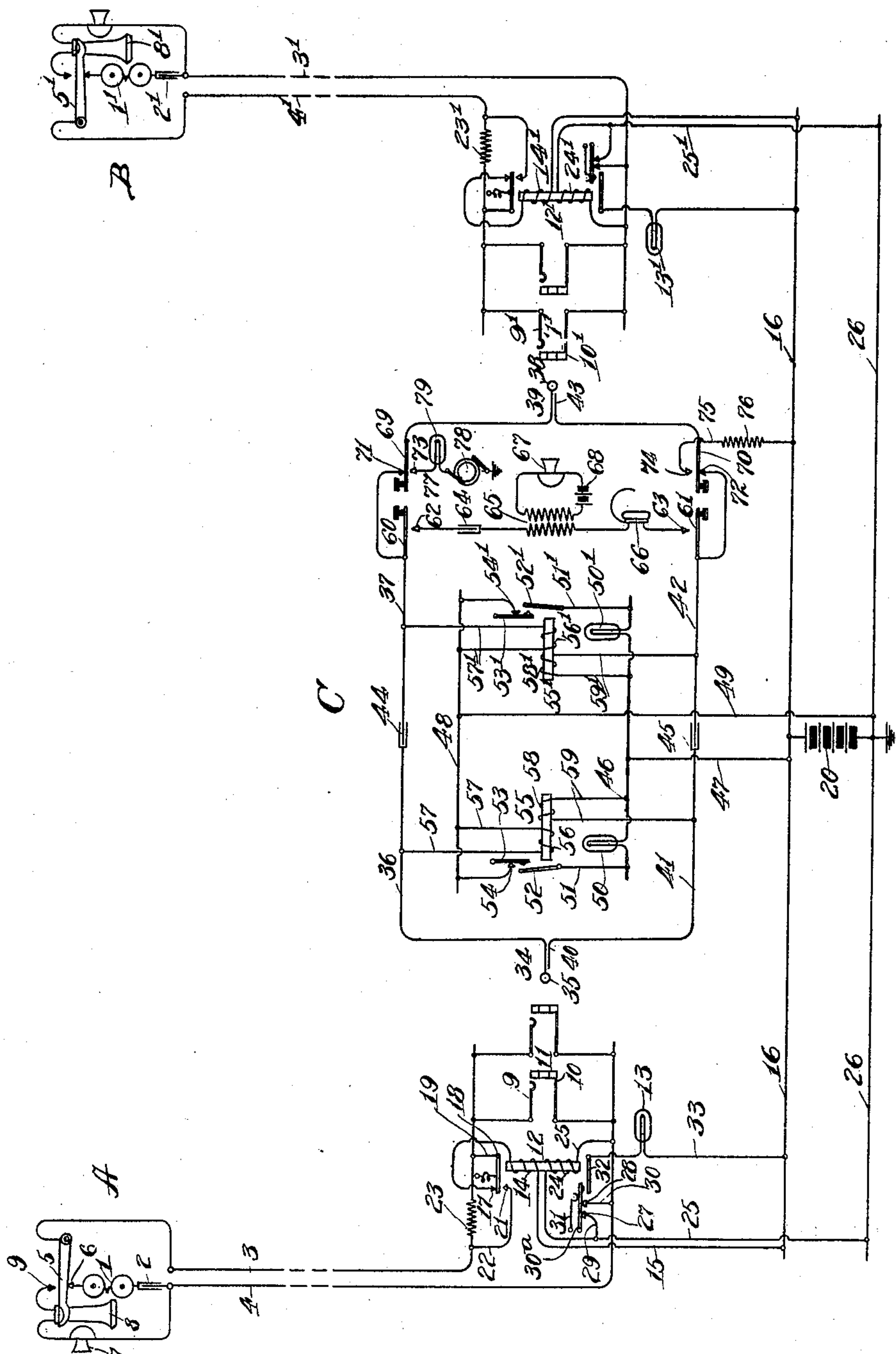


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H. G. WEBSTER.
TELEPHONE SYSTEM.
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Witnesses
G. E. Mueller.
A. H. Syron

Inventor
HARRY G. WEBSTER
Thomas H. Ferguson
Attorney

UNITED STATES PATENT OFFICE.

