby removing the control of the line lamp 24' from substation B. Upon the removal of the receiver 10' at the substation B, the current flow over the line circuit will energize the line relay 18' sufficiently to attract its armature 17' to interrupt the connection of the supervisory lamp 31' to the live pole of the battery 12, which constitutes a high potential source, and to replace it by a connection to the live pole of the battery 13 which constitutes a low potential source. As previously indicated, the resulting current flow will be insufficient to maintain the supervisory lamp 31' illuminated, but will be sufficient to maintain the cut-off relay contacts out of engagement and therefore to maintain the line lamp extinguished.

From the above description, it will be seen that the line circuits, which include the windings 11, or 11', of the repeating coils, are conductively independent of each other and of the intermediate circuit by which they are connected for conversation. The latter circuit provides a path between the terminals of the windings 15 on the one hand and 15' on the other. As indicated in the diagram, the connection between the upper terminals of these windings includes the jacks 16—16' and the connecting link-circuit, while the connection between the lower terminals of the same windings will include either the conductors 14 and 14' or 21 and 21', according to the position of the line relay armature contacts 17—17'. In the former case, the batteries 12 and 13 are connected in series bridge of this circuit; and in the latter case, the battery 13 alone is connected in bridge. At all times, the supervisory lamps 31 and 31' are included in bridge of this circuit and they are illuminated or remain dark, according to whether the two batteries 12 and 13, or the single battery 13, are included in circuit. This intermediate connecting circuit, as pointed out in the early part of the specification, is substantially devoid of resistance and impedance, the only resistance being

that of the windings 15 and 15' of the repeating coils, and obviously these may be made of very low resistance. The bridges including the supervisory lamps 31 and 31', as previously pointed out, do not interfere with speech transmission over this intermediate circuit, under the circuit conditions indicated.

In carrying out my invention, obviously many modifications may be made therein without departing from the spirit and scope of my invention. I, therefore, do not wish to be limited to the specific matter illustrated, but aim to cover, by the terms of the appended claims, all such modifications. In these claims, I have used the term, "cut-off relay," in its broad sense to cover any relay by which the substation control of the line signal is destroyed.

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

1. A telephone system comprising a plurality of telephone lines extending from substations to a central office, means at the central office for inductively uniting said lines for conversation by a talking circuit substantially devoid of resistance and impedance, and an electrically actuated signal connected in bridge of said circuit, said bridge being substantially devoid of impedance.

2. A telephone system comprising a plurality of telephone lines extending from substations to a central office, means at the central office for inductively uniting said lines for conversation by a talking circuit substantially devoid of resistance and impedance, and an incandescent signal-lamp, and that only, connected in bridge of said circuit.

3. A telephone system comprising a plurality of telephone lines extending from substations to a central office, means at the central office for inductively uniting said lines for conversation by a talking circuit substantially devoid of resistance and impedance, and a signal offering non-inductive resistance, and that only, in bridge of said circuit.

4. A telephone system comprising a plurality of telephone lines extending from substations to a central office, repeating coils and an intermediate connecting circuit for uniting said lines for conversation, said circuit being substantially devoid of resistance and impedance, and an electrically actuated signal connected in bridge of said circuit, said bridge being substantially devoid of impedance.

5. A telephone system comprising a plurality of telephone lines extending from substations to a central office, repeating coils and an intermediate connecting circuit for uniting said lines for conversation, said circuit being substantially devoid of resistance and impedance, and a signal offering non-inductive resistance, and that only, in bridge of said circuit.

6. A telephone system comprising a plu-

rality of telephone lines extending from sub-
 stations to a central office, a normally open
 circuit at the central office substantially de-
 void of resistance and impedance, means in-
 5 cluded therein for inductively uniting said
 lines for conversation when said circuit is
 completed, a single strand link-circuit for
 completing said circuit, and an electrically
 actuated signal included in bridge between
 10 the link-circuit strand and the other leg of
 said normally open circuit, said bridge being
 substantially devoid of impedance.

7. A telephone system comprising a plu-
 rality of telephone lines extending from sub-
 15 stations to a central office, a normally open
 circuit at the central office substantially de-
 void of resistance and impedance, means in-
 cluded therein for inductively uniting said
 lines for conversation when said circuit is
 20 completed, a single strand link-circuit for
 completing said circuit, and a signal offering
 non-inductive resistance, and that only, in-
 cluded in bridge between the link-circuit
 strand and the other leg of said normally
 25 open circuit.

8. A telephone system comprising a plu-
 rality of telephone lines extending from sub-
 stations to a central office, a normally open
 circuit at the central office substantially de-
 30 void of resistance and impedance, means in-
 cluded therein for inductively uniting said
 lines for conversation when said circuit is
 completed, a single strand link-circuit for
 completing said circuit, and an incandescent
 35 signal-lamp, and that only, connected in
 bridge between the link-circuit strand and
 the other leg of said normally open circuit.

9. In a telephone system, the combination
 of a conductor extending between two sta-
 40 tions, an electrically actuated signal and
 sources of current of different potentials
 associated therewith, means under the con-
 trol of one station to supply current to said
 signal from said high potential source to
 45 cause the display of said signal, and means
 under the control of the other station for
 substituting said low potential source of cur-
 rent for said high potential source to cause
 the effacement of said signal.

10. A telephone system comprising a tele-
 phone line extending from a substation to a
 central station, a link-circuit for making con-
 nection to said line, means for holding con-
 50 versation over said line and link-circuit,
 sources of current of different potentials, an
 electrically actuated signal, means under the
 control of one station to supply current to
 said signal from the high potential source,
 and means under the control of the other
 60 station for substituting said low potential
 source of current for said high potential
 source to cause the effacement of said signal.

11. A telephone system comprising a tele-
 phone line extending from a substation to a
 65 central station, a connection terminal for

said line, a repeating coil for inductively
 uniting said line to said terminal, a link-cir-
 cuit for making connection to said terminal
 to establish a conversational circuit, sources
 of current of different potentials, an elec- 70
 trically actuated signal, means under the
 control of one station to supply current to
 said signal from the high potential source,
 and means under the control of the other
 station for substituting said low potential 75
 source of current for said high potential
 source to cause the effacement of said signal.

12. A telephone system comprising a tele-
 phone line extending from a substation to a
 central station, a connection terminal for 80
 said line, a repeating coil for inductively
 uniting said line to said terminal, a link-cir-
 cuit for making connection to said terminal
 to establish a conversational circuit, sources
 of current of different potentials, an electric- 85
 ally actuated signal, means under the control
 of one station for supplying current to said
 signal from the high potential source through
 one of the repeating coil windings to cause
 the display of said signal, and means under 90
 the control of the other station for substi-
 tuting said low potential source of current
 for said high potential source to cause the ef-
 facement of said signal.

13. A telephone system comprising a tele- 95
 phone line extending from a substation to a
 central office, a link-circuit for making con-
 nection to said line, means for holding con-
 versation over said line and link-circuit,
 sources of current of different potentials, a 100
 signal associated with said link-circuit, means
 operative upon the connection of said link-cir-
 cuit to said line to supply current to said sig-
 nal from the high potential source to cause
 its display, and means under the control of 105
 the subscriber for substituting said low po-
 tential source for said high potential source
 to cause the effacement of said signal.

14. A telephone system comprising a tele- 110
 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 estab- 115
 lish a conversational circuit, sources of cur-
 rent of different potentials, a signal asso-
 ciated with said link-circuit, means operative
 upon the connection of said link-circuit to
 said terminal to supply current to said signal
 from the high potential source to cause its 120
 display, and means under the control of the
 subscriber for substituting said low potential
 source for said high potential source to cause
 the effacement of said signal.

15. A telephone system comprising a tele- 125
 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 estab- 130

lish a conversational circuit, sources of current of different potentials, a signal associated with said link-circuit, means operative upon the connection of said link-circuit to said terminal to supply current to said signal from said high potential source through one of the repeating coil windings to cause the display of said signal, and means under the control of the subscriber for substituting said low potential source to cause the effacement of said signal.

16. A telephone system comprising a telephone line extending from a substation to a central station, a link-circuit for making connection to said line, means for holding conversation over said line and link-circuit, sources of current of different potentials, a line signal normally under the control of the subscriber, a cut-off relay for destroying said control, a link-circuit signal, means normally operative upon the connection of said link-circuit to said line to supply current from said high potential source to said link-circuit signal to cause its display and to said cut-off relay to cause the attraction of its armature, and means under the control of the subscriber for substituting said low potential source of current for said high potential source to cause the effacement of said link-circuit signal and to maintain said cut-off relay armature attracted.

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 for making connection to said terminal to establish a conversational circuit, sources of current of different potentials, a line signal normally under the control of the subscriber, a cut-off relay for destroying said control, a link-circuit signal, means normally operative upon the connection of said link-circuit to said terminal to supply current from said high potential source to said link-circuit signal to cause its display and to said cut-off relay to cause the attraction of its armature, and means under the control of the subscriber for substituting said low potential source of current for said high potential source to cause the effacement of said link-circuit signal and to maintain said cut-off relay armature attracted.

18. 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, sources of current of different potentials, a line signal, a line relay for controlling the display of said signal, a cut-off relay for destroying said control, a link-circuit signal, means normally operative upon the connection of said link-circuit to said line to supply current from said high potential source to said link-circuit signal to cause its display and to said cut-off relay to cause its actuation, and means under the control of the subscriber operative normally to energize said line relay to display said line signal and operative after the connection of said link-circuit to said line to substitute said low potential source of current for said high potential source in the link-circuit signal and cut-off relay circuit to cause the effacement of said link-circuit signal and to maintain said cut-off relay actuated.

19. 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, sources of current of different potentials, a line signal, a line relay for controlling the display of said signal, a cut-off relay for destroying said control, a link-circuit signal, means normally operative upon the connection of said link-circuit to said terminal to supply current from said high potential source to said link-circuit signal to cause its display and to said cut-off relay to cause its actuation, and means under the control of the subscriber operative normally to energize said line relay to display said line signal and operative after the connection of said link-circuit to said terminal to substitute said low potential source of current for said high potential source in the link-circuit signal and cut-off relay circuit to cause the effacement of said link-circuit signal and to maintain said cut-off relay actuated.

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

HARRY G. WEBSTER.

Witnesses:

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