

907,658.

Patented Dec. 22, 1908.

2 SHEETS—SHEET 1.

Fig. 2

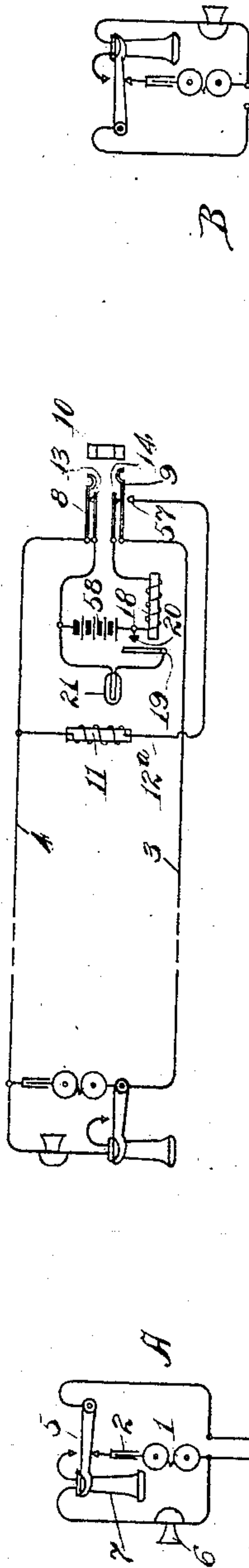
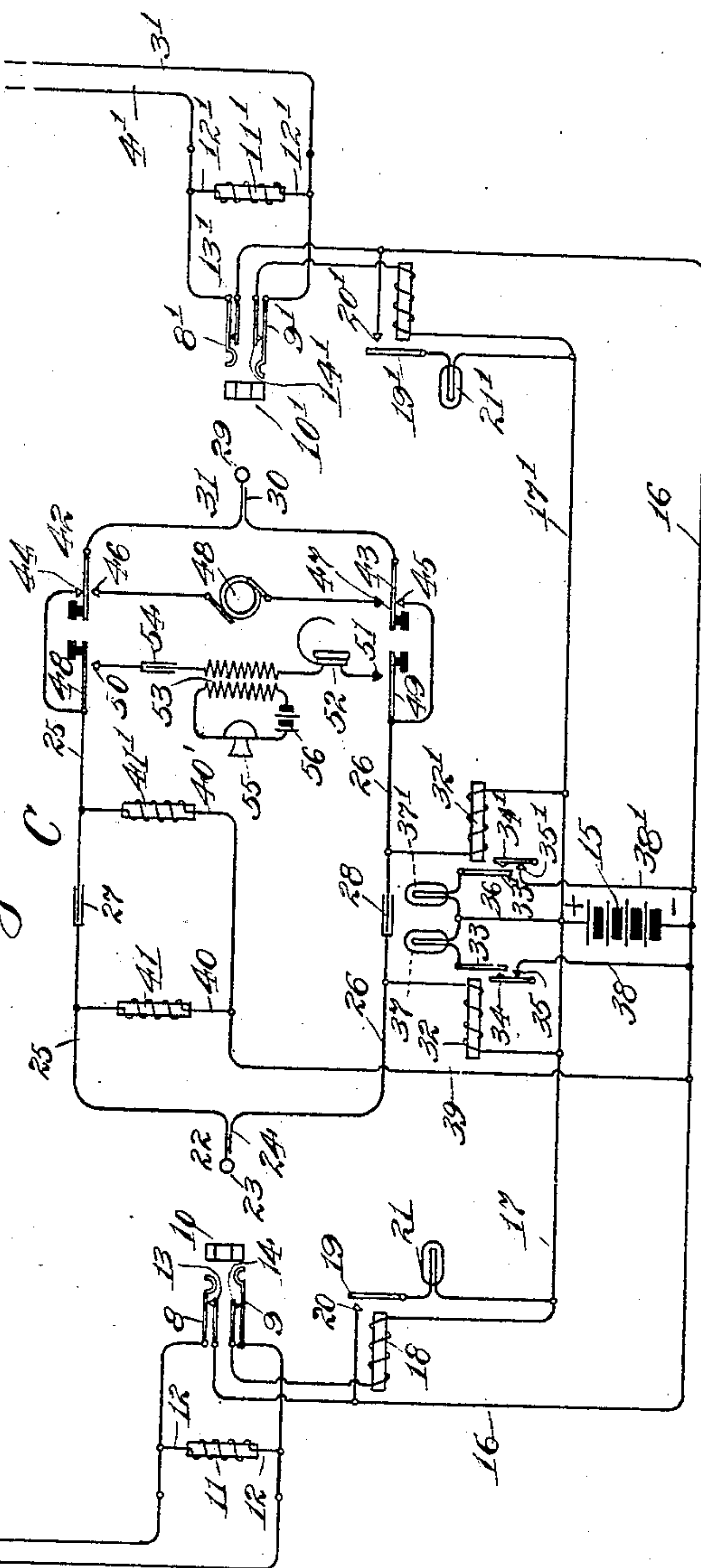


Fig. 1



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TELEPHONE SYSTEM.

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2 SHEETS—SHEET 2.