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

TELEPHONE SYSTEM.

No. 897,237.

Specification of Letters Patent.

Patented Aug. 25, 1908.

Application filed February 10, 1906. Serial No. 300,448.

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 telephone systems generally and more particularly to the arrangement of line circuits and associated apparatus, by which the usual signals are transmitted and controlled by the subscriber and operator.

The principal object of the invention is to provide a novel organization of circuits and apparatus for accomplishing these functions, which shall be simple in construction, efficient in operation and economical to manufacture.

In carrying out my invention, I employ, in association with the telephone line circuit, a novel controlling relay of the so-called "double acting" type. This "double acting" relay, which is along the line of those disclosed by me in prior applications, is arranged to cause the display of a line signal in response to a given energization, and to efface said signal in response to a different energization. This is preferably brought about by arranging the relay contacts so that they will be moved through a portion of their maximum range in response to a lesser energization of the relay, and through the remainder of their range in response to a greater energization—the former to light a lamp, and the latter to extinguish it. In addition to these functions, the relay also varies the connections to its windings and to a resistance which coöperates with it. In the cord circuit, I also preferably employ a relay of the "double acting" type for controlling the display and effacement of the usual supervisory signal.

The nature and objects of the invention will more fully appear from 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 constructed in accordance with the present invention, 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, normally included in bridge of the telephone line limbs 3—4 by the engagement of the switch-hook 5 with the contact 6. A second normally open bridge, 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 limbs are extended in the usual manner to a source of current and to the contacts 9 and 10 of multiple jacks 11. A "double acting" relay 12, which is employed in the control of the line signal 13, here shown as an incandescent lamp, comprises a winding 14 normally included in a branch 15 which, together with a conductor 16, relay contacts 17—18, and a conductor 19, normally extends the line limb 3 to the live pole of the battery 20. A contact 21 and its connecting conductor 22 coöperate with the movable contact 18 and its conductor 19 to short circuit a resistance 23, which is normally included in the line limb 3, or its extension to the jack contact 9. The relay 12 is also provided with a winding 24 which is included in a branch 25, by which the line limb 4 is extended to the conductor 26 and the grounded side of the battery 20. The winding 24 is normally short circuited through the agency of the fixed contacts 27 and 28, which are respectively connected by the conductors 29 and 30 to the conductor 25 and the line limb 4, and a coöperating contact 30^a, which is normally held in engagement with the fixed contacts by a spring 31. The movable contact 30^a is adapted to be drawn out of engagement with the fixed contacts 27—28 by a second movable contact 32, which is permanently connected to the live conductor 16 by a conductor 33, which includes the signal lamp 13 in circuit.

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

At the central office, the means for connecting subscribers' lines for conversation comprises an answering plug 34, whose tip contact 35 is connected by strands 36 and 37 to the tip contact 38 of a calling plug 39, and whose sleeve contact 40 is connected by strands 41 and 42 to the sleeve contact 43 of

the calling plug 39. The strands 36 and 37 on the one hand, and 41 and 42 on the other, are separated by the usual condensers 44 and 45 respectively. A conductor 46 is permanently connected by a lead 47 to the live pole of the battery 20, while a second conductor 48 is normally maintained at the potential of ground by the lead 49, connecting it to the grounded side of the battery. The supervisory signal lamp 50, associated with the answering end of the link-circuit, is included in a bridge 51 between the conductors 46 and 48, which is adapted to be made and broken by the contacts 52, 53 and 54 of a "double acting" relay 55, whose winding 56, is included in a branch 57 between the strand 36 and the grounded conductor 48; and whose winding 58 is included in a like branch 59 between the strand 41 and the live conductor 46. A similar supervisory lamp 50' is associated with the calling plug 39. This lamp is included in a bridge 51' between the conductors 46 and 48, which is similarly made and broken by the contacts 52', 53' and 54' of a similar supervisory relay 55', whose winding 56' is included in a branch 57' between the strand 37 and the grounded conductor 48; and whose winding 58' is included in a branch 59' between the strand 42 and the live conductor 46.

The strands 37 and 42 of the calling end of the link-circuit are connected to the usual listening-key levers 60—61, which may be depressed into engagement with the contacts 62—63 to close a bridge between the strands including a condenser 64, the secondary winding of an induction coil 65 and the operator's receiver 66. The operator's transmitter 67 is included in a local circuit with the primary winding of the induction coil 65 and the battery 68. These strands are also provided with the usual ringing key levers 69, 70, which normally engage the fixed contacts 71 and 72 to maintain the continuity of the strands 37 and 42, but which are adapted to be moved into engagement with the contacts 73 and 74 on the one hand to connect the sleeve strand 42 to the live pole of the battery 20 through the conductor 75, which includes a protective resistance 76; and on the other hand, to connect the tip strand 37 to the grounded branch 77, which includes the generator 78 and the resistance lamp 79.

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 so as to allow the latter to complete the normally open bridge between the telephone line limbs 3 and 4. Since the opposite poles of the battery 20 are normally connected to the line limbs 3 and 4, the closing of the bridge at the substation will complete a circuit through resistance 23 and the winding 14 of the relay 12, thereby sufficiently energizing it to move its contact

32 into engagement with its contact 30^a to complete the bridge through the signal lamp 13 to cause its display, as an indication to the operator that a connection is desired. The circuit, closed in this manner by the removal of the receiver 8 at the substation A, may be traced as follows: from the live pole of the battery 20, through the conductor 16, the conductor 15 including the winding 14 of the relay 12, relay contacts 17—18, conductor 19, resistance 23, line limb 3, switch-hook 5, contact 9, receiver 8 and transmitter 7, line limb 4, the short circuiting connection including conductors 29 and 30 and contacts 27, 28 and 30^a, and conductors 25 and 26 to the grounded side of the battery. Upon observing the signal displayed in response to the closure of this circuit, the operator will insert the answering plug 34 into the answering jack of the line 3—4 and depress the listening key 60—61 to connect her receiver 66 in circuit with the substation to learn the wishes of the calling party. The insertion of the plug 34 into the answering jack will close a circuit from the live pole of the battery 20, through the conductor 16, the conductor 15 including the winding 14 of the relay 12, contacts 17, 18, conductor 19, a portion of the extended line limb 3, jack contact 9, tip contact 35, strand 36, branch 57 including the winding 56 of the supervisory relay 55, to the grounded conductor 48. The closing of this circuit will energize the relay 12 sufficiently to bring the contacts 18 and 21 into engagement, thereby breaking the circuit just traced and short circuiting the resistance 23. At the same time, however, the contact 32 is attracted with sufficient force to carry the contact 30^a out of engagement with its fixed contacts 27 and 28, thereby removing the short circuit from about the winding 24 of the relay 12 and permitting the latter to be energized over a new path sufficiently to maintain the parts in their attracted positions. The path through the second winding 24 may be traced from the live pole of the battery 20, through the conductors 47—46, the branch 59 including the winding 58 of the supervisory relay 55, strand 41, plug contact 40, jack contact 10, the conductor 25 including the winding 24, to the grounded side of the battery 20. In addition to providing this path for current through the second winding 24, the attraction of the contact 32 will break the bridge including the signal lamp 13 at the contacts 27 and 30^a, thereby causing the effacement of the call signal.

As soon as the contacts of the relay 12 have been moved into their final positions, a path for current from the jack contact 10 to the grounded side of the battery 20, in addition to that through the winding 24 of the cut-off relay, will be provided as follows: over the line limb 4, through the closed

bridge at the substation, line limb 3, around the resistance 23 by way of the short circuiting path including the conductor 22, contacts 21—18 and conductor 19, jack contact 9, plug contact 35, strand 36, branch 57 including the winding 56 of the supervisory relay 55, to the grounded conductor 48. By reason of the fact that both of these paths for current are closed, the supervisory relay 55 will be sufficiently energized to cause the separation of the contacts 53 and 54, thereby breaking the bridge 51 through the signal lamp 50 and preventing its display. However, if the path through the substation is broken, the resulting energization will be sufficient only to maintain the contacts 52 and 53 in engagement, but not to separate the contacts 53 and 54. Thus, if the subscriber returns the receiver 8 to its hook, the bridge through the supervisory lamp 50 will be closed and the lamp will be lighted, as an indication of the subscriber's act.

Upon depressing the listening key 60—61 and learning that the calling party desires connection with the line 3'—4', the operator will touch the tip contact 38 of her plug 39 against the jack contact 10' to determine the busy or idle condition of the line. From the circuits previously traced, it will be seen that if the line 3'—4' is in use, a potential above that of ground will exist at the testing contact 10'; and as soon as the contact 38 is touched to it, there will be an instantaneous flow of current from the tip 38 through the strand 37, branch 57' to the grounded conductor 48. This will vary the charge on the condenser 64, resulting from the initial closure of the listening key 60—61, and will produce a "click" in the operator's receiver 66, thus indicating to her the busy condition of the line. If the line is found to be idle, the operator will insert the plug 39 into the jack 11', thereby momentarily closing a circuit through the winding 14' of the relay 12' to completely actuate its contacts in a manner previously described in connection with the relay 12. This will immediately remove the call-signal 13' from the control of the party at substation B, short circuit the resistance 23', and substitute the winding 24' for the winding 14' as the energizing medium for retaining the relay contacts in their attracted positions. At this time, the only circuit through the supervisory relay 55' will be that through its winding 58'. This, as previously indicated, will be sufficient to bring its contacts 52'—53' into engagement, without separating the contacts 53'—54', and will thus complete the bridge through the lamp 50', causing its display. This lamp will remain lighted until the normally open bridge at the substation B is closed by the removal of the receiver 8' from its switch-hook 5'. The closing of this bridge will complete the alternative path from the jack contact 10',

through the substation and the winding 56' of the supervisory relay 55', thereby increasing the energization of said relay sufficiently to break the bridge of the lamp 50' at the relay contacts 53'—54', as an indication to the operator that the called party has answered.

In ringing the party at substation B, the operator depresses the ringing key 69—70, thereby connecting the sleeve strand 42 of the link-circuit with the live pole of the battery through the protective resistance 76, so as to continue the supply of battery current to the winding 24' of the relay 12'. At the same time, ringing current will be applied to the tip strand 37 and thence out over the line limb 4', through the bell 1' and condenser 2' at the substation, back over the line limb 3' to ground, either by way of the winding 24' and the conductors 25'—26, or by way of the sleeve strand 42, the conductors 75—16, and the battery 20. With the parties thus connected, the supervisory lamps 50 and 50' will remain dark during conversation. As soon as either party finishes his conversation and hangs up his receiver, the circuit through the lesser energizing winding of the supervisory relay, corresponding to his line, will be broken, and the bridge through the lamp completed by the engagement of the relay contacts. The lighting of both lamps will be a signal to the operator to disconnect the lines. It will also be observed that, with the parties thus connected, the resistances 23 and 23' are not included in the talking circuit, and that the latter is properly balanced by the arrangement of the windings of the line relays.

Obviously, in carrying out my invention, the batteries 20 and 68 may be one and the same, the various ground connections may be replaced by a common return, and other alterations and modifications may be made 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 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 conductively uniting a substation with a jack at the central office, a link-circuit, a connecting plug adapted to be inserted into said jack to connect said line and link-circuit, means for holding conversation over said line and link-circuit, a resistance normally included in said line, a controlling electro-magnet associated with said line at the central office, means under the control of the subscriber for energizing said magnet by closing a circuit through said resistance, means under the control of the operator for modifying said energization, and means ac-

tuated by the latter energization to close a short circuit about said resistance.

2. A telephone system comprising a telephone line conductively uniting a substation with a jack at the central office, a link-circuit, a connecting plug adapted to be inserted into said jack to connect said line and link-circuit, means for holding conversation over said line and link-circuit, a resistance normally included in said line, electrically operated signaling apparatus associated with said line at the central office, means under the control of the subscriber for actuating said apparatus to cause the display of a signal by closing a circuit through said resistance, means under the control of the operator for actuating said apparatus to efface said signal, and means actuated therewith to close a short circuit about said resistance.

3. A telephone system comprising a telephone line conductively uniting a substation with a jack at the central office, a link-circuit, a connecting plug adapted to be inserted into said jack to connect said line and link-circuit, means for holding conversation over said line and link-circuit, a resistance normally included in said line, a call signal associated with said line at the central office, a controlling electro-magnet for said signal, means under the control of the subscriber for energizing said electro-magnet by supplying current over a path through said resistance and a winding of said magnet, means under the control of the operator for modifying the said energization of said electromagnet, and means responsive to the former energization to display said signal and to the latter energization to efface said signal and to close a short circuit about said resistance.

4. A telephone system comprising a telephone line conductively uniting a substation with a jack at the central office, a link-circuit, a connecting plug adapted to be inserted into said jack to connect said line and link-circuit, means for holding conversation over said line and link-circuit, a resistance normally included in said line, a call signal associated with said line at the central office, a controlling electromagnet for said signal, means under the control of the subscriber for energizing said electro-magnet by supplying current over a path through said resistance and a winding of said magnet, means under the control of the operator for increasing the said energization of said electromagnet, and means responsive to the former energization to display said signal and to the latter energization to efface said signal and to close a short circuit about said resistance.

5. 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, a resistance normally included in said line, a call

signal associated with said line at the central office, a controlling electromagnet for said signal, means under the control of the subscriber for energizing said electromagnet by supplying current over a path through said resistance and a winding of said magnet, means under the control of the operator for increasing the energization of said magnet by supplying current over a second path through the same magnet winding, and means responsive to the said former energization to display said signal and to the latter energization to efface said signal and to close a short circuit about said resistance.

6. A telephone system comprising a telephone line conductively uniting a substation with a jack at the central office, a link-circuit, a connecting plug adapted to be inserted into the said jack to connect said line and link-circuit, means for holding conversation over said line and link-circuit, a resistance normally included in said line, a call signal associated with said line at the central office, a controlling electromagnet for said signal, means under the control of the subscriber for energizing said electromagnet by supplying current over a path through said resistance and a winding of said magnet, means under the control of the operator for increasing the energization of said magnet by supplying current over a second path through the same magnet winding, and means responsive to the said former energization to display said signal and to the latter energization to efface said signal and to close a short circuit about said resistance.

7. 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, a controlling electro-magnet having two windings associated with said line at the central office, means under the control of the subscriber for energizing said magnet, means under the control of the operator for modifying the energization of said magnet by supplying current over a path through one of said magnet windings, and means responsive to the modified energization to change said path of current supply to exclude said one magnet winding and include the other.

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, a controlling electromagnet having two windings associated with said line at the central office, means under the control of the subscriber for energizing said electromagnet by supplying current over a path through one of said magnet windings, means under the control of the operator for modifying the energization of said magnet by supplying

current over a second path through the same magnet winding, and means responsive to the modified energization to change said second path to exclude said magnet winding and to include the other magnet winding.

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, a call signal associated with said line at the central office, a two-winding controlling magnet for said signal, means under the control of the subscriber for energizing said magnet, means under the control of the operator for modifying the energization of said magnet by supplying current over a path through one of said magnet windings, and means responsive to the initial energization of said magnet to display said signal and to the modified energization to efface said signal and to change said path of current supply to exclude said one magnet winding and include the other.

10. 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, a call signal associated with said line at the central office, a two winding controlling electromagnet for said signal, means under the control of the subscriber for energizing said electromagnet by supplying current over a path through one of said magnet windings, means under the control of the operator for modifying the energization of said magnet by supplying current over a second path through the same magnet winding, and means responsive to the initial energization of said magnet to display said signal and to the modified energization to efface said signal and to change said path to exclude said magnet winding and to include the other magnet winding.

11. 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, a resistance normally included in said line, a call signal associated with said line at the central office, a controlling electro-magnet for said signal having two energizing windings, means under the control of the subscriber for energizing said electro-magnet by supplying current over a path through one of said windings, means under the control of the operator for modifying said energization by supplying current first to one of said windings and then to the other, and means responsive to the initial energization to display said signal and to the modified energization to efface said signal and close a short circuit about said resistance.

12. 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, a resistance normally included in said line, a call signal associated with said line at the central office, a controlling electro-magnet for said signal having two energizing windings, means under the control of the subscriber for energizing said electro-magnet by supplying current over a path through one of said windings, means under the control of the operator for increasing said energization by supplying current first to one of said windings and then to the other, and means responsive to the initial energization to display said signal and to the increased energization to efface said signal and close a short circuit about said resistance.

13. 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, a resistance normally included in said line, a controlling electromagnet associated with said line at the central office, means under the control of the subscriber for energizing said magnet, means under the control of the operator for modifying said energization by supplying current over a definite path, and means responsive to the latter energization to change said path and to short circuit said resistance.

14. 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, a resistance normally included in said line, a two winding controlling electromagnet associated with said line at the central office, means under the control of the subscriber for energizing said magnet, means under the control of the operator for modifying the energization of said magnet by supplying current over a path through one of said magnet windings, and means responsive to the modified energization both to change said path of current supply to exclude said one magnet winding and include the other, and to short circuit said resistance.

15. 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, a resistance normally included in said line, a two winding controlling electro-magnet associated with said line at the central office, means under the control of the subscriber for energizing said electro-magnet by supplying current over a path through one of said magnet windings, means under the control of the

operator for modifying the energization of said magnet by supplying current over a second path through the same magnet winding, and means responsive to the modified energization both to change said path to exclude said magnet winding and include the other magnet winding, and to short circuit said resistance.

16. 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, a resistance normally included in said line, a two winding controlling electro-magnet associated with said line at the central office, means under the control of the subscriber for energizing said electro-magnet by supplying current over a path through said resistance and one of said magnet windings, means under the control of the operator for modifying the energization of said magnet by supplying current over a second path through the same magnet winding, and means responsive to the modified energization both to change said path to exclude said magnet winding and include the other magnet winding, and to short circuit said resistance.

17. 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, a resistance normally included in said line, a call signal associated with said line at the central office, a two winding controlling electromagnet for said signal, means under the control of the subscriber for energizing said electromagnet by supplying current over a path through said resistance and one of said magnet windings, means under the control of the operator for modifying the energization of said magnet by supplying current over a second path through the same magnet winding, and means responsive to the initial energization of said magnet to display said signal and to the modified energization to efface said signal, to change said path to exclude said magnet winding and include the other magnet winding, and to close a short circuit about said resistance.

18. 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 resistance normally included in one limb of said line, a source of current, a controlling electromagnet having two windings, means for including its windings in circuit between the poles of said source of current and said line limbs respectively, means for interrupting one of these paths and short circuiting said resistance, means normally short circuiting the winding included in the other

path, and means for removing said short circuit.

19. 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 resistance normally included in said line, a call signal associated with said line, a two winding electromagnet for controlling said call signal, means for including said windings in circuit between the poles of said source of current and said line limbs respectively, means normally short circuiting one of said windings, means at the substation for bridging said line limbs to cause a limited energization of said electromagnet, means responsive thereto to display said signal, means operative upon the connection of said link-circuit to said line to modify said energization, and means responsive to said modified energization to remove the short circuit about said winding to open the circuit of the other winding and to short circuit said resistance.

20. A telephone system comprising a telephone line conductively uniting a substation with a jack at the central office, a link-circuit, a connecting plug adapted to be inserted into said jack to connect said line and link-circuit, means for holding conversation over said line and link-circuit, a call signal apparatus associated with said line at the central office, a resistance independent of that of said call signal apparatus normally included in said line, means under the control of the subscriber for operating said apparatus by closing a circuit through said resistance, supervisory apparatus associated with the link-circuit, and means under the control of the operator for modifying said call signal apparatus by closing a circuit through said supervisory apparatus and means actuated thereby to close a short circuit about said resistance.

21. 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 grounded source of current, a controlling relay having two energizing windings included on opposite sides of said source in bridge of said line limbs, a grounded branch connected from one line limb through normal contacts of said relay, a resistance associated with the other line limb, and means for cutting out said resistance when the relay operates.

22. 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 grounded source of current, a con-

trolling relay having two energizing windings included on opposite sides of said source in bridge of said line limbs, a grounded branch connected from one line limb through normal contacts of said relay, a resistance normally included in the other line limb, and means for cutting out said resistance when the relay operates.

23. 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 grounded source of current, a controlling relay having two energizing windings

included on opposite sides of said source in bridge of said line limbs, a grounded branch connected from one line limb through normal contacts of said relay, a resistance normally included in the other line limb, a signal lamp connected in circuit with said source through normally open contacts of said relay, and means for cutting out said resistance when said relay operates.

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

HARRY G. WEBSTER.

Witnesses:

A. H. DYSON,
CAROLYN WEBER.