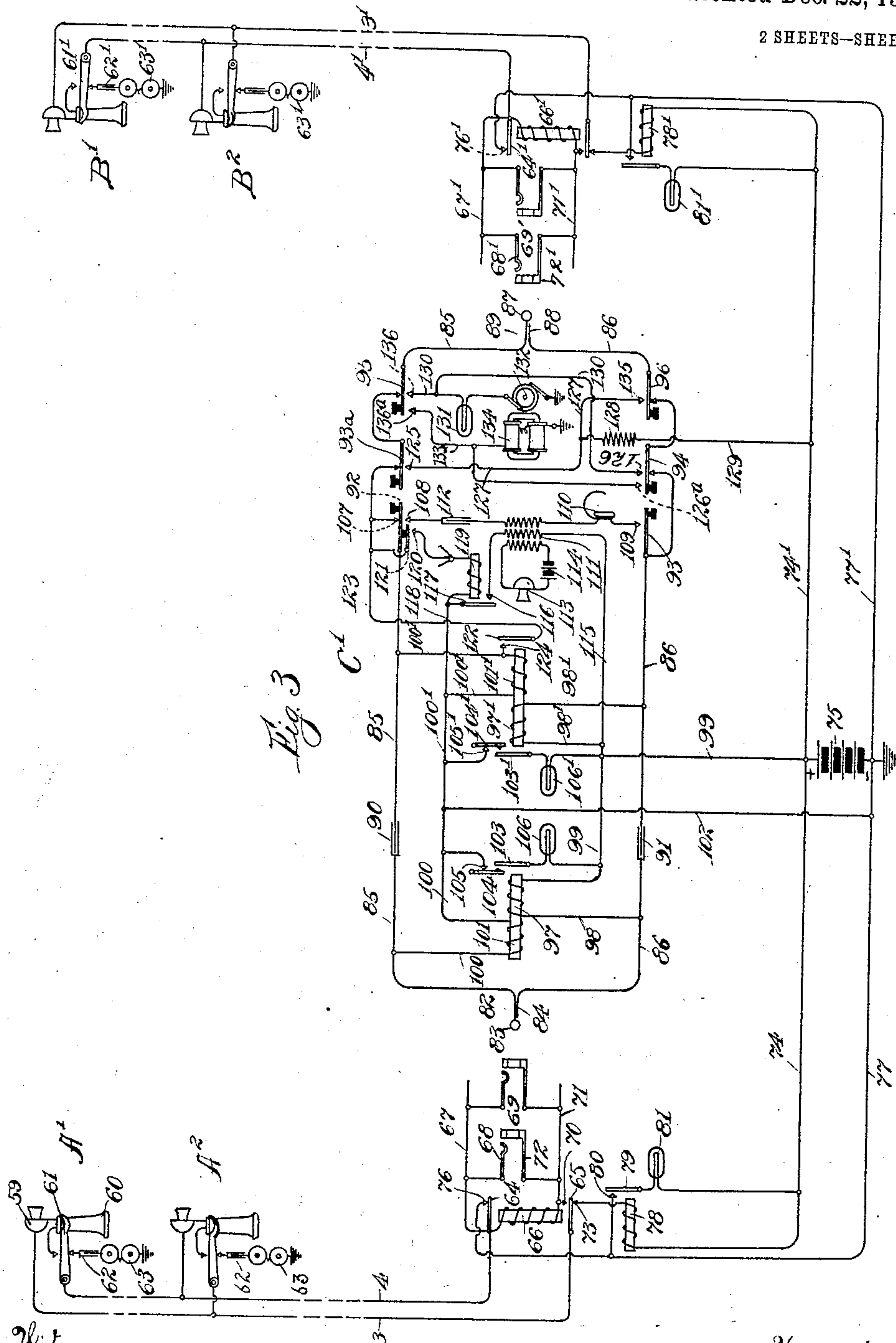


Fig. 3

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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

No. 907,658.

Specification of Letters Patent.

Patented Dec. 22, 1908.

Application filed January 13, 1906. Serial No. 295,984.

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 Invention 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 circuits and apparatus by which the operator and subscriber may signal each other, and by which the operator may be informed of the operative condition of a connected telephone line.

The object of this invention is to provide a novel organization of circuits and apparatus for accomplishing these functions, which shall be simple in construction, efficient in operation, cheap to manufacture and applicable alike to multiple and non-multiple systems.

In carrying out my invention, I employ a supervisory signal which is controlled by a "double-acting" relay associated with the cord or link-circuit, in combination with an inductive resistance adapted to be included in bridge of the talking circuit when the link-circuit is connected to a telephone line. The "double-acting" relay, which I have disclosed in prior applications, is arranged to cause the display of its 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 the lesser energization, and through the remainder of the range in response to the greater energization—the former to light a lamp, and the latter to extinguish it. The inductive resistance may be permanently included in bridge of the talking-circuit, or it may be included only when the line and link-circuit are connected. It is preferably arranged to be bridged across the limbs of the telephone line. The arrangements and connections of these parts are such that upon establishing the connection between the link-circuit and the line, a circuit is completed over both sides of the talking circuit through the said inductive resistance and the winding of the supervisory relay. When so connected, the removal of the receiver at the connected substation

completes an additional path for current which varies the current flow in the winding of the relay. The path completed by the subscriber is preferably of low resistance, so that the current flow through the relay winding is increased by the removal of the receiver.

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 the scope of the invention will be indicated in the appended claims.

In the said drawing, Figure 1 is a diagram of a non-multiple telephone system, constructed in accordance with the present invention; Fig. 2 is a diagram of a modified line-circuit arrangement, and Fig. 3 is a diagram similar to Fig. 1, of a multiple telephone system constructed in accordance with the invention, arranged for party line ringing.

Referring in detail to said drawing, and for the present, to Fig. 1, A and B designate substations which are connected to the central office C. The equipment at substation A, which may be of any preferred type, is here shown embodying a call-bell 1, in series with a condenser 2, normally connected between the limbs 3—4 of the telephone line, by the switch-hook 5. Included in a normally broken path between the limbs 3 and 4 of the telephone line, is the transmitter 6, in series with the receiver 7. When the receiver 7 is in place on the switch-hook 5, a path for incoming ringing current is provided through the call-bell 1 and when removed from its hook, the circuit through the call-bell is broken, and the circuit through the transmitter and receiver is completed. At the central office, the limbs 3 and 4 of the telephone line terminate in spring-contacts 8 and 9 of a jack 10. In this form of the invention, a resistance in the form of an impedance 11 is permanently included in bridge of the limbs 3 and 4 by a conductor 12. The spring-contacts 8 and 9 are normally in engagement with coöperating contacts 13 and 14 respectively, to complete the line-circuit to the opposite poles of the battery 15 by way of the conductors 16 and 17 respectively, thereby also normally maintaining a closed circuit through the impedance 11. The conductor 17 includes the winding of the line-signal relay 18 which, through its contacts 19

and 20, controls a bridge between the conductors 16 and 17, through the call-signal lamp 21. The adjustment of relay 18 is such that the normal current flowing through its winding over the circuit including the impedance 11 will not maintain the contacts 19 and 20 in engagement.

The circuits and apparatus, associated with substation B, are substantially the same as those just described in connection with substation A and are designated by corresponding primed characters.

Referring to the interconnecting means at the central office for placing the different subscribers in communication with each other, 22 represents the answering plug whose tip 23 and sleeve 24 are respectively connected to the strands 25 and 26 of the cord or link-circuit. These strands are provided with the usual condensers 27 and 28 and terminate at their opposite ends in the tip 29 and sleeve 30, respectively, of the calling-plug 31. The "double-acting" relay 32, associated with the answering end of the cord circuit, has its magnet winding included in the path between one pole of the battery 15 and the strand 26. It is provided with contacts 33, 34 and 35. The arrangement of these contacts is such that upon a given energization of the magnet, contact 33, which is pivoted, will be drawn into engagement with the contact 34 to close a circuit from one pole of the battery 15, over the conductor 36, the supervisory lamp 37 and the conductor 38, to the opposite pole of the said battery. A greater energization of the relay magnet will pull upon the contact 33 with sufficient force to carry the contact 34, which is also pivoted, out of engagement with the fixed contact 35, thus breaking the circuit of the lamp 37. The negative pole of the battery 15 is connected, by means of the conductors 39 and 40, to the strand 25 at the answering side of the condenser 27. An impedance 41 is included in the branch 40.

Upon the calling side of the condensers 27 and 28, the strand 25 is connected to the negative pole of the battery 15 by means of conductors 40' and 39, and an impedance 41', similar to the impedance 41, is included in the branch 40'. A supervisory relay 32', similar to the relay 32, has its energizing winding included in circuit between the positive pole of the battery 15 and the conductor 26 and, by means of the contacts 33', 34' and 35' and the conductor 38', makes and breaks a circuit through the supervisory lamp 37' in the same manner as the relay 32 controls the circuit of the lamp 37. A ringing-key 42—43 normally engages the contacts 44 and 45 to maintain the continuity of the strands 25 and 26, but may be depressed into engagement with the contacts 46 and 47 to include the ringing generator 48 in bridge of the link-circuit strands. A listening-key 48—49 may

have its levers pressed into engagement with the contacts 50 and 51 to include the operator's receiver 52, the secondary winding of the induction coil 53, and the condenser 54, in bridge of the strands of the link-circuit. The operator's transmitter 55 is included in a local circuit with the primary of the induction-coil 53 and a battery 56.

In the operation of the system, assuming that a party at substation A desires to converse with a party at substation B, he removes his receiver 7, thereby completing a path for current from the positive side of the battery 15, through conductor 17, including the winding of the line-relay 18, contacts 14 and 9, telephone line limbs 3—4, contacts 8—13 and conductor 16, to the negative pole of the battery 15. This circuit sufficiently energizes the magnet of the line-relay 18 to close the branch including the call lamp 21, thereby causing the latter to light to give an indication to the operator that the party at substation A desires a connection. Upon observing the signal, the operator inserts the answering-plug 22 into the jack 10. The insertion of the plug forces the contacts 8 and 9 out of engagement with the contacts 13 and 14, thus disconnecting the conductors 16 and 17 from the telephone line and thereby effacing the signal 21. The insertion of the plug 22 also completes a circuit from the positive pole of the battery 15, through the winding of the supervisory relay 32, the strand 26, sleeve 24 of the plug 22, contact 9 of the jack 10, impedance 11, contact 8 of the jack 10, tip 23 of the plug 22, strand 25, impedance 41 and conductor 39, to the negative pole of the battery 15. At the same time, there will be a path for current between the points of connection of the conductor 12 to the limbs 3 and 4 of the telephone line, by way of said limbs, through the switch-hook 5 at the substation. This latter path through the substation is of lower resistance than the path through the conductor 12 and the impedance 11, and will permit a sufficient flow of current through the winding of the relay 32 to attract the contact 33 with sufficient force to break the circuit of the supervisory lamp 37 at the contacts 34 and 35. From this, it will be seen that as long as the subscriber's receiver is off the hook 5, the lamp 37 will remain dark; but when the receiver is replaced and the low resistance path through the substation thereby broken, the flow of current over the circuit, including the impedance 11, will be considerably reduced. The supervisory relay 32 is so adjusted that this current flow will be sufficient to permit the contacts 34 and 35 to return into engagement and to hold the contacts 33 and 34 also in engagement, thereby completing the circuit of the supervisory lamp 37 and causing its display.

As soon as the operator has made connec-

tion with the line 3—4, she depresses the listening-key 48—49 and obtains the wishes of the calling party in the usual manner. Having learned that connection with substation B is desired, if the line be idle, she inserts the calling-plug 31 into the jack 10'. The insertion of the plug mechanically separates the contacts 8'—13' and 9'—14', thereby removing the substation control from the associated line-signal lamp 21'. At the same time, a circuit is completed from the positive pole of the battery 15, through the winding of the supervisory relay 32', strand 26, sleeve 30 of the calling-plug 31, contact 9' of the jack 10', conductor 12' including the impedance 11', contact 8' of the jack 10', tip 29 of the calling-plug 31, strand 25, conductor 40', including the impedance 41', and conductor 38 to the negative pole of the battery 15. This circuit will cause the lesser energization of the supervisory relay 32', which is sufficient to bring the contacts 33'—34' into engagement without separating the contacts 34' and 35'. This will cause the display of the lamp 37', which will remain lighted until the party at the substation B, by removing his receiver, closes the low resistance branch over the telephone limbs 3'—4' around the impedance 11'. When this is done, the flow of current through the winding of the relay 32' will be increased sufficiently to break the circuit of the lamp 37' at the contacts 34'—35', thus indicating to the operator that the party at substation B has answered. Thus, it will be seen that during conversation between the parties at the substations A and B, the supervisory lamps 37 and 37' remain dark; and as soon as either party hangs up his receiver, the lamp associated with his line will be lighted. When both lamps 37 and 37' are lighted, the operator will take this as a signal to disconnect.

Instead of having the impedance 11 permanently connected between the limbs 3 and 4 of the telephone line, in which case there is a continuous normal flow of current through its winding, the impedance may be arranged so as to be connected in bridge only when the plug 22 is inserted in the jack 10. This may be accomplished in the manner illustrated in Fig. 2, where the impedance is included in a branch 12^a, which terminates in a contact 57 which is adapted to be engaged by the spring contact 9 of the jack when the plug 22 is inserted. This figure also shows an additional source of current 58 which is included, with the winding of the line relay 18, in a branch between the contacts 13 and 14. The line signal lamp 21 is controlled, as before, by the engagement and separation of the contacts 19 and 20 of the line relay.

Referring to Fig. 3 of the drawing, which shows a multiple telephone system embodying the features of the present invention, the resistance to be included in bridge of the

line limbs is provided by the winding of a cut-off relay, and the impedance between the negative pole of the main battery and the tip strand of the cord circuit is provided by a second winding on the core of the "double-acting" supervisory relay. In this embodiment of the invention, I have also shown party lines, together with the necessary means for interconnecting and signaling over them. Referring in detail to said figure, the telephone line, comprising the limbs 3—4, connects the substations A' and A² with the central office C'; and the telephone line, comprising the limbs 3'—4', connects the substations B'—B² with the central office. At each of the substations A' and A², a transmitter 59 is included in series with a receiver 60 in a normally open branch between the limbs 3 and 4 controlled by the switch-hook 61. At substation A', the switch-hook normally closes a grounded branch from the limb 4 including the condenser 62 and the call-bell 63. At substation A², the condenser 62 and call-bell 63 are included in a grounded branch from the line limb 3. At the central office, the limbs 3 and 4 of the telephone line terminate in the movable contacts 64—65 of the cut-off relay 66. The line limb 4 is permanently connected by a conductor 67 with the contact springs 68 of multiple jacks 69. The limb 3 is adapted to be connected through the movable contact 65 and the fixed contact 70 and a conductor 71 to the sleeve 72 of the jack 69. The winding of the cut-off relay 66 is permanently connected between the fixed contact 70 and the limb 4 of the telephone line. The contact 65 is normally in engagement with the contact 73, which is permanently connected by the conductor 74 with the positive or active pole of the battery 75. The limb 4 of the telephone line is also normally connected through the movable contact 64, the fixed contact 76 and the conductor 77, to the negative and grounded pole of the battery 75. The conductor 74 includes the winding of the line relay 78 which, through its contacts 79 and 80, controls a branch between the conductors 74 and 77, including the line signal lamp 81.

The circuits associated with the substations B' and B² are substantially the same as those just described in connection with substations A' and A² and are designated by corresponding primed characters.

The central office equipment comprises the answering plug 82 whose tip 83 and sleeve 84 are connected respectively to strands 85—86 of the cord or link circuit, which terminate at the calling end of the link-circuit in the tip 87 and sleeve 88, respectively of the calling plug 89. The strands 85 and 86 are provided with the usual condensers 90 and 91 and are normally maintained continuous through the

listening key 92—93 and the ringing keys 93^a—94 and 95—96.

At the answering end of the cord circuit, a "double-acting" relay 97, of the type described in connection with Fig. 1, but with an additional winding, is employed. One winding of this relay is included in a branch 98 extending from the strand 86 and, by way of the common conductor 99, to the live side of the battery 75. The strand 85 is connected by branch 100, which includes the other winding of the relay 101, to the grounded or negative side of the battery by way of the common conductor 102. The contacts 103, 104 and 105 control the flow of current from the conductor 99, which is connected to the live side of the battery, through the supervisory lamp 106 to the conductor 100 which is connected to the negative side of the battery. A similar "double-acting" relay 97' is associated with the calling end of the link-circuit and has one of its windings included between the strand 86 and the live pole of the battery 75, by way of the branch 98' and the conductor 99 and its other winding 101' similarly connected by conductors 100' and 102 between the strand 85 and the grounded side of the battery 75. Similar relay contacts 103', 104' and 105' cooperate to control the supply of current to the supervisory lamp 106'.

The lever 92 of the listening key normally engages a contact 107 to maintain the continuity of the strand 85, but both this lever and the companion lever 93 may be depressed against the contacts 108 and 109 to complete a bridge between the cord strands, including the operator's receiver 110, the primary of the induction-coil 111, and a condenser 112. The operator's transmitter 113 is included in a local circuit with the battery 114 and the primary of the induction coil 111. A tertiary winding of the induction coil 111 is included in a branch 115 extending from the conductor 99, which is connected to the live pole of the battery 75, to a relay contact 116. A cooperating contact 117 is adapted to complete the circuit of the tertiary winding by way of the conductors 118, 100' and 102, to the negative pole of the battery 75. The contact 117 is controlled in its operation by a testing relay magnet 119, common to a plurality of cord-circuits. The winding of this magnet is connected to a contact 120, which is engaged by a contact 121, when the listening key is depressed, to connect the tip strand of the link-circuit to the grounded side of the battery. In order to maintain the continuity of the strand 85 independently of the listening key while the plug 89 remains inserted in the jack, an armature 122, connected to a conductor 123 engages a fixed contact 124 connected to the conductor 100' thereby completing the

path around the listening key in response to the resulting energization of the supervisory relay 97'.

The ringing key 93—94, when depressed, engages the fixed contacts 125—126—126^a. The former contact is connected by a path through a conductor 127, a protective resistance 128 and a conductor 129 to the live pole of the battery 75. The contact 126, on the other hand, is connected to the grounded branch 130 which includes a lamp 131 and a generator 132. Similarly, the contact 126^a is connected to the grounded branch 133, which includes an impedance 134. The ringing key 95—96, when depressed, engages contacts 135, 136 and 136^a, which are respectively connected to the conductors 127, 130 and 133.

The operation of the particular embodiment of the invention disclosed in Fig. 3, assuming that a party at one of the substations A' or A² desires to converse with a party at one of the substations B' or B², he removes his receiver from its hook and thereby closes a circuit from the live pole of the battery 75, through conductor 74 including the winding of the line signal relay 78, contacts 73—65, line limbs 3—4, contacts 64—76 and conductor 77, to the negative pole of the battery. This will energize the line relay 78 in the usual way to close the branch including the line signal lamp 81 to cause it to light, as a signal to the operator that a call is desired. Upon observing this signal, the operator will insert the plug 82 into one of the jacks associated with the telephone line 3—4, and thereby complete a circuit from the positive pole of the battery 75, through conductors 99—98, including one winding of the "double-acting" supervisory relay 97, strand 86, plug sleeve 84, sleeve of jack 69, conductor 71, winding of the cut-off relay 66, contacts 64—76 and conductor 77, to the negative pole of the battery. This circuit will energize the cut-off relay 66 sufficiently to attract the contacts 64 and 65—the former out of engagement with the fixed contact 76, and the latter out of engagement with the contact 73 and into engagement with the contact 70, thereby continuing the line limbs to the jack contacts. The separation of the contacts 64 and 76 breaks the circuit just traced; and, in order that the cut-off relay 66 may continue to be energized, a new path is completed from the winding of said relay, over the conductor 67, jack contact 68, plug tip 83, strand 85, conductor 100, including the relay winding 101, and conductor 102, to the negative side of the battery. In addition to the circuits through the cut-off relay winding just traced, there is a path for current from the contacts 65 and 70 over the telephone line limbs, including the transmitter, receiver and switch-

hook at the calling substation, to the conductor 67. This latter is in parallel to the path through the cut-off relay 66 in bridge of the line limbs. By reason of this second
 5 path through the substation which is lower in resistance than the path through the cut-off relay winding, the flow of current through the winding of the "double-acting" supervisory relay 97 will be sufficient to draw the
 10 contacts 103 and 104 into their extreme position, thereby breaking the branch including the lamp 106 at the contacts 104 and 105, thus preventing the display of the supervisory signal.

15 The operator now, by depressing the listening key 92—93, closes a circuit through her receiver 110 and obtains the wishes of the calling party. Learning that conversation is desired with the party on the tele-
 20 phone line 3'—4' at one of the substations B' or B², she touches the tip 87 of the calling plug 89 against the testing terminal 72' of one of the jacks connected to the line 3'—4', to determine whether it is idle or busy.
 25 From the circuit previously described, it will be seen that if the line 3'—4' is busy, there will be a potential above that of ground upon the sleeve 72' of the jack 69'. Therefore, when the tip 87 is touched to the sleeve, a
 30 circuit will be completed over the strand 85 through the contacts 121 and 120 of the listening key which has been depressed, through the common testing relay 119 to ground, by way of the conductors 118, 100'
 35 and 102. The closing of this path will cause a momentary flow of current, which will be sufficient to energize the relay 119 to bring the contacts 117 and 116 into engagement, thereby closing a circuit through the ter-
 40 tiary winding of the operator's induction coil 111 from the positive pole of the battery 75, through the conductors 99—115, to the negative side of said battery, by way of the contacts 116—117 and the conductors 118, 100'
 45 and 102. Since the flow of current from the tip of the calling plug will be only momentary, contacts 116—117 will also remain in engagement only for a moment, and the re-
 50 sult of the momentary flow of current through the tertiary winding of the induction coil 111 will be a "click" in the operator's receiver 110, indicating to her the busy condition of the line. If no "click" is heard, the plug 89 is inserted into the jack. This
 55 act will close a circuit from the positive pole of the battery 75, through the conductors 99—98' including one winding of the supervisory relay 97', strand 86, plug sleeve 88, jack sleeve 72', winding of the cut-off relay
 60 66', and from this point, at first by way of the contacts 64'—76' and the conductor 77' to the negative pole of the battery 75; and later, from this point to the same side of the battery, over the path including the con-
 65 ductor 67', jack contact 68', tip 87, strand 85,

conductor 100' including the other relay winding 101', and conductor 102. The energization of the cut-off relay 66' disconnects the call signal relay 78', and its associated lamp 81', from the control of the sub-
 70 scribers at substations B' and B². The closing of the circuit for producing this action also brings the contacts 122 and 124, associated with the supervisory relay, into engagement to close a path through the con-
 75 ductor 123 about the listening-in key 92, so that the same may be depressed by the operator to listen in upon the circuit, without interrupting the continuity of the path between the plug tips 83 and 87.
 80

If it is desired to call a party at substation B', the operator now depresses the ringing key 95—96. This interrupts the circuit, previously traced, through the winding of the cut-off relay 66', but current to main-
 85 tain its contacts in their attracted positions is supplied over a circuit from the positive pole of the battery 75, through the conductors 74'—129, including the protective resistance 128, conductor 127, contacts 135
 90 and 96 of the ringing key, strand 86, plug sleeve 88, jack sleeve 72', conductor 71', winding of the cut-off relay 66', conductor 67', jack contact 68', plug tip 87, strand 85, contacts 95, 136 and 136^a of the ringing key,
 95 thence either over the conductor 133 including the impedance 134, or over the conductor 130 including the lamp 131 and the generator 132 to ground. By the same depression of the ringing key 95—96, alternating current
 100 will be sent from the generator through the calling bell at substation B' over a path from ground at the central office, through the generator 132, conductor 130, contacts 136 and 95 of the ringing key, strand 85, tip
 105 87, jack contact 68', conductor 67', telephone line limb 4', switch-hook 61', condenser 62', call-bell 63', to ground. Since the potential of the current furnished by the generator 132 is, in practice, in excess of the
 110 potential of the battery, the by-path around the generator over the conductor 133 will allow battery current to be supplied at all times to the relay 66' and thereby prevent chattering of its contacts or interruption of
 115 the line circuit, as would occur if the only path for battery current were through the generator, since in the latter case, the generator current would neutralize and overcome the battery current, thereby reversing
 120 the current supplied to the relay 66' in accordance with the reversals of the generator current. The impedance 134 in the branch 133 prevents the short circuiting of the gen-
 125 erator 132.

In case it is desired to call substation B², instead of depressing the ringing key 95—96, the operator will depress the ringing key
 93—94. This will supply alternating calling
 130 current on the sleeve side of the cord circuit

and the limb 3' of the telephone line to operate the call-bell 63' at substation B². The current for maintaining the contacts of the relay 66' in their attracted positions will
 5 be furnished from the positive pole of the battery to the tip strand of the cord circuit, thence over the conductor 67', the winding of the relay 66', conductor 71' to the sleeve strand of the cord circuit, thence through the
 10 contacts 94, 126 and 126^a of the ringing key, to ground by way of the parallel branches 130 and 133, as previously indicated.

The closing of the circuit through the supervisory relay 97', upon inserting the
 15 plug 89 into a jack of the line 3'—4', provided a path only through the relatively high resistance of the cut-off relay 66', since the path over the line limbs 3'—4' is open at the substations. This permits only sufficient
 20 current flow to bring the supervisory relay contacts 122 and 124 into engagement and to move said relay contacts 103'—104' to their intermediate position, thus completing the bridge about the listening key and closing
 25 the circuit through the supervisory lamp 106' and causing its display. Now, as soon as the called party removes his receiver from its switch-hook, the alternative path over the telephone line limbs 3'—4' is closed, and the
 30 greater flow of current through the windings of the supervisory relay 97', resulting therefrom, moves the contacts 103' and 104' to their extreme position, thereby breaking the circuit of the supervisory lamp 106', thus
 35 indicating to the operator that the called party has answered. With the parties thus connected, both the supervisory lamps 106 and 106' remain dark and will continue in this condition until either party hangs up
 40 his receiver, in which event the supervisory lamp associated with his line will light, by reason of the resulting partial energization of the corresponding relay. The lighting of both supervisory lamps 106 and 106' constitutes a signal to the operator to disconnect
 45 the lines.

In view of the above disclosure, in which three different embodiments of my invention in its broad aspect are presented, it will be
 50 apparent that other alterations and modifications may be made within the scope of the invention. I, therefore, do not wish to be limited to the specific matter disclosed herein, but aim to cover, by the terms of the ap-
 55 pended 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 tele-
 60 phone line extending from a substation in two limbs to a central office, a two-strand link-circuit for making connection to said limbs, means for holding conversation over said line and link-circuit, a battery, a signal
 65 under the joint control of the operator and

subscriber, means for exercising said control on behalf of the operator by closing a simple series circuit including portions of both strands of said link-circuit and a definite number of cells of said battery in bridge of
 70 said strands, and means for exercising said control on behalf of the subscriber by a circuit also including portions of both strands of said link-circuit and the same number of
 75 cells of said battery.

2. A telephone system comprising a telephone line extending from a substation in two limbs to the central office, a two-strand link-circuit for making connection to said
 80 limbs, means for holding conversation over said line and link-circuit, a battery, a signal associated with said link-circuit under the joint control of the operator and subscriber, means for exercising said control on behalf of
 85 the operator by closing a simple series circuit including portions of both strands of said link-circuit and a definite number of cells of said battery in bridge of said strands, and means for exercising said control on behalf of
 90 the subscriber by closing the circuit including portions of both of said strands, both limbs of the telephone line and the same number of cells of said battery.

3. A telephone system comprising a telephone line extending from a substation in
 95 two limbs to a central office; suitable connection terminals therefor; a two-strand link-circuit terminating in a connecting plug adapted to make connection with said terminals; means for holding conversation over
 100 said line and link-circuit; a battery; a signal associated with said link-circuit under the joint control of the operator and subscriber; means for exercising the said control on behalf of the operator by closing a simple series
 105 circuit including portions of both strands of the link-circuit, the portions of the connected line limbs and a definite number of cells of said battery in bridge of said strands; and means for exercising said control on behalf of
 110 the subscriber by closing circuit including portions of both of said strands, said line limbs and the same number of cells of said battery.

4. A telephone system comprising a tele-
 115 phone line extending from a substation in two limbs to a central office; suitable connection terminals therefor; a two-strand link-circuit terminating in a connecting plug adapted to make connection with said terminals; means
 120 for holding conversation over said line and link-circuit; a battery; a signal associated with said link-circuit under the joint control of the operator and subscriber; means for exercising said control on behalf of the oper-
 125 ator by inserting said plug to close a simple series circuit including portions of both strands of the link-circuit, portions of the connected line limbs and a definite number of cells of said battery in bridge of said strands; 130

and means for exercising said control on behalf of the subscriber by closing a circuit including portions of both of said strands, said line limbs, and the same number of cells of said battery.

5. A telephone system comprising a telephone line extending from a substation to a central office, means for holding conversation over said line, a signal controlling electro-magnet having a single energizing winding, means normally under the control of the operator for supplying current to said winding over a circuit including portions of both sides of the talking circuit, means under the control of the subscriber for subsequently increasing the strength of the current in said winding and a signal displayed in response to said supplying of current to said winding and effaced by said increase of current strength therein.

6. A telephone system comprising a telephone line extending from a substation to a central office, means for holding conversation over said line, a signal controlling electro-magnet having a single energizing winding, means normally under the control of the operator for closing a circuit of definite resistance over portions of both sides of the talking circuit and through said winding, means under the control of the subscriber for subsequently increasing the strength of current in said winding, and a signal displayed in response to the closing of said circuit of definite resistance through said winding and effaced in response to the increased current strength therein.

7. A telephone system comprising a telephone line extending from a substation to a central office, means for holding conversation over said line, a signal controlling electro-magnet having a single energizing winding, means normally under the control of the operator for closing a circuit of a given resistance over portions of both sides of the talking circuit and through said winding to permit a definite flow of current in said winding, means under the control of the subscriber for subsequently increasing the current in said winding, and a signal displayed during said definite current flow and effaced by said subsequent current increase.

8. A telephone system comprising a telephone line extending from a substation to the central office, means for holding conversation over said line, a signal controlling electro-magnet, means under the control of the operator for closing a simple series circuit of definite resistance over portions of both sides of the talking circuit and through the electro-magnet winding to permit a definite flow of current in said winding, means under the control of the subscriber to close a low resistance path to increase the current flow in said winding, and a signal displayed during

ing said definite current flow and effaced during said increased current flow.

9. A telephone system comprising a telephone line extending from a substation in two limbs to a central office, a two strand link-circuit for making connection to said limbs, means for holding conversation over said line and link circuit, a signal controlling electro-magnet having a single energizing winding, means normally under the control of the operator for closing a circuit of definite resistance over portions of both strands of said link-circuit and through said winding, means under the control of the subscriber for subsequently increasing the current in said winding, and a signal displayed in response to the closing of said circuit of definite resistance through said winding and effaced by said subsequent current increase.

10. A telephone system comprising a telephone line extending from a substation in two limbs to a central office, a two strand link-circuit for making connection to said limbs, means for holding conversation over said line and link circuit, a signal controlling electro-magnet, means under the control of the operator for closing a simple series circuit of definite resistance over portions of both strands of said link-circuit and through the electro-magnet winding to permit a definite flow of current in said winding, means under the control of the subscriber to close a low resistance path to increase the said current flow in said winding, and a signal displayed during said definite current flow and effaced during said increased current flow.

11. A telephone system comprising a telephone line extending from a substation in two limbs to a central office, a two strand link-circuit for making connection to said limbs, means for holding conversation over said line and link-circuit, a signal controlling electro-magnet, means under the control of the operator for closing a circuit of definite resistance over portions of both strands of said link circuit and through the electro-magnet winding to permit a definite flow of current in said winding, means under the control of the subscriber to close a low resistance path over both limbs of the telephone line to increase said current flow in said winding, and a signal displayed during said definite current flow and effaced during said increased current flow.

12. A telephone system comprising a telephone line extending from a substation in two limbs to a central office, suitable connection terminals therefor, a two strand link-circuit terminating in a connecting plug adapted to make connection with said terminals, means for holding conversation over said line and link-circuit, a signal controlling electro-magnet, means operative upon the connection of said plug to said terminals to

close a simple series circuit of definite resistance over portions of both strands of said link-circuit and through the electro-magnet winding to permit a definite flow of current in said winding, means under the control of the subscriber to close a low resistance path over both limbs of the telephone line to increase said current flow in said winding, and a signal displayed during said definite current flow and effaced during said increased current flow.

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, means for including said resistance in bridge of the talking circuit, an electromagnetic signal under the joint control of the operator and subscriber, means for exercising said control on behalf of the operator by closing a simple series circuit through the signal magnet and said resistance while connected in bridge and means for exercising said control on behalf of the subscriber by closing a path in shunt to 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, means for including said resistance in bridge of the talking circuit, an electromagnetic signal under the joint control of the operator and subscriber, means for exercising said control on behalf of the operator by closing a simple series circuit through the signal magnet and said resistance while connected in bridge and over portions of both sides of the talking circuit and means for exercising said control on behalf of the subscriber by closing a path in shunt to said resistance.

15. A telephone system comprising a telephone line extending from a substation in two limbs to a central office, a two strand link-circuit for making connection to said limbs, means for holding conversation over said line and link-circuit, a resistance, means for including said resistance in bridge of the talking circuit, an electromagnetic signal under the joint control of the operator and subscriber, means for exercising said control on behalf of the operator by closing a simple series circuit through the signal magnet and said resistance while connected in bridge over portions of the strands of said link-circuit and means for exercising said control on behalf of the subscriber by closing a path in shunt to said resistance.

16. A telephone system comprising a telephone line extending from a substation in two limbs to a central office, suitable connection terminals therefor, a two strand link-circuit terminating in a connecting plug

adapted to make connection with said terminals, means for holding conversation over said line and link-circuit, a resistance, means for including said resistance in bridge of the telephone line limbs, an electromagnetic signal associated with said link-circuit under the joint control of the operator and subscriber, means for exercising said control on behalf of the operator by closing a simple series circuit through the signal magnet and said resistance, while connected in bridge, over portions of both strands of the link-circuit and portions of the connected line limbs, and means for exercising said control on behalf of the subscriber by closing a path in shunt to said resistance over said line limbs.

17. A telephone system comprising a telephone line extending from a substation to a central office, means for holding conversation over said line, a resistance, means for connecting said resistance in bridge of the talking circuit, a signal controlling electro-magnet having a single energizing winding, means under the control of the operator for supplying current to said winding over a circuit including said resistance and portions of both sides of the talking circuit, means under the control of the subscriber for subsequently increasing the strength of the current in said winding and a signal displayed in response to said supplying of current to said winding and effaced by said increase of current strength therein.

18. A telephone system comprising a telephone line extending from a substation to a central office, means for holding conversation over said line, a resistance, means for connecting said resistance in bridge of the talking circuit, a signal controlling electro-magnet having a single energizing winding, means under the control of the operator for closing a circuit over portions of both sides of the talking-circuit through said resistance and winding, means under the control of the subscriber for subsequently increasing the strength of current in said winding and a signal displayed in response to the closing of said circuit through said resistance and effaced by said increase of current strength therein.

19. A telephone system comprising a telephone line extending from a substation to a central office, means for holding conversation over said line, a resistance, means for connecting said resistance in bridge of the talking-circuit, a signal controlling electro-magnet having a single energizing winding, means under the control of the operator for closing a circuit over portions of both sides of the talking circuit through said resistance and winding to permit a definite flow of current in said winding, means under the control of the subscriber for subsequently increasing the current in said wind-

ing and a signal displayed during said definite current flow and effaced by said subsequent current increase.

20. A telephone system comprising a telephone line extending from a substation to a central office, means for holding conversation over said line, a resistance, means for connecting said resistance in bridge of the talking circuit, a signal controlling electro-magnet, means under the control of the operator for closing a circuit over portions of both sides of the talking circuit through said resistance and the electro-magnet winding to permit a definite flow of current in said winding, means under the control of the subscriber to close a low resistance path to increase the current flow in said winding and a signal displayed during said definite current flow and effaced during said increased current flow.

21. A telephone system comprising a telephone line extending from a substation in two limbs to a central office, a two strand link-circuit for making connection to said limbs, means for holding conversation over said line and link-circuit, a resistance, means for connecting said resistance in bridge of the talking circuit, a signal controlling electro-magnet having an energizing winding, means under the control of the operator for closing a circuit over portions of both strands of said link-circuit and through said resistance and winding, means under the control of the subscriber for subsequently increasing the current in said winding and a signal displayed in response to the closing of said circuit through said resistance and winding and effaced in response to said current increase.

22. A telephone system comprising a telephone line extending from a substation in two limbs to a central office, a two strand link-circuit for making connection to said limbs, means for holding conversation over said line and link-circuit, a resistance, means for connecting said resistance in bridge of the talking circuit, a signal controlling electro-magnet, means under the control of the operator for closing a circuit over portions of both strands of said link-circuit and through said resistance and the electro-magnet winding to permit a definite flow of current in said winding, means under the control of the subscriber to close a low resistance path to increase the said current flow in said winding and a signal displayed during said definite current flow and effaced during said increased current flow.

23. A telephone system comprising a telephone line extending from a substation in two limbs to a central office, a two strand link-circuit for making connection to said limbs, means for holding conversation over said line and link-circuit, a resistance, means for connecting said resistance in bridge of

the talking circuit, a signal controlling electro-magnet, means under the control of the operator for closing a circuit over portions of both strands of said link-circuit and through said resistance and the electro-magnet winding to permit a definite flow of current in said winding, means under the control of the subscriber to close a low resistance path over both limbs of the telephone line to increase said current flow in said winding, and a signal displayed during said definite current flow and effaced during said increased current flow.

24. A telephone system comprising a telephone line extending from a substation in two limbs to a central office, suitable connection terminals therefor, a two strand link-circuit terminating in a connecting plug adapted to make connection with said terminals, means for holding conversation over said line and link-circuit, a resistance, means for connecting said resistance in bridge of the talking circuit, a signal controlling electro-magnet, means operative upon the connection of said plug to said terminals to close a circuit over portions of both strands of said link-circuit and through said resistance and the electro-magnet winding to permit a definite flow of current in said winding, means under the control of the subscriber to close a low resistance path over both limbs of the telephone line to increase said current flow in said winding and a signal displayed during said definite current flow and effaced during said increased current flow.

25. A telephone system comprising a telephone line extending from a substation in two limbs to a central office, a jack at the central office in which said limbs terminate, a two strand link-circuit terminating in a connecting-plug adapted to make connection with said jack, means for holding conversation over said line and link-circuit, a resistance, means for connecting said resistance in bridge of the telephone line limbs, a source of current connected in bridge of the link-circuit strands, a signal controlling electro-magnet included in said bridge between the battery and one of said strands, an impedance included in said bridge between the battery and the other of said strands, means operative upon the insertion of said plug into said jack to close a circuit over portions of both strands of said link-circuit and through said resistance and battery bridge to permit a definite flow of current in said signal controlling electro-magnet winding, switching means under the control of the subscriber to close a low resistance path over both limbs of the telephone line to increase the current flow in said electro-magnet winding, and a signal displayed during said definite current flow and effaced during said increased current flow.

26. A telephone system comprising a tele-

phone line extending from a substation in two limbs to a central office, a line signal associated with said line normally under the direct control of the subscriber, a jack at the central office in which said line limbs terminate, a two strand link-circuit terminating in a connecting plug adapted to make connection with said jack, means for holding conversation over said line and link-circuit, a resistance, means for connecting said resistance in bridge of the telephone line limbs, a source of current connected in bridge of the link-circuit strands, a signal controlling electro-magnet included in said bridge between the battery and one of said strands, an impedance included in said bridge between the battery and the other of said strands, means operative upon the insertion of said plug into said jack to remove the line signal from the control of the subscriber and to close a circuit over portions of both strands of said link-circuit and through said resistance and battery bridge to permit a definite flow of current in said signal controlling electro-magnet winding, switching means under the control of the subscriber to close a low resistance path over both limbs of the telephone line to increase the current flow in said electro-magnet winding, and a signal displayed during said definite current flow and effaced during said increased current flow.

27. A telephone system comprising a telephone line extending from a substation to a central office, means for holding conversation over said line, an electromagnetic signal under the joint control of the operator and subscriber, a resistance, means for exercising said control in one instance by closing a simple series circuit over both sides of the talking circuit through the signal magnet and said resistance and in the other instance by closing a path in shunt to said resistance.

28. 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, means for including said resistance in bridge of said telephone line, a signal, means for including said signal in bridge of said link-circuit, means whereby the operator may exercise a control over said signal by closing a simple series circuit through said resistance while connected in bridge, and means whereby the subscriber may exercise a control over said signal by closing a path including both line limbs in shunt to said resistance.

29. A telephone system comprising a tele-

phone 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, a signal, means for including said signal in bridge of said link-circuit, means whereby the operator may exercise a control over said signal by closing a simple series circuit through said resistance while connected in bridge and over portions of both sides of the talking circuit, and means whereby the subscriber may exercise a control over said signal by closing a path over both line limbs in shunt to said resistance.

30. A telephone system comprising a telephone line extending from a substation in two limbs to a central office, a two strand link-circuit for making connection to said limbs, means for holding conversation over said line and link-circuit, a resistance, means for including said resistance in bridge of said telephone line, a signal, means for including said signal in bridge of said link-circuit, means whereby the operator may exercise a control over said signal by closing a circuit through said resistance while connected in bridge over portions of the strands of said link-circuits, and means whereby the subscriber may exercise control over said signal by closing a path over both line limbs in shunt to said resistance.

31. A telephone system comprising a telephone line extending from a substation in two limbs to the central office, suitable connection terminals therefor, a two-strand link-circuit terminating in a connecting plug adapted to make connection with said terminals, means for holding conversation over said line and link-circuit, a resistance, means for including said resistance in bridge of the telephone line limbs, a signal, means for including said signal in bridge of said link-circuit, means whereby the operator may exercise a control over said signal by closing a circuit through said resistance while connected in bridge over portions of both strands of the link-circuit and portions of the connected line limbs, and means whereby the subscriber may exercise control over said signal by closing a path over said line limbs in shunt to said resistance.

In witness whereof, I hereunto subscribe my name this 11th day of Jany. A. D., 1906.

HARRY G. WEBSTER.

Witnesses:

L. D. KELLOGG,
CAROLYN WEBER